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Improving the Nutritional Status of Children During the Weaning Period

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A Manual for Policymakers, Program Planners, and Fieldworkers

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A Manual for Policymakers, Program Planners, and Fieldworker

Karen Mitzner
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Robert Morgan
Editors

A publication of the HOVIPREP (Home- and Village-Prepared Weaning-Foods) Project, which was conducted under a cooperative agreement between the International Food and Nutrition Program of the Massachusetts Institute of Technology and Harvard University, and the Office of International Cooperation and Development (OICD) of the US Department of Agriculture, with support and cooperation from the Office of Nutrition of the US Agency for International Development.

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Foreword

In recent years third world countries, international donor agencies, and the nutrition community at large have begun to focus greater attention on weaning-age malnutrition. New program concepts have been developed and tested, old approaches critically examined, and leadership has begun to be sensitized to the need to mobilize resources to attack the problem.

A variety of activities have been undertaken, including donation feeding programs, community-based weaning foods, growth monitoring and evaluation, and many other important aspects of prevention and treatment of malnutrition in children. While the work is far from complete, a substantial body of information has already been developed that can be drawn on by policy makers, program planners, and field workers in their efforts to improve the nutritional status of children during the weaning period.

This manual provides a summary of the current state of the art that should provide useful guidance to all who are committed to work in this area. The U S Agency For International Development and the U S Department of Agriculture are pleased to have assisted in the preparation of the manual and hope it will contribute to renewed efforts to reduce childhood malnutrition in developing countries.

Martin J. Forman
Director, Office of Nutrition
U S Agency For International
Development

Preface

This manual has been prepared by the HOVIPREP (Home- and Village-Prepared Weaning Foods) Project of the MIT-Harvard International Food and Nutrition Program, and the US Department of Agriculture, Office of International Cooperation and Development, with support from the US Agency for International Development, Office of Nutrition.

Originally, the manual was intended to focus solely on projects that were targeted at the home, village, and community levels and that used only locally available foods. However, because weaning-food strategies complement and overlap each other at the national, regional, and local levels, we broadened the scope of the manual to include the use of manufactured and packaged foods distributed via the market and via national and international subsidy programs. Often in a developing country, strategies involving marketed, subsidized, and locally made foods must be meshed to maximize the chances of reaching the entire population of weaning-age children.

The manual had its origin when a group experienced in nutrition field programs was invited to meet at the Massachusetts Institute of Technology from June the 20th to the 24th, 1982. The group prepared background papers that were discussed and modified at the workshop. An editorial committee was subsequently chosen to put these materials into manual form, and the committee consulted with a writer-editor who prepared a coherent text for publication. While all of these people have contributed to the manual, the editorial committee takes responsibility for the form and substance of this publication as it now appears. The manual does not represent the exact positions of all the people who contributed to it, nor does it represent the policies and positions of the US government or other bodies.

Weaning-period malnutrition acting together with infectious diseases is a major cause of death in the world today. The strategies and techniques for weaning-food projects described in this manual can help improve the nutritional status of small children and reduce the high levels of morbidity and mortality associated with malnutrition. The manual provides a state-of-the-art review of the kinds of weaning project strategies and techniques that are in use in the developing world. The strategies in most cases have been tailored to specific countries and are still largely experimental in nature.

We believe that this manual, which is the first of its kind, is urgently needed. It is intended to complement the excellent volume by Margaret Cameron and Yngve Hofvander, *Manual on Feeding Infants and Young Children*, published by the United Nations and now in its third edition. Cameron and Hofvander's book focuses on physiological and clinical processes, the chemical properties of foods, and child-feeding practices, whereas this manual provides guidelines for implementing and maintaining three kinds of weaning projects: the preparation of foods in the home and the village, the commercial processing and packaging of weaning foods, and the use of food aid and subsidized feeding

programs as crisis interventions. Special emphasis is placed on home- and village-level projects.

This manual is intended for people with some academic and/or professional training, although not necessarily as nutritionists, who will take part in weaning-food projects at the policy level, as program planners, and in the field. We have tried to provide information useful to a very broad audience, which we hope will include people in government, members of research organizations, community development teams, medical and agricultural extension workers, and teachers. International agencies, such as the United States Agency for International Development and the United Nations International Children's Endowment Fund, and the many staff members of private voluntary organizations around the world should be able to make use of this publication.

The members of the Working Group of Experts, who convened at the Massachusetts Institute of Technology from June 20th to the 24th, 1982, were as follows:

Gretchen G. Berggren	James M. Pines
Abraham Besrat	Jon Rohde
Ricardo Bressani	David Sahn
Susan Colgate	Tina Sanghvi
Hossein Ghassemi	Nevin S. Scrimshaw
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Ron Israel	Charles Sykes
Richard Lockwood	Juliet Tuakli
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The members of the Editorial Committee were as follows:

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Nevin S. Scrimshaw
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Chapter 1

Overview: Scope, Purpose, and Methodology

Purpose of this Manual

In developing countries children under five years of age suffer the highest mortality rate. Over half of all deaths in the developing world occur in this age group. Malnutrition, acting concurrently with infectious diseases, is a major cause of mortality among postneonatal infants and preschool children.[1]

Studies of Central and South American children less than five years old, excluding newborns, showed nutritional deficiency to be a significant contributing factor in over 60% of deaths caused by infectious diseases.[2] Other studies have indicated that malnutrition and infectious diseases, most notably diarrheal disease and common communicable diseases of childhood, have a synergistic effect: each contributes to the precipitation and the severity of the other. Malnourished children have less resistance to infection than well-nourished ones. Consequently they fall ill more often and their illnesses tend to be more prolonged and severe. Moreover, the cycle of poor nutritional status and disease is self-perpetuating: infections further weaken a malnourished child by reducing appetite and contributing to a loss of protein and other essential nutrients.

The nutritional deficiencies endured in early childhood can have debilitating mental and physical consequences that are carried into adulthood. The existence of such conditions in any population clearly has a negative impact on the growth and production of a nation. This manual's purpose is to make a

*Kathryn Kolasa and Alanna Mozar were the primary contributors to the methodology section of this chapter. Robert Morgan and Karen Mitzner prepared the remainder of the text.

[1] A neonate is a child who is newborn to 28 days old; an infant is from 28 days to one year old; and a preschool child is from 1.0 to 3.9 years old.

[2] Ruth Rice Puffer and Carlos V. Serrano, *Patterns of Mortality in Childhood* (Washington, DC: Pan American Health Organization, 1973), p. 184.

contribution toward improving the nutritional status of weaning-age children in developing countries. The manual promotes three kinds of weaning-food strategies: the preparation of foods in the home and village; indigenous commercial processing and packaging of weaning foods; and the use of food aid and subsidized feeding programs as temporary measures, which can play a role in initiating and supporting the other two strategies.

The manual's strategies are focused on improving nutrition during the weaning period, because it is the time of a child's life when it is most vulnerable to malnutrition, morbidity, and mortality. Ideally, weaning should be a gradual process, during which breast milk is increasingly complemented with other foods that fully meet the growing child's needs. This transitional phase can extend from about four months to as much as 36 months of age in some children, ending when a child is fed entirely with foods other than breast milk. The primary threats to a child's health during the weaning period come from nutritionally inadequate complements to or substitutes for breast milk and infections attributable primarily to poor environmental sanitation and personal hygiene.

The Problem of Weaning-Age Malnutrition

In the developed countries, foremost among the improvements that have led to better health have been nutritional advances and progress in sanitation, particularly the provision of pure food and water.[1] In contrast, the developing countries have inadequate food, impure water, unsanitary living conditions, and a high incidence of infectious diseases. Debilitating poverty, grave maldistribution of land and income, widespread illiteracy, especially among women, and technological underdevelopment are at the root of these problems, which are aggravated by periodic droughts and other natural disasters.

One promising fact stands out in contrast to the cycle of malnutrition and disease that takes its greatest toll among weaning-age children. In most developing countries, the diet includes one or more legume sources of protein that can be suitably prepared for consumption by young children. These protein sources, combined with common energy-dense foods like sugar, fats, and oils, could provide the basis for adequate weaning diets. Animal sources of protein and commercially manufactured baby foods are usually too expensive for the majority of families in developing countries or unavailable to them. However, even when nutritious foods are easily obtained, they are most often not used to make weaning mixtures for children.

Why are vegetable sources of calories and protein not sufficiently used to meet the food needs of weaning-age children? The reasons vary from culture to

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[1] Thomas McKeown, in *The Role of Medicine: Dream, Mirage, or Nemesis?* (Princeton: Princeton University Press, 1979), examines the interplay of various factors that have brought about longer lifespans for people in the developed countries during the past three centuries.

(Photo by Ruth Angove)

A NEPALESE MOTHER breast-feeds two children. Breast-feeding should continue as long as possible.

culture. One set of explanations has its basis in social beliefs and practices. Mothers usually are unaware of the value of high protein and energy-dense foods and of the measures necessary to prevent contamination of food and water. Moreover, the use of some protein sources in weaning diets may be restricted because they are consumed entirely by adults, or because they are believed to be harmful to children.

Technological and economic factors also affect the feeding of young children. Weaning foods must be carefully prepared to be soft enough to be consumed by a child whose teeth have not come in. They must also be relatively dense in nutrients and must be fed to a child several times a day in small quantities because a child's stomach cannot accommodate a large amount at a single feeding. Often mothers must work away from home during the day and do not have time to feed their children a specially prepared weaning food at frequent and regular intervals. Many mothers do not have sufficient income to purchase expensive firewood or other fuel necessary for preparing uncontaminated weaning foods. Such small amounts of food are required for babies who are also receiving breast milk that most families could afford nutritious weaning foods.

Problem Solution

The provision of basic human requirements, such as housing, nutritious food, clean water, and health care, are prerequisites to the attainment of economic growth. Until the past decade, governments in developing countries had been extremely slow in enacting programs providing for these basic needs. The development of educational institutions was the first major step taken by some governments toward building the social infrastructures necessary to meet these needs. The provision of health-care services and improvements in housing, water supplies, and sanitation were undertaken later in some countries. To date most governments have neglected to provide their people with sufficient food and nutritional and health education.

Chapter X in this manual discusses both direct and indirect approaches by which governments can affect the two principal factors limiting appropriate feeding of the young child: inadequate knowledge of sound nutrition and hygiene practices and lack of purchasing power. A separate chapter is devoted to the implementation of each of the direct measures discussed in Chapter X: projects for developing home- and village-prepared weaning foods, for increasing the availability of indigenous centrally processed foods, and for distributing donated and locally produced foods.

In evaluating whether to implement the weaning-food projects or other measures discussed in this manual, planners must keep in mind that the costs to a society of children who are permanently crippled mentally or physically are not human costs alone, nor is the loss of many children's lives a great tragedy

only for their families. Weaning-period malnutrition results in incalculable economic losses to nations. Although economic analysts have had difficulty assigning precise monetary costs to weaning period malnutrition, the relative costs of providing adequate nutrition are far less than those of combating the effects of malnutrition. These effects include: the loss of productivity and resources devoted to a child who dies or is severely impaired and the large expenditures for medical care to children who are frequently ill or who become severely malnourished. As we have already pointed out, in many countries the ingredients for nutritious weaning foods are readily available. The costs of the strategies fostered by this manual for preventing malnutrition include those for complementary feeding programs, for subsidizing the manufacture and distribution of commercially processed and packaged foods, and for nutrition measures integrated into primary health-care services.

Principles and Methodology of Fieldwork

This manual depicts weaning-age malnutrition in the matrix of social and economic factors that have caused it. The solutions the manual proposes have been devised to address malnutrition not as an isolated medical problem to be solved in a clinic but as part of a larger cluster of causes and effects in the community. The following sections are addressed primarily to fieldworkers in home- and village-level projects. (The terms "fieldworkers" and "project workers" are used interchangeably in this manual.) The purpose of the sections that follow is to provide a general view of the complex interrelationships among weaning behaviors and other aspects of a culture.

The Interdependence of Weaning Practices and Other Aspects of Culture

To develop an adequate perspective on infant feeding and weaning practices, the fieldworker must take time to study and understand them and their interactions with other factors in their natural and cultural environments. The most important cultural factors influencing infant feeding and weaning practices are dietary and sex-related taboos and restrictions, economic concerns, kinship and other social networks, and religion. The project worker must also learn about the environmental factors that affect sanitation, the spread of disease, and the availability of adequate food resources. In addition, the psychosocial needs of the child, the child's parents, and other involved individuals must be evaluated. An example in many societies of a psychosocial need would be to have a male child; an example of a grandmother's psychosocial need would be to relay the culture's weaning rules to new mothers.

Anthropologists have developed an approach useful for studying the complex aspects of a community – the ecosystems approach. An ecosystem is a complex composed of a biological population and its environment, functioning as an integrated whole. An ecosystem includes many interdependent subsystems, such as human and other life forms, technologies, culture, and the natural

environment. A change in one subsystem affects the others and, thus, the entire ecosystem. Since people and their communities change, maintaining a system that will function smoothly requires constant spontaneous or planned adjustments. However, a natural or an externally introduced change in a given subsystem will make adjustments necessary in other subsystems. The fieldworker must understand and carefully weigh the relative benefits and risks of a behavior change before introducing a change in weaning behavior through an intervention campaign. For example, a change in the age of weaning may have financial implications for a family. If limited funds are spent on a relatively expensive commercial baby food, often family members may be deprived of goods or services essential to their well-being.

The Weaning Process

The weaning process, the transition from a diet of breast milk to a diet that includes breast milk and other foods, and finally to a family diet, is depicted graphically in Figure 1 of Chapter IV. The patterns assumed by this process vary greatly around the world because they are affected by many factors, including cultural and individual beliefs, taboos, traditions, recommendations of family and friends, lifestyle, local resources, and economic concerns. These principal variations are determined by three decisions women must make:

- the ages at which weaning will begin and end;
- the length of the weaning period;
- the types of weaning foods provided to the baby.

The age of weaning Complementation[4], or the adding of food to a child's diet of mother's milk, may begin as early as the day of birth or be delayed until many months later. In most cases, the weaning process is completed by two years after birth or sooner in many societies. In general, social scientists and anthropologists view weaning practices as learned behaviors or part of a culture's tradition. However, the weaning practices of the nomadic *!Kung*, who live in the Kalahari Desert, can be understood in large part as a direct response to their physical environment. They have no soft foods available, and it is reported that they breast-feed exclusively until their children are three to four years old. The following are examples of other weaning practices. In some rural Thai villages, prechewed rice is sometimes given an infant at birth. Other premasticated foods—primarily banana and snack foods—may be given to Thai infants younger than six months of age; foods that have not been premasticated tend to be given in small amounts and not until the infant is five to six months old; weaning is generally completed when the baby is thirty-six

[4] The term "complementary foods" is used in this manual to express the idea that weaning foods are complements to, rather than replacements for, breast milk. The terms "weaning foods" and "complementary foods" are used interchangeably throughout this manual instead of the term "supplementary foods."

months old. Nigerian mothers in Benin City begin to complement breast milk with bottle-feedings one month after birth; they offer their infants other foods at four to six months; and they stop breast-feeding at fifteen months. In many cultures food is given as a complement to breast milk before the infant is three to four months of age. In others it is not given until the baby is six months old; and in still others, not until the baby is one year old. There is no simple answer to the question, "Is there a 'best' age for infants to receive complementary feedings?" Complementation may be advisable as early as two to four months after birth, depending upon the quantity of the mother's breast milk, which is related to many factors, including natural variations, the baby's ability to suck, the mother's health, and the mother's activities or her availability to breast feed.[5] A weight-for-age chart, evaluated with information about infant illness, is a practical indicator of the adequacy of breast-milk consumption.[6]

Length of weaning Weaning may occur abruptly or gradually. In some cultures, women report weaning their children by sending them away to relatives or smearing repellent substances on the breast. However, in such cases generally the child has been introduced to other foods before this complete severance occurs. In most cultures mothers shift their infants gradually from a predominantly milk diet to a predominantly adult food diet.

Types of food Researchers have been very interested in the large variety of foods provided to weanlings because of their significance to a child's growth and health. Some cultures provide watery carbohydrate gruels; others provide animal milk; and some use portions of adult foods.

Harmful and beneficial aspects of traditional feeding practices From the points of view of nutrition and maternal and child health, some feeding practices and beliefs common throughout the developing world are harmful or scientifically unsound. For example, colostrum, which is the yellowish early milk, is rich in antibodies and vitamins, is thought in many cultures, including some in Africa, South America, and Indonesia, to be bad for a baby. Another example is the belief that sexual relations during lactation will spoil a mother's milk and make a baby sick. While both of these beliefs may have negative effects, they may have potentially beneficial functions as well. Breast-feeding of a child by a neighbor woman in the period until a mother's mature milk comes in may set up the culturally important relationship of milk brother to the neighbor's child. Similarly, postpartum sexual abstinence may be beneficial because it is an effective birth-spacing method.[7]

The community context The project worker must identify the weaning practices prevalent in a community and understand the relationships of the

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[5] See Chapter IV for more detailed information on early complementation of breast milk.

[6] See Chapter V.

[7] See Study II, *Nutrition Education*, pp. 63-67 by Marian Zeitlin and Candelaria Formacion in *Nutrition Intervention in Developing Countries*, ed. James Austin (Boston: O.G. & H., 1981) for an extensive treatment of both harmful and beneficial aspects of feeding practices.

weaning age, the length of the weaning period, and feeding practices to one another and to other aspects of the culture. For example, the length of the weaning period may be influenced by several factors. It is generally related to the availability of appropriate weaning foods and to the traditions and beliefs in a community. However, the length of the breast-feeding period often may be shortened for economic reasons, such as the need for a woman to be employed. A mother might also stop breast-feeding because she perceives the alternative of a formula to be an indicator of social status.

Assessing the Need for an Intervention

Assessing the need for an intervention is the first step in the development of a program. Many of the research methods commonly used for this assessment, however, provide very limited and narrowly focused data. For example, anthropometry, the science of measuring the human body to determine differences between individuals and among groups, can provide information about the current physical status of a population, but cannot identify the causes of characteristics such as below-average weight or height-for-age. These single measurements will not provide sufficient data to establish the need for an intervention since children who are below average in weight- or height-for-age may have been malnourished in the past but may be adequately nourished in the present. Furthermore, most food-consumption surveys are inherently limited because they do not provide data about the distribution patterns of various foodstuffs among or within families, and because the data are on per capita food consumption within a community, and, therefore, they say nothing about the availability and use of the foodstuffs as weaning foods.

Traditional nutrition field research methods must be combined critically with strategies developed in other disciplines. For example, if a project has sufficient resources, fieldworkers may want to use participant observation, a major anthropologic research technique for obtaining firsthand knowledge of the environment and lifestyle of families in a community. The observer interacts informally with many individuals and participates in the community and/or family event. After the fieldworker has gained knowledge of significant aspects of community and individual lifestyles as a participant observer, techniques such as informal interviews and recording the child feeding practices in these families may be used.

Information gathered by observational techniques and informal interviews may be used effectively to complement quantitative data obtained from nutrition studies. Anthropometric data, such as heights and weights, and sometimes red-blood-cell volume (hematocrit) are particularly useful. By combining research methods focusing on different aspects of the local ecosystem, a broader data base can be obtained. With this information fieldworkers can realistically appraise the target population's needs, provide justifications for or against a particular program to be implemented, and give indications of potential risks and benefits of proposed interventions.

The Cultural Rules

Through observation, the project worker will be able to identify weaning practices common to a large number of mothers and those limited to only a few. Mothers are usually able to state the cultural rules for their weaning practices. For example, a widespread rule in Nigeria and the Soviet Union is that a child must not be given breast milk if he or she has not sucked at the breast for the previous 24 hours. The rationale is that milk spoils if it remains in the breast for this period of time.

The fieldworker must identify both the rules and their rationales. Even if mothers cannot recite a list of them, the fieldworker can derive this information from observation, using the information provided by the mothers and other community people. In a village in central Mexico fieldworkers combined information from many women's conversations and compiled a list of rules and rationales that included the following:

A child should be weaned when its first tooth comes in;

Weaning should not be gradual because a combination of breast milk and food will poison a child;

No animal milk can be given to a child.

Cultural rules enforce weaning patterns. In Santa Maria Cauque, Guatemala, women perceive breast-feeding to be the only acceptable way to feed a baby. Mothers who deviated from this pattern of feeding jeopardized social position and acceptance.

The social importance of a given set of weaning behaviors is intensified when it has a significance beyond child nurturance. In some cultures, the sex of the child is a factor in weaning practices, and weaning interventions must be designed not to interfere with the enculturation of a child's sexual identity. In addition, a comprehensive knowledge of the cultural and physical settings for weaning behaviors will provide clues to alternative behaviors that will be acceptable because they are based in local traditions and lifestyle.

Once the fieldworker understands the context within which a weaning behavior is embedded, he or she can more readily identify problem areas and approach them with a greater appreciation of their interrelationships with other aspects of the system. Behaviors should be targeted for change only if altering them will not cause harmful disruption of the social system.

Enlisting Community Support

It is essential that home- and village-based weaning-food projects have the understanding and support of the community. Unless the community becomes intimately involved and eventually takes over the major responsibility, such projects will be ineffective and short-lived. While there is no single formula for achieving this goal, there are certain common principles and procedures to be followed.

The first of these is to take the steps necessary to obtain the support of both official leaders and prestigious individuals in a community. Community leaders include the mayor and town council or their equivalents, school teachers, public-health and other government workers; respected individuals may include religious leaders, midwives, native healers, and highly esteemed elders. Systematic efforts must be made to meet these individuals and discuss the project with them in terms that solicit their input and make clear its benefits for their community.

The second principle is to invite discussion with the whole community and assure their understanding of and commitment to the project to the greatest extent possible. While information on the project is likely to have been already widely disseminated by the leaders previously reached, this step must not be omitted. Although the approach will vary with the community, an entertaining outdoor evening movie is often successful in bringing most of the community together and giving an opportunity to discuss the project. House-to-house visiting or meeting with informal groups in various neighborhoods are traditional approaches that should not be neglected.

A third principle is that a single explanation or session is never enough. Project workers must be prepared to explain and discuss repeatedly and to reiterate answers to the same questions with great patience. They must realize that a community has its own system of beliefs about illness and growth, diet and feeding practices. Above all, project workers must listen to the comments and suggestions of the people and be prepared to modify their own preconceptions accordingly. *Neglecting to learn from the community is the most serious omission in the approach of many community projects and the cause of their ultimate failure.*

The direct benefits of a program may be its primary objective, but there may also be secondary benefits of equal importance to the community. If increased medical and dental benefits are part of a program, they always add to its attractiveness. There may be other felt needs of the community that the project can help meet. Even the collection of information may be well accepted if the participants are convinced that this may help them to get more government assistance or improve government policies affecting them. However, such possibilities should always be presented realistically. In fact, honesty in dealing with the community and scrupulousness in meeting all commitments are absolute requirements for success.

The Outcome of an Intervention

The project worker should attempt to predict the effects of the proposed intervention before beginning to implement it. A program for change may have both primary desired impacts and secondary, sometimes harmful effects. For example, in many parts of the world the diet of pregnant mothers is restricted so that the infant does not grow too large. Providing a more generous diet to

expectant mothers in locations where hospital delivery is not possible could increase the risk of difficult labor.

Choosing the best intervention or alternative behavior is not the only challenge facing the planner and fieldworker. Involving community residents in planning strategies provides an inside perspective that can lead to a more appropriate and acceptable weaning program. In addition to providing information and ideas, community residents may also participate in testing the proposed strategies and make recommendations regarding the best options.

When mothers are asked to participate in finding the solutions to their children's nutrition problems, the fieldworker can adopt a variety of roles: facilitator, materials developer, organizer, trainer, problem-poser, and co-learner. The extent of mothers' participation can vary with the weaning project, but the greater the involvement of mothers and other community people in the entire process, the greater the chances for the community and fieldworkers to identify and adopt realistic and beneficial weaning practices.

Change does not come easily, and the means by which a weaning intervention is presented to the target population is critical. A pilot study undertaken in Mexico illustrates this point. An infant-feeding educational program was tested in six rural and urban communities. Several of these communities had a history of resistance to government health-intervention programs. The researchers chose as educators Mexican medical showmen who are well-known participants in Mexican folklife. The researchers carefully designed an educational message that included information such as the value of breast-feeding in the child's first year, the use of early complementary feedings, a unique method of cleansing the breast with chamomile tea, and the functions of several vitamins. The medicine men were effective in producing changes in knowledge, attitudes, and behaviors in both rural and urban communities.

Alternative Information Networks

Women's networks, based in work activities or social functions, may be utilized for the spread of weaning information. Kinship structures, that is, hierarchical social patterns based on blood relationships, can also be valuable to a weaning program because individuals with power and influence (for example, grandmothers, aunts, or uncles) may not be in the immediate nuclear family. By identifying key individuals and cultivating them as special contacts, their range of influence may be used to the advantage of the program.

Pilot Programs

Before major investments of resources are made, testing strategies with small-scale pilot programs is essential for identifying and coping with obstacles to behavioral change. Resistance may stem from individual priorities, misunderstanding of the motives of the project worker, or fundamental conflicts between modern, cosmopolitan approaches to weaning and traditional weaning

(Source: WHO)

GROUP ACTIVITIES MAY BE REQUIRED TO TEACH NEW BEHAVIORS. In the photo above, Mexican housewives learn about nutrition and receive instruction in fruit canning and food production as part of a comprehensive rural development project.

beliefs and practices. The fieldworker must note not only these barriers to change, but also more practical constraints, such as lack of resources, and devise program strategies to counteract them.[8]

The Inclination to Change

The most effective means for change are strategies designed to appeal to a target population's intrinsic motives and priorities. Communications researchers have found that when change occurs it tends to be in the direction of previous inclinations and that the reinforcement of desirable preexisting behaviors is more feasible than actual change. Thus, interventions intended to produce weaning-behavior change must be based on the inclinations or predispositions of the target population. Incentives for change that appeal to the people's needs and beliefs may also be provided. For example, mothers may not relate food-intake to health, but may wish to delay their next pregnancy. Prolonged breast-feeding promoted for child health may not be as well accepted as if presented as a means of increasing the interval between pregnancies.

Broad-Based Evaluation Strategies

Once a program has been designed, pretested, and implemented, evaluation becomes a major concern for the policy maker, planner, and fieldworker. As with other aspects of a program, its evaluation must encompass a broad range of possible effects—physical, social, and economic—and a combination of strategies must be used. To provide the basis for improving a project, the effectiveness of its strategies must undergo frequent evaluation. After an appropriate period of operation, a project should produce evidence to support its continuance, expansion, or termination.[9]

Conclusion

Developing a program to effect changes in weaning behaviors is a complex task. The weaning phenomenon is one that involves many aspects of life—both individual and community. The fieldworker must discover and understand the factors that determine the choices of weaning age, length of weaning, and weaning foods. These factors must be understood as interrelated. The implications of changing any aspect of this system of factors must be evaluated and communicated to planners and policymakers before an intervention is undertaken. The chapters that follow attempt to provide guidelines for problem identification, program development, and project implementation.

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[8] Chapter VI lists other obstacles to change that may be encountered once a project is underway.

[9] See Chapter IX.

(Photo by Ruth Angove)

THE GREATER THE INVOLVEMENT OF community members in weaning projects, the greater the chances the community will adopt beneficial new weaning practices.

Chapter II

Recognizing the Problem: Assessing Nutritional Status in Weaning-Age Populations

How to Evaluate the Prevalence of Undernutrition

To plan and budget for weaning-food interventions, nutritional and health planners must be able to determine the prevalence of undernutrition in weaning-age children in a given population and location. The team assigned to work in the field also needs this information. In addition, both planners and the field team will find it useful to understand the major contributing factors to malnutrition in a community, such as inappropriate child-rearing practices, underfeeding of available weaning foods, frequent episodes of disease combined with food withdrawal, or the many conflicting responsibilities of mothers, including work outside the home. This chapter illustrates briefly how planners can use this information in relation to other indicators of malnutrition. Chapter III provides a discussion of how project workers can evaluate the major contributing factors to malnutrition.

Approaches to Obtaining Data

The following three approaches are most commonly used to assess the extent of malnutrition either in a community or a larger population group:

1. Clinical records, usually retrospective from hospital and outpatient clinics, which give clinical and biochemical evidence of malnutrition.

2. Cross-sectional nutrition surveys of anthropometric and clinical measurements, which, if age is reliably obtained, can be analyzed to show the proportion of undernourished children by age group and by sex.

3. Longitudinal surveys of weight changes in weaning-age children carried out prospectively by growth-monitoring programs or by mothers themselves. These surveys are primarily useful for collecting data on weight-for-age but can

*The primary contributors to this chapter were Gretchen Berggren, Juliet Tuakli, Nevin Scrimshaw, and Heidi Van Arsdell.

(Photo by Anne Haaland)

ASSESSMENTS OF NUTRITIONAL STATUS are valuable only if used in effective programs. Often weight for age data are collected, for example, but mothers are not provided with either appropriate instructions concerning when to provide more or better food or with adequate health care services for their children.

also be used to obtain information on morbidity and mortality.[1]

Of these three approaches to obtaining data, longitudinal surveys of weight changes in children provide the most accurate evidence of nutritional status of a weaning-age population. However, if cost, time, and manpower are paramount considerations in choosing among the possible approaches, a cross-sectional survey of anthropometric indicators for a representative sample, such as those listed in Table 1, is the best option. In theory, assessing nutritional status through a clinical examination should provide a record that would offer an initial step in a field-team evaluation of a project site or region. Such records, however, provide a biased sample, and frequently information on nutritional status is found to be incomplete and inadequate.

Each of these three approaches can be used to assess the nutritional status of both local and larger populations, and also lend themselves to different specialized purposes, such as using cross-sectional surveys to assess prevalence of various grades of malnutrition and surveillance; extracting data from clinical records to evaluate the need for clinical intervention; and analyzing growth monitoring data to evaluate the effect of a project. A detailed discussion of each approach follows.

Clinical Records

An evaluation of nutritional status based on health records from dispensary or outpatient clinics usually underestimates malnutrition because frequently only the most severe cases are seen in clinics and because coverage is generally incomplete. Programs that utilize outpatient clinics or dispensaries without a community outreach program commonly cover only from one-fifth to one-third of preschool children; for the purposes of evaluation, such a sample is biased. In general, the greater the distance between a health unit and a household, the less likely that it will be reached with preventive services, including nutrition programs.

A second bias in records is related to the consistency with which healthworkers look for, and reliably diagnose, malnutrition in various degrees of severity. Unless a protocol is in effect that requires consistent anthropometric, clinical, and laboratory measurements of *all* children who enter a clinical unit, milder forms of malnutrition will be underreported. Often in developing countries, malnutrition is diagnosed and reported only for children who are severely ill. Only the following diagnoses are commonly recorded: kwashiorkor; marasmus; failure to thrive; anemia; and, in francophone countries, hypodevelopment. If a protocol for screening children for less severe malnutrition is instituted, such as weight-for-age measurements, the number of cases reported is dramatically higher.

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[1] See Chapter V.

Table 1
Direct Indicators*

Anthropometric*

1. Birth weight
2. Weight-for-age
3. Longitudinal growth faltering
4. Weight-for-height
5. Head circumference
6. Arm circumference

Biochemical*

1. Hematocrit or hemoglobin
2. Serum albumin
3. Delayed cutaneous hypersensitivity
4. Other immunological tests
5. Analysis of nutrients in blood or urine

Clinical*

1. Protein-calorie deficiency
   a. Protein deficiency relative to calories: Kwashiorkor
   b. Protein and calorie deficiency: Marasmus
2. Iron deficiency, folic acid deficiency: Nutritional anemias
3. Iodine deficiency: Goiter, cretinism, mental retardation
4. Vitamin A deficiency: Night blindness, xerosis, xerophthalmia
5. Vitamin D deficiency: Rickets, bow-legging, wrist-swelling, rachitic rosary, tetany
6. Thiamine deficiency: Beriberi**
7. Thiamine-niacin deficiency: Characteristic dermatosis, diarrhea**
8. Vitamin C deficiency: Swollen gums and subperiosteal hemorrhages, skin petechiae, and mucosal bleeding.

*In approximate order of usefulness; for the strengths and limitations of anthropometric indicators 2 through 6 in the list below, see Chapter V.
**Now rare.

Cross-Sectional Nutrition Surveys

Local surveys Some simple techniques for assessing the nutritional status of the children of a village have been outlined by Morley and Woodland[2], based on their research in Nigeria. Their approach maps a village to assure one-hundred-percent coverage, and all the children in the village are weighed. The results are interpreted to indicate the severity and prevalence of malnutrition. Weight surveys of this type done by community-based health projects are far better than surveys of clinic populations, which are characteristically biased by self-selection.

[2] David Morley and M. Woodland, *How They Grow: Monitoring Child Growth for Appropriate Health Care in Developing Countries.* New York: Oxford University Press, 1979.

National surveys The preliminary steps for a national nutrition survey, which collects data on anthropometric and clinical measurements, include: obtaining existing data on population distribution and demographic composition of the population; and, based on these data, determination of the sample size needed to obtain representative information. The determination of sample size is influenced by (a) the resources available, (b) time and logistical constraints, (c) the nature of sample distribution assumed applicable, (d) the extent and depth of information required, and (e) the precision desired for statistical estimates.

National nutrition surveys will be costly and may contribute very little information useful in improving the nutritional status of mothers and children unless:

a. Competent health workers experienced with local views and customs participate in developing the survey protocol;
b. A statistically reliable sample is obtained;
c. Fieldworkers undergo standardized training (standardization exercises should be repeated at regular intervals if data collection is prolonged);
d. Equipment is accurate and precise and standardized at least daily;
e. Manpower and equipment are available to check data for errors, to process data, and to carry out statistical analysis;
f. Findings are interpreted with a multisectoral view (agronomists, economists, physicians, and educators should be available to help evaluate the significance of the data within the context of the population from which it was obtained);
g. National agencies and local individuals are motivated to utilize survey findings in devising more appropriate nutrition messages and developing cost-effective programs.

National nutrition surveys conducted in the past have usually had cross-sectional research designs, that is, individuals of many ages are measured at one calendar time. These studies have tended to show that the effects of malnutrition peak in the second or third year of life. This finding may be wrongly interpreted since longitudinal surveys, which are designed to measure individuals several times at a series of ages, reveal that growth faltering begins much earlier, often within the first six months of life. The most reliable survey data are longitudinal weight measurements of individual children, combined with less frequent length measurements, but this approach is seldom feasible in national surveys.

Longitudinal Surveys: Growth Monitoring

Advantages Growth monitoring is preferable to cross-sectional nutritional surveys as a method for detecting malnutrition.[3] The growth monitoring method

[3] Growth monitoring is described in detail in Chapter V.

can detect a malnourished child who may be overlooked by a point-prevalence nutritional survey. A glance at a longitudinal growth record will reveal whether a child is currently undernourished, and information about the pattern of weight over time together with morbidity information can reveal a child on the road to malnutrition.

Weight measurements can also be analyzed together with less frequent measurements of length, both in growth charts for changes over age spans and also for specific ages, according to Waterlow's method of cross-tabulation.[4]

Sometimes weights at specific ages—data that can be recorded in cross-sectional nutrition surveys—are analyzed according to a method devised by Gomez[5] that relates weight-for-age to a reference population; this method does not differentiate between *wasting* and *stunting* (see Glossary) as do the Waterlow tables, but this distinction is not important during the first two years of a child's life. The Gomez weight classification has been used most frequently with the Harvard reference standards. Now, this classification system should be used with World Health Organization reference values, which are equivalent to the preferred standards: the United States National Center for Health Statistics standards.[6]

The interpretation of longitudinal weight data is helped by accompanying data on the occurrence of acute and chronic diseases because these influence weight gain. Also useful for interpreting growth curve data is information on critical variables that affect early growth, such as, birth weight, season of birth, child feeding practices with respect to mother's activities, and socioeconomic status.

Disadvantages The major disadvantage of this approach to collecting data is that growth monitoring cannot be done so quickly as a cross-sectional survey. Growth monitoring requires the long-term cooperation of a family and repeat visits to a household, which may be logistically difficult. It has been demonstrated in several parts of the world that, when weighing scales are made available, mothers' groups can maintain weight-for-age charts themselves, which lessens the logistical burden. However, some continuing external advice and encouragement is required, and mothers' cooperation may vary. A project must plan for mothers to have long-term access to a neighborhood scale, and they will need guidance so that they can understand the meaning of the charts. Another problem with mothers' using growth charts for making decisions about infant feeding is that interpreting them for the onset of growth faltering is somewhat subjective. Methodologies have been proposed that assess precisely this change in the weight curve in an objective and consistent manner, but these methods are too complex for use by most mothers in developing countries.

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[4] Waterlow's method is described in Chapter IX and in the Glossary.

[5] See Chapter V.

[6] See Chapter IX for a discussion of standards.

Kinds of Indicators

Clinical records, cross-sectional surveys, and longitudinal surveys, can all be used to obtain data on a variety of either direct or indirect indicators of nutritional status.

Direct Indicators

Direct indicators include *anthropometric measurements*, such as weight, height, and head circumference; *clinical evidence*, such as edema, scaly skin, or apathy; and *biochemical measurements*, such as hemoglobin and serum albumin. Table 1 lists a number of direct indicators.

Indirect Indicators

Indirect indicators include food consumption *surveys* and *observations* on infant feeding practices, including what the infant consumes, as well as how the food is prepared and fed. *Morbidity* and *mortality rates* from infectious diseases, such as diarrhea and measles, are also indirect indicators. Age-specific mortality rates of infants and preschool children, particularly the rate for one-to-four-year olds, are useful for determining the consequences of improper weaning. The importance of the relationships between death in the second year of life and malnutrition, infection, and inappropriate weaning practices has been well described.[7]

How to Interpret Clinical Indicators of Malnutrition

Clinical signs are most important for diagnosis of protein and energy malnutrition, anemia, cretinism from severe maternal iodine deficiency, and for vitamin A deficiency. Protein-energy malnutrition of early childhood is a designation that includes a spectrum of nutritional disorders ranging from acute protein deficiency, known as *kwashiorkor*, at one end of the spectrum, and acute energy deficiency or *nutritional marasmus* at the other. Marasmus is a disease of weaning-age children who have received grossly insufficient food, either in association with inadequate breast-milk intake or as inadequate replacement of breast-feeding. Kwashiorkor occurs in association with abrupt lowering of the protein content of the diet: the dietary protein content can fall when breast-milk intake is dramatically lessened and typically replaced by a starchy gruel.

Kwashiorkor

Edema is the most obvious and consistent sign of kwashiorkor. Edema is readily diagnosed by applying thumb pressure to the lower leg for three

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[7] John E. Gordon, John B. Wyon, and Werner Ascoli, "The Second Year Death Rate in Less Developed Countries," *The American Journal of the Medical Sciences* 254(1967):357-380.

seconds. If an indentation persists after pressure is removed, then edema is present, and a clinical diagnosis of protein deficiency can be considered positive. Other causes of edema in young children, such as kidney disease, are too rare to be of public health significance. When edema is present, the fluid accumulation increases the child's weight beyond that of the true body mass, so that weight measurements are unreliable indicators of nutritional status.

(Photo by Kirsti Kormu)

BABY SUFFERING FROM KWASHIORKOR.

In addition to being edematous, the child with kwashiorkor is characteristically emotionally unresponsive unless provoked, anorexic, and wretched in appearance. Some individuals also exhibit the following signs: a so-called moon face, and skin lesions in which there is dyspigmentation of sharp-edged patches or a flaky-paint dermatosis. Alterations in the hair include changes in texture, lightening of color, easy pluckability, and thinning. If periods of depletion and rehabilitation alternate, bands of lighter and darker hair may be seen (the flag sign).

Marasmus

The most noticeable feature of marasmus, which primarily affects infants (children in the first year of life), is marked wasting of fat and muscle and retarded growth. An infant suffering from this syndrome may have a characteristically wizened face and a prematurely old appearance.

The Continuum of Signs of Malnutrition

It is important to recognize that advanced kwashiorkor and marked marasmus are extremes in a continuum of intermediate signs. A child may be on the road to malnutrition without these dramatic signs.

Vitamin A Deficiency

Clinical vitamin A deficiency can also be diagnosed through direct examination. Damage to the eye ranges from functional changes in dim light vision (night blindness) to total irreversible blindness. Surveys that seek information on how a child sees at sunset or when coming indoors after playing in the bright

(Institute of Child Health, University of London)

BABY SUFFERING FROM SEVERE MARASMUS.

sun are helpful. Field staff should be trained to use standard procedures and local terminology to identify varying degrees of vitamin A deficiency, such as night blindness, Bitot's spots, drying of the cornea, and nutrition-related blindness.

Anemia

Anemia is common in underdeveloped populations and is most often due to iron deficiency. Its functional consequences lead to reduced resistance to infection, lowered physical capacity, and impairment of some types of cognition. Anemia can be readily detected from a fingertip blood sample even under field conditions. Anemia cannot be reliably diagnosed by physical examination. The easiest reliable method is collection of blood in a small heparinized capillary tube and determination of packed cell volume (hematocrit) in a battery-operated microcentrifuge that can be held in the hand and can handle eight samples at one time in only two minutes. Alternatively, hemoglobin may be estimated with the same size sample and a Sahli hemoglobinometer for obtaining color-comparison readings. Where samples can be brought back to a nearby laboratory, there are convenient photometric methods. Fortunately, for public-health purposes it is not necessary to obtain the larger blood sample and carry out the complex and costly battery of tests required to distinguish among the various other nutritional causes of anemia.

Goiter

If endemic goiter is detected in the mother of an infant, this finding can be taken as presumptive evidence of at least borderline iodine status in the infant. Endemic goiters due to iodine deficiency can be readily detected by palpation and visual examination of the front of the neck. A thyroid gland is judged as goitrous if each of its lima-bean-shaped lateral lobes is determined to be three to four times the size of the outline of the thumb nail of the individual examined. (The lateral lobes of a normal thyroid gland are relatively flat.) If visible upon inspection with the head in a normal position, the goiter is rated as Grade two or, if visible at a distance, as Grade three. Field staff can be readily trained in the examination procedures.

How to Interpret Indirect Indicators of Nutritional Status

Mortality Rates

Infant mortality rates Several kinds of mortality rates routinely calculated for children can serve as indirect indicators of malnutrition during the weaning process. A high rate of fatalities from infectious diseases, especially diarrhea and measles, suggests undernutrition as a complicating factor. While many deaths in the first few months of life, such as those due to neonatal tetanus, are not directly related to nutrition, infant mortality is still a good reflection of the

Table 2

Comparison of Mortality Rates in Some Developing and Developed Countries for Infants and One-to-Four-Year Olds

Country (circa 1980)	IMR 0-12 months (per 1000 live births)	Death rates ages 1-4 years (per 1000 same age)
Benin	154	34.0
Mauritania	143	31.0
India	123	17.0
Guatemala	70	6.0
Mexico	56	4.0
United States	12	0.7
Denmark	8	0.5

SOURCE: World Bank, *World Development Report* (Washington, DC: World Bank, 1982).

nutritional status in a population.[5] Excess mortality in the one-to-four-year age-range is an even more specific indicator. The postneonatal infant mortality rate is a still better indicator, but is seldom available.

Fortunately, infantile beriberi due to thiamine deficiency in the mother's milk is now rare. Where it occurs, however, it contributes to mortality three to four months postpartum.

One-to-four-year mortality-rate The one-to-four-year mortality-rate in many developing countries is as high as 20 to 40 per 1000 and is a sensitive indicator of the extent of a nutrition problem during the weaning period. The one-to-four-year mortality-rate in developed countries is less than one per 1000, or 20 to 40 times less than that in most developing countries (Table 2). On a global basis deaths in this age group total 5.4 million per year and studies suggest that at least two-thirds of these deaths are associated directly or indirectly with malnutrition.

The six-to-24-month mortality-rate Probably the most sensitive indirect indicator of nutritional deficiencies during the weaning process is the mortality rate between the ages of six and 24 months. In this period the synergistic interaction of malnutrition and infection is responsible for most of the deaths regardless of whether the cause listed is due to one or the other. Mortality data are generally available, however, only for the first year (infant mortality), and then for one to four years, unless specially collected for research or surveillance purposes.

Cause of Death

The cause of death in children in developing countries is usually listed either as diarrhea or respiratory infection. Deaths are also often attributed to parasites.

[5] Infant mortality is defined as death in the first year of a child's life.

Table 3

Causes of Death by Age in Children under 15 Years of Age in Four Highland Villages in Guatemala, 1956 and 1957*

Cause	Official vital statistics	INCAP investigation
Congenital malformations and diseases peculiar to early infancy	43	49
Diseases of the respiratory system	35	42
Diseases of the digestive system	21	37
Infective and parasitic diseases:		
Whooping cough	12	17
Intestinal parasites	58	0
Other	9	10
Other specified causes:		
Kwashiorkor	0	40
Other deficiency diseases	1**	3
Other	2	0
Ill-defined or unknown	41	17
Not investigated	0	7
Total	222	222

*This table was adapted from one appearing in "An Investigation into the Causes of Death in Children in Four Rural Communities in Guatemala," by M. Behar, W. Ascoli, and N. Scrimshaw, *Bulletin of the World Health Organization*, 19:(1958), p. 1099.

**Died in a hospital in Antigua, Guatemala.

However, the latter two are most often associated with malnutrition and are commonly complications in malnourished children of infectious diseases like measles, tuberculosis, and whooping cough. Behar and co-workers have tabulated the major causes of deaths of children in four Guatemalan villages as determined by investigation of each compared with the cause reported by the town clerk in the official records (Table 3).[9] Nearly one-fifth of the deaths occurred with signs of kwashiorkor and most of the remainder were caused by infections that would not have been fatal to well-nourished children. These

[9] Moises Behar, Werner Ascoli, and Nevin Scrimshaw, "An Investigation into the Causes of Death of Children in Four Rural Communities in Guatemala," *Bulletin of the World Health Organization*, 19(1958):1093-1102.

findings would not have been apparent from the town records that are used in national and international vital statistics for a given country. In Table 3 the first column shows causes of death classified according to the national vital statistics. It should be emphasized that, with the exception of one child who died in a hospital in Antigua, none of these deaths was certified by a physician. The town clerk wrote down his own interpretation of the cause of death, based on the opinion of a relative or a family friend. The second column in Table 3 lists the deaths as classified in the investigation by Behar and co-workers (the INCAP investigation) in which the findings were markedly different from the first in several important categories, especially kwashiorkor and also diseases of the respiratory and digestive systems and whooping cough. Similarly, Puffer and co-workers analyzed the cause of death excluding neonatal deaths in children under five years old from death records in Latin American populations and calculated that over 60% of the deaths from infectious diseases were related to nutritional deficiencies. This figure may be low.[10] When postneonatal deaths under 15 years of age in four Guatemalan villages were investigated by home visits immediately after death, it was concluded that over 80% would not have died had they not been malnourished.[11]

Indirect Indicators Other Than Mortality and Morbidity

Factors other than morbidity, which are associated with the evolution of malnutrition, are useful indirect indicators. In developing countries, in communities in which breast-feeding is not the rule during at least the first six months of an infant's life, rates of infant malnutrition are usually higher than in communities where breast-feeding is more common. Unavailability of weaning foods or obviously poor child care may also be useful indirect indicators of malnutrition. The presence of a cluster of indirect indicators is a more reliable predictor of the magnitude of malnutrition in a community than a single indicator.

Groups of indirect indicators can be evaluated by organizing them in a table that shows the association with problems diagnosed in a population. Table 4 is an illustration of this technique.

What to Do in the Absence of Large-Scale Survey Data

When it is not possible to use existing survey data or to set up surveys to measure indicators of the nutritional status of mothers and children, time and effort must be spent examining any previous studies and extracting other evidence of malnutrition, such as data from hospital and clinic records. (See

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[10] Ruth Rice Puffer and Carlos V. Serrano, *Patterns of Mortality in Childhood* (Washington, DC: Pan American Health Organization, 1973), p. 184.

[11] Behar, Ascoli, and Scrimshaw, "An Investigation into the Causes of Death of Children in Four Rural Communities in Guatemala," pp. 1100-1102.

the beginning of this chapter.) An appraisal of resources available for solving nutrition problems should also be made.

Studying the Determinants of Malnutrition

A health planner should go beyond a simple assessment of the extent of malnutrition in a population. The primary determinants of malnutrition must also be studied. Table 5 provides a framework for understanding the evolution of fatal malnutrition. Sociocultural and economic factors related to weaning-age malnutrition, such as those listed in the first two columns in Table 5, are discussed in detail in the next chapter in this manual.

Table 4

Problem Evaluation Using Indicator Clusters

Problem Presented to Health Planners	Indicator Examples	Factors Contributing to the Problem	Some Information Needed
High mortality associated with diarrhea	• High death rates in second year of life	• Contaminated weaning foods and water • Withdrawal of food during illness • Dehydration • Poor personal sanitary practices	• Microbiological evaluation of weaning food as prepared and fed and water contamination • Serial records of weight gain and morbidity • Observations of feeding and other care during illness • Cultural views of illness and treatment
Malnutrition	• Cross-sectional weight, length, and arm circumference data and individual growth curves indicating growth faltering between six and 24 months	• Inadequate food consumption together with infection • Inadequate breast-milk production or feeding schedule	• 24 hr diet recall • Intrafamilial food distribution • Vaccination coverage and morbidity rates • Assessment of breast-milk intake (feeding practices)
High mortality associated with measles	• Diarrhea with measles	• Malnutrition during weaning period • Lack of immunization	• Nutrition assessment studies • breast-feeding prevalence study • Vaccination coverage

Table 5

Information Useful in Assessing the Evolution of Malnutrition

Risk Factors	Inadequate Nutrient Intake	Inadequate Rate of Weight Gain	Frank Malnutrition	Death
Low birth-weight	Breast-feeding practices	Growth charts	Anthropometric data	Age-specific and cause-specific mortality rates
Single parent family	Age of introduction of complementary food	Morbidity record		
Low socioeconomic status	Frequency of feeding and type of food	Dietary intake		
Contamination of environment	Anorexia due to illness			
Lack of running water or limited supply of water	Feeding practices during illness			
Detrimental cultural views regarding value of children, appropriate foods and feeding practices for infants	Who feeds baby			
Seasonal variations in availability of foods				
Heavy work schedule of mother				
Illiteracy of mother				
Large family size				

[illegible]

Chapter III*

How to Collect Information on Child Diet and Feeding Practices

Introduction

In nearly all developing countries, relatively low-cost vegetable sources of protein and energy suitable for weaning-food mixtures can be identified.[1] However, the weaning foods actually in use are often inadequate in caloric density, protein concentration and quality, and sanitary characteristics. Inadequate weaning foods may lead to growth faltering, increased morbidity from infections, and high mortality. This chapter discusses (1) the kinds of information that should be collected in a community in order to evaluate dietary adequacy and feeding practices for infants and young children during the weaning period, (2) data collection techniques, and (3) a step-by-step procedure for obtaining data.

To evaluate weaning diets and feeding practices, information is needed on: (1) the kinds of feeding practices and the composition of weaning diets; (2) the foods available in the home and community suitable for feeding young children; and (3) the environmental, economic, and sociocultural factors that influence the choice of weaning foods, the way they are fed, and by whom and under what circumstances they are prepared and given to the young child.

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*Contributors to this chapter were Tina Sanghvi, Shubh Kumar, Gretel Pelto, Mary Scrimshaw, and Karen Mitzner. Heidi Van Arsdell and Ellen Messer provided valuable suggestions.

[1] The weaning period is the time during which a child receives liquid, semi-solid, or solid foods in addition to breast milk. Chapter IV contains a more thorough treatment of this subject and provides information concerning nutritious weaning diets and sanitary food preparation and storage techniques. The terms "weaning foods" and "complementary foods" are used interchangeably in this manual.

Child Feeding Practices

A task of the highest priority for project workers is identifying the feeding patterns and practices in a community that contribute to good health and nutrition. Some children may be healthy and adequately nourished because their mothers have been able to overcome potentially hazardous conditions, beliefs, and practices characteristic of their community. For example, they may provide their babies with sanitary preparations of high protein, energy-dense, easily digested weaning foods such as those described in Chapter IV. Much can be learned by the project team from such mothers, and they may be extremely important in effecting changes in weaning diets and practices in a community.

Table 1 lists practices frequently linked with malnutrition. In conjunction with identifying beneficial feeding patterns and practices, an early task should be to determine which practices--those listed in the table or others--may be associated with weaning-age malnutrition in the project area. For example, a very prevalent weaning problem leading to diarrhea and other diseases is fecal contamination of weaning foods, mainly due to poor personal hygiene of food handlers.[7] A possible scenario resulting in contamination would be a mother's defecating, not washing her hands sufficiently, and then preparing food for her baby. In addition, a diet inadequate in quantity and quality, particularly if the child is ill, contributes to the synergism between malnutrition and disease described in Chapter I.

Factors Affecting Diet and Feeding Practices

It is critical that the team realize, as was emphasized in Chapter I in this manual, that the factors responsible for weaning-age malnutrition are only a part of a much larger cluster of causes and effects of ill health in a community. Feeding practices are directly related to economic, social, technological, and biological factors in the community. Some examples include cultural beliefs about acceptable foods, availability or distribution of household income, and the amount of time a mother has available to prepare food. Before proposing changes in existing feeding practices, fieldworkers must make thorough efforts to understand the bases for them. Figure 1 provides an overview of major factors related to weaning problems. The sections that follow give detailed information on some of the most important of these factors.

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[7] Fieldworkers should be aware that diarrheal diseases are primarily spread by contact, not primarily by contaminated water. In many communities, even where basic sanitation facilities exist and are used by adults, young children are permitted to defecate indiscriminately. Fecal contamination can also result from animal feces. The organisms present in feces and responsible for most acute diarrheal episodes in young children are introduced into weaning foods by unhygienic food handling and from contaminated utensils and contaminated water.

Food Availability and Usage

Weaning diets used in a community will, of course, be directly influenced by the food available. Both to understand a community's choices from available foods and also to formulate recommendations for new complementary feeding patterns, the project team needs the following information on food availability and usage: what protein- and energy-rich sources are available to families from their own production and from markets and stores; what seasonal variations occur in the availability of foods; what foods are used in family diets; and what are the resources available for cooking and storing foods? For many rural households, home food-production is a major source of dietary intake, but when a household has no cash income, a proportion of the foods produced may be used to barter. In areas where family food-production is a major source of food, project workers should determine what proportion of the foods they produce a family usually consumes. The availability and usage of foods from complementary feeding programs (Chapter VIII) should also be documented. Gathering information on food availability and usage is treated in detail in the present chapter in the section, "Data Collection Procedure."

Knowledge and Beliefs

The knowledge, attitudes, and beliefs of a child's caretaker may be the most important determinants of whether the child will be well-nourished. A mother's beliefs about the nutritional content of foods and her understanding of the causal factors of disease may have very powerful effects on a child's well-being. For example, children may be fed food that is inadequate in quantity and quality because a community believes that feedings of sugary liquids are appropriate for babies. Another example of a common detrimental practice is starving children during illness, a practice that can seriously reduce a child's chances of recovery.[3]

On the other hand, it is also critically important to consider the usefulness of attitudes or beliefs that appear to be mere superstitions. For example, mothers in the South Pacific do not give babies fish because they believe it will make their offspring wanderers in life, like fish. In fact, some fish in the region contain a nerve toxin that could cause illness.

Acceptability and Avoidance of Foods

Even if nutritious foods, such as soybeans and cowpeas, are available, food customs may prevent their utilization for weaning-age children. Such a custom may have developed because these vegetable sources of protein are digested poorly by a young child if they are not adequately cooked.[4]

The project team should pay very careful attention to the preparation of foods that are already acceptable to a community. Making minor alterations in

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[3] See Chapter IV.

[4] See Chapter IV and Appendix 2.

Table 1

Examples of Detrimental Feeding Practices

Type of Detrimental Feeding Practices	Specific Example
Feeding Infants Contaminated Foods	Feeding liquid or solid foods that have been fecally contaminated, made with contaminated water, or inadequately cooked or stored under conditions that allow the growth of viruses, bacteria, and/or parasites.
Insufficient Quantity	Giving child nutritious food in too small amounts.
Inadequate Quality	(1) Overly diluted or nonnutritious starchy foods, such as starchy root, tuber, or cereal preparations (widely reported in African countries). (2) Bottle-feeding of starch water, sugar water, or diluted milk-based preparations (common in urbanizing communities around the world, and more widespread in Central and South American and Caribbean countries).
Inappropriate Age for Introducing Supplements	(1) Delayed complementary feeding, sometimes until 12 months of age (common in many parts of Africa, India, Pakistan, Sri Lanka and other Asian countries, especially in rural communities). (2) Too early feeding of prechewed rice preparation in Thailand.
Starving Sick Children	Children with diarrhea are often not given food (common in Asian countries and elsewhere).

Table 1 (continued)

Effects of Harmful Feeding Practices	Comments
Diarrheal and other diseases commonly caused by infectious agents and parasites.	This is perhaps the most widespread of all problems. The unhygienic conditions mentioned in the Specific Example column may be due either to inadequate maternal care or to the child's being cared for by an older sibling, grandparent or another member of the extended family.
Marasmus, failure to thrive	Parents sometimes have incorrect beliefs concerning a young child's capacity or needs for food or sometimes do not feed an infant frequently enough. Insufficient quantity is also linked to seasons of high workload in households or communities.
Both (1) and (2) in the Specific Example column are associated with kwashiorkor and growth retardation that begin around six months of age. They are also associated with diarrheal disease and growth retardation, sometimes as early as three months of age, and with an early end to breast-feeding.	Foods do not provide either adequate protein or adequate energy in quantities that can be accommodated by the stomach of a small child.
(1) Results in growth retardation that begins around four months and usually peaks between six to 24 months. (2) Results in reduction in the amount of breast milk produced by mother.	Parents often determine schedule of regular feeding of supplements by developmental milestones (e.g., appearance of teeth, learning to walk, or learning to say the words "food" or "bread") because they are unaware of the nutritional requirements of the growing child.
Results in delayed recuperation, severe growth retardation, and increased susceptibility to bouts of infectious diseases.	We are not referring to not giving children food when they are anorexic or unable to tolerate any food by mouth. We are concerned with the denial of all or some foods because of such beliefs as that illness and foods have "hot" and "cold" attributes or that feeding will hurt the digestive system.

Figure 1

Sociocultural, Economic, and Other Determinants of Weaning Problems

Sociocultural Variables

- Unsanitary practices leading to fecal and other forms of contamination
- Lack of education and knowledge about nutrition and health
- Avoidance of nutritious foods, such as soybeans
- Customary use of nonnutritious complementary foods, such as sugary liquids
- Harmful traditional food preparation methods, such as using unsanitary utensils
- Failure to feed infants nutritious food available to other household members
- Limitations on women's role in household decision-making, so that infants' and nursing mothers' needs are not adequately met
- Disruption of breast-feeding because of migration or urbanization and employment

Biological Variables

- Infectious diseases
- Low birth weight
- Low birth order
- Sex of infant: female[1]

Economic Variables

- Unavailability or excessive cost of fuel[2]
- Inadequate family food production
- Insufficient cash incomes and food budgets
- Lack of maternal employment, income, and time
- Economic devaluation of child and caretakers
- Scarcity or lack of nutritious weaning-food alternatives

Technological Variables

- Unsanitary waste disposal
- Impure water supply
- Inadequate food-storage and preservation facilities
- Absence of or inadequate food processing
- Lack of feeding utensils
- Inadequate communication system
- Lack of time/labor-saving devices for women

Health Care Variables

- Lack of immunization
- Absence of feeding or oral rehydration programs

[1] Female babies in some cultures receive weaning diets of poorer quality and/or quantity than male babies.

[2] Fuel cost and availability is particularly important because cooking is necessary for all the weaning preparations described in this manual (Chapters IV and VI); the cost of fuel can be a major obstacle in developing countries.

how these are prepared or fed to improve them nutritionally is more likely to be accepted than introducing new foods. However, new family foods, for example, pasta in Guatemala, have been readily accepted, especially convenience foods. In the context of new weaning foods, particularly convenience foods, it is important to stress that nutrition education is crucial to: (1) assure that such preparations are not used as replacements for breast milk and (2) that they are prepared, fed, and stored appropriately and hygienically as described in Chapter IV.

Influence of Family or Community Members on Weaning Diets

A broad range of influences, other than the mother's, may affect what kinds of complementary foods are used and how much of them are given to a child. Fieldworkers may find, for example, that a young sibling or a grandmother prepares most of the complementary food for a weaning-age child.

Fuel Availability

Fuel availability can be critical to the success of recommendations for new weaning diets. Obtaining traditional cooking fuel, such as firewood or dung patties, may require excessive time, while purchased fuel, such as charcoal or kerosene, can require cash that is difficult for rural households to earn. In addition, the appropriate fuel may vary with the kinds of food preparation. Fuel availability may influence the following:

- The frequency of food preparation;
- The amount and variety of cooked food;
- The feasibility of boiling water and sterilizing utensils; and
- The amount of time available for food preparation.

Maternal Employment, Income, and Availability of Time

In many households two factors determine a mother's capacity to give improved complementary foods to her child: her access to cash and other family resources and the time she has to prepare and feed complementary foods. Most women in developing countries do time-consuming labor outside the home, such as planting and harvesting crops, or in urban areas, service and factory labor. Unfortunately, increasing a mother's income by nondomestic employment may decrease the time available for food preparation and childrearing. In this case, the alternative child caretakers should be directly involved in the weaning-food project.

When people own land, self-employment is more common than wage labor. Regardless of the kind of employment or whether it is paid, there are great seasonal variations in the time women require for work outside the home. This variation should be taken into account in assessing the feasibility of weaning-

THE PHOTOGRAPHS ON THIS PAGE AND THE NEXT ILLUSTRATE TWO ASPECTS OF THE CRITICAL ROLE OF WATER IN WEANING-FOOD PROJECTS.

The factors responsible for weaning-age malnutrition are only a part of a much larger cluster of causes and effects of ill health in a community. Feeding practices are directly related to economic, social, technological, and biological factors.

(Source: AID)

SEASONAL DROUGHTS AND WATER SHORTAGES MAY AFFECT WEANING PRACTICES. In this photo an Indian farmer starts the pump that raises water more than 50 feet to irrigate his rice paddies.

[illegible]

[illegible]

food recommendations. Furthermore, independent of season, women may move in and out of the work force more than men, especially women in developing countries who tend to have little training and are employed at lower income levels if their labor is reimbursed at all. Women with several young children are more likely to withdraw from the paid work force until other household members can assist in childcare.

Cash Incomes and Food Budgets

In most rural areas, the proportion of households with a steady cash income is extremely small. If a weaning-food project (see Chapter VI) requires a cash outlay from participants, households with little or no regular income will automatically be excluded from participation, will drop out very soon, or participate only sporadically. In addition, who brings in the cash can determine whether money is spent on complementary food. If income is earned by the weaning-age child's parents, it may be more available for the child's needs than if the earner is a relative. A mother's earned cash may more often be used for an infant's foods than a father's income.

Project workers need to learn how the food budget is allocated to determine how it may be modified for securing weaning foods. Recommended alterations in the allocation of the food budget must be based on the needs of the entire household, not just those of the weaning-age child.

Degree of Food Sharing

Another variable affecting child feeding is unequal food sharing. Unequal food sharing that is not the result of differences in appetite or food preferences is more likely to occur in households where overall diets are deficient. Observations of order of eating, such as adult males eating first, can provide valuable clues to patterns of unequal food sharing. A pattern of unequal food distribution in which adult males are most favored and female infants most deprived can result from the economic and social status of adult males who may be the sole or primary providers of income and/or food.

Guidelines and Techniques for Data Collection

This section provides background information on principles and techniques for collecting data. How to use these techniques in a systematic investigation of a community's diet and feeding practices is discussed in the section, "Data Collection Procedure."

Interview Attitudes

Fieldworkers need to be aware that practices leading to weaning-period malnutrition, such as those indicated in Table 1, are common in many communities. Fieldworkers also need to have an understanding of sound nutrition, health, and sanitation practices as discussed in Chapter IV.

Fieldworkers must be extremely careful, however, not to try to impose their understanding on a community in a didactic, overbearing, impersonal, or arrogant manner. Understanding the principles of good health and nutrition is important for fieldworkers, but this knowledge must be kept in reserve when fieldworkers are interacting with people in a community with the intention of gathering information. When collecting data, fieldworkers need to approach people in an open-minded manner because their paramount aim is to *learn from a community*. To obtain complete and accurate information, they must hold firmly in check their negative attitudes toward what they may view as detrimental practices and diets and try to be objective, that is, as nonjudgmental as a blank page.

A spirit of humility and respect is necessary if fieldworkers are to learn from a community the answers to such complex questions as how existing weaning diets and practices may have been influenced by cultural, economic, and technological factors; how the people understand and explain their weaning choices and feeding practices; and whether dietary variations and practices that promote good health and nutrition exist in a community.

Fieldworkers who are unable to be sensitive, open-minded, and compassionate are unlikely to succeed in gathering complete and accurate information or in implementing a project's goals. People are more willing to give information to, and receive it from, people with whom they have warm and trusting feelings. In this context fieldworkers must be aware that it is extremely important to accommodate interview length and scheduling to the time and work constraints of those they interview, especially mothers with very young children.

In general, a team's attitudes toward a given weaning behavior and their ideas about changing it must be firmly grounded in (1) an understanding of the bases for the behavior, (2) an appreciation for the obstacles to change[5], and (3) an awareness that a change may bring about harmful effects as well as beneficial ones.[6]

Information-Gathering Techniques

Table 2 contains brief descriptions of several basic information-gathering techniques. Of these, conversations, informal interviews, and observation will probably be the most useful to the project team. Formal interviews and participant observation may also be used if a project has sufficient resources. The appendix to this chapter (Appendix 1) contains additional information on techniques for interviews and observation as well as some interesting examples of interview situations and dialogues. The following sections focus on techniques for data collection.

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[5] See Chapter VI.

[6] See Chapter I.

Table 2
Information Gathering Techniques

1. **Conversations:** Important data can be obtained through very informal conversations with individuals or with small groups. In some cases people are more at ease in informal settings and talk more freely.
2. **Informal interviewing:** Compared with formal interviewing (no. 4 in this list), informal interviewing is open-ended in structure. A general outline is followed by the interviewer, but additional subjects can be easily incorporated into the outline as they arise from the exchange between the interviewer and the respondent. Several kinds of notes may be recorded, but they are usually less detailed than those from a formal interview.
3. **Observation:** The project team should observe events and the behavior of people in the community carefully. Observation provides valuable nonverbal clues as to what is actually occurring.
4. **Formal interviewing:** A written series of questions concerning specific topics are asked of one individual (respondent) and recorded in detail.
5. **Participant observation:** This technique involves both participating in and observing household or community activities. Through participant observation fieldworkers can gain important insights into the everyday life of community members.

Interview Format

A general guideline for the length of an informal interview is that it should not last longer than an hour. Interviewers must be sensitive to other demands on a mother's time.

Interviewers* should familiarize themselves thoroughly with the questions they will ask and with the overall goals of the interview ahead of time. They should strive as much as possible to conduct their interviews with spontaneity.

The interviewers should explain their project carefully to each respondent so as not to arouse fear, hostility, or a desire to fabricate information. The project team should be aware that people sometimes answer questions in a manner consistent with their values or those of the questioner instead of their actual practices. For example, mothers may say or believe a food is acceptable for a weaning-age child, when in practice it is routinely eaten only by adult males. Such a statement by a mother reflects what is desirable, not what is actually practiced. Mothers (and others responsible for the care of a child) may also try to provide an answer they believe the interviewer wants to hear.

The interview should be informal so as not to raise the fears or doubts of a child's caretaker. Note-taking should be unobtrusive. The structure of the

* It is generally advisable that the person who interviews mothers be a woman and that local residents be involved in the team's efforts. However, if a local interviewer is an intimidating authority figure, as is sometimes true of a school teacher or a health worker, mothers' responses may be influenced. As an example of one kind of distortion, mothers may emphasize only what they think the interviewer may see in a positive light.

interview should be open-ended, that is, if a mother's response inspires a question that was not planned in advance, the interviewer should ask the question anyway.

Recording Interview Results

Detailed results of each interview should be recorded by the interviewers as soon as possible in an office away from the interview site. When ten to twelve interviews have been completed, the results should be reviewed for emergent patterns.

General Questions on Diet and Feeding Practices

To identify the weaning diets and practices prevalent in a community and the individuals responsible for decisions affecting babies' diets, the project team must find answers to the general questions listed in Table 3.

Probing to Answer the General Questions

Before conducting an interview the interviewers should understand that to obtain complete answers to the general questions on diet and feeding practices listed in Table 3, information from observations as well as from additional questions will probably be necessary. The information presented in the section "Factors Affecting Diet and Feeding Practices" provides a framework for understanding various implications of the general questions, for developing questioning priorities, and for determining what kind of detailed information

Table 3

General Questions on Diet and Feeding Practices

1. **What are the foods used for babies in a community and at what ages are they introduced?**[1]
2. **What are the ingredients**[2] **used in foods for babies and how are they prepared and stored?**
3. **What equipment is used in food preparation?**
4. **Who prepares complementary foods?**
5. **Who gives complementary foods to baby?**
6. **What techniques are used to feed baby?**
7. **Who decides the age at which complementation begins; what baby is getting now; and why baby is being fed particular foods?**

[1]These questions must be answered whether breast milk or a human milk substitute is the principal food for children. The age of introduction of each complementary food must be recorded to determine any range of variation in the community. See Chapter IV for a definition of complementary foods.

[2]Interviewers should ask initially for all ingredients in weaning foods. After an answer is given, interviewers may want to probe for specific food additives people tend to forget, such as sugar (refined or unrefined), salt, coffee, tea (sometimes added to milk or milk substitute), flavorings, cumin, clove, and chocolate.

is needed. In some communities fieldworkers may find people reluctant to answer direct questions about their children because of a belief that such questions can have a bad effect on the health and future of a child. Fieldworkers should then try a pattern of indirect questioning and rely more on observation.

The purpose of the present section is to expose the reader to the concept of probing, which may be defined as a technique of asking direct and sometimes minutely detailed questions in a pleasant and unobtrusive manner. The purpose of probing is to obtain data needed as background information for objective evaluation and corrective responses to detrimental weaning practices.

For example, to answer the general question, Who gives complementary foods to a child? the following questions may be useful:

Is the child taken by the mother to her place of work (formal or informal) or to the fields to breast-feed or bottle-feed? How often is the baby offered food and drink?

If the mother does not feed the baby, who does: for example, grandmother, grandfather, sibling, father, or other caretaker? Does the caretaker feed the child on a regular basis or only when the mother is sick or busy? How often does the caretaker feed the child? Where does feeding take place: in the parent's home or elsewhere?

To answer the general question, What techniques are used to feed baby? interviewers might ask the mother or other caretaker the following questions:

Are liquid foods given by bottle, cup, feeding tubes, or by another means? Does the caretaker give solid foods by hand, by spoon, chopstick, or by another means? Does the baby feed itself by hand? Is food masticated before being fed to baby? Is a plate or bowl or equivalent used?

Is the child urged to eat, and if so, how persistently?* Is food simply placed in front of the child?

Observation may be necessary to round out the picture of complementary feeding, including a baby's scavenging on its own.

Diet History

The first of the general questions listed in Table 3, What are the foods used for babies in a community and at what ages are they introduced? is the most difficult to get a full and detailed answer to. This section, therefore, focuses on important considerations for interviewers when asking a mother to recount what complementary foods have been given to her baby and at what age, that is, a history of the child's diet. This question indicates a whole area of concern. A procedure to follow in obtaining information on this broad area is suggested later in this chapter. Both current intake and past diet histories are implied by this question. Because calendar-time and clock-time are not universally used to account for passage of time, especially in rural communities in

* See Chapter IV for the importance of feeding a child persistently.

developing countries, it may be better to ask about periods of time or events rather than a particular hour or 24 hours. To construct a complete history of a child's recent diet, the interviewer should ask a child's mother or caretaker[9] four basic questions: (1) What, how often, and in what quantities has the child eaten in the past 24 hours (from sunup to sunup)? (2) What has the child eaten during the past week (recently)? (3) Has the child been ill during that period? (4) Has the current diet varied in any way from that of recent weeks? Interviewers should also determine how food items and their preparation are related to the adult foods and dietary preparations of the community. These basic questions should be supplemented by observation.

Additional questions should be asked about the quantity and sweetening of all liquids consumed. It is important to keep in mind that the caretaker may not classify as foods some items ingested by children, for example, snacks of candy, ices, fruit, and breads. Questions, therefore, should be phrased carefully to elicit *all* of a baby's food intake. Care should also be taken to cover *all* periods of the day and night, not just meal times, because a mother may forget some items or consider them unimportant or a young child may scavenge a great deal for small food items.

A retrospective diet history may be necessary for determining ages of introduction of complementary foods and can often reveal variations in food intake resulting from seasonal changes in climate, employment opportunities, commodity availability, and prices. Diet variations can also occur during illnesses. Illnesses may be ones recognized by western medicine, for example, diarrhea, measles, or fever; alternatively, they may be folk illnesses thought to be caused by an evil eye or fright (for example, in Guatemala, *ojo* or *susto*, respectively). Local terms or names of illnesses or health conditions may be obtained from traditional curers, midwives, or local health workers or project members, as well as from mothers.

Caretakers should be asked what is done when the child does not want to eat, or if the child is considered weak or pale. Interviewers should also ask: What foods are given to an ill child or to a child in a special condition? What foods are not given to or withdrawn from a sick child or one in a special condition? What are the characteristics of these foods?

General Questions about Socioeconomic Factors

Table 4 gives some examples of general questions about socioeconomic factors that will probably be most useful in initial interviews with key individuals in a village, such as the mayor, health-care professionals, and teachers. Information from these individuals and from the team's investigations of foods available in local stores (see Step 4 in the next section) will enable the team to form hypotheses or hunches about which factors play the most

[9] To get the most complete information, it is best to interview both mother and caretaker together.

Table 4

Sample General Questions about Socioeconomic Factors Related to Detrimental Weaning Practices[1]

FACTORS	QUESTIONS FOR KEY INFORMANTS
1. Food availability and usage	*For a rural area:* What kinds of legumes are grown by families in the community? What kinds of grains are grown by families? What kinds of vegetables and fruits are grown by families? What kinds of legumes, grains, vegetables, and fruits are consumed by families? Are these products sold? Are the above foods used in weaning preparations? How much, and how often? *For an urban area:* What are the most common store-bought weaning foods used in the community? Do families use milk, sugar, and/or oil in weaning preparations?
2. Attitudes and beliefs	What factors are believed to cause diarrhea in babies? Are weaning-age children fed when they are ill? At what age does weaning generally begin?
3. Acceptability and avoidance of foods	What ingredients are considered good for use in weaning foods? Why? Are any foods tabooed or considered undesirable? If so, why?
4. Influence of family and/or community members on weaning diets	Do individuals other than mothers feed weaning-age children complementary foods? If so, who? How often? Why?
5. Fuel availability	Is fuel expensive in your community? How much does it cost? Are there ever shortages of fuel?
6. Maternal employment, income, and availability of time	Do many mothers work outside their homes? If so, how often, where?
7. Cash income and food budgets	How much income, on the average, do women earn from work? Do most women in the community have control over any income they earn?
8. Degree of food sharing	Are there foods traditionally consumed only by adults? Which foods? Why?

[1]These questions are not intended to provide a comprehensive survey. The project workers should amplify them with other questions to assure well-rounded information on the influence of socioeconomic factors in the target community.

important roles in a given community. Mothers of weaning-age children can provide more specific and detailed information about how the factors influence their decisions and, therefore, a different set of questions will probably be more useful in interviews with them. Interviewing mothers about these factors is discussed later.

Data Collection Procedure

The data collection procedure recommended in this chapter combines the techniques of conversations, informal interviews, and observation. The procedure has been designed to obtain, at the lowest possible cost, the minimum amount of information needed by a project team. If a project's resources allow, this basic information can be amplified and verified as we describe in the last section in this chapter.

Procedure Steps

The procedure consists of the following steps:

1. Explanations of the project must first be given and approval obtained at all the necessary higher administrative levels of a country's government.

2. The project team should contact village leaders, such as the mayor, before beginning work in a community. The purposes of these initial contacts are to obtain sanction for the project and useful information of any kind.

To obtain the cooperation of the community the project must be thoroughly explained in advance and some prospect of benefit offered. To succeed, a project must be something done *with* a community, not to it. The process of obtaining cooperation should only begin, *not end with*, community leaders; as many community members as possible should be reached.

The most popular benefits to offer a community are often medical or dental assistance, but help with community projects may also be welcome. Prospects for enhanced government assistance or better government policies are sometimes possible justifications for a project, but such possibilities must be presented in realistic and not overly optimistic terms.

Village leaders should be able to provide the names of other key individuals in the community, for example, health-care professionals, and perhaps the names of mothers of weaning-age children. Project members should ask village leaders a wide range of questions about weaning diets, practices, and beliefs, and about the factors that are likely to influence weaning behavior. Tables 3 and 4 provide samples of useful questions.

In a community that is highly stratified along socioeconomic lines, professionals and community leaders will probably not be as good sources of information concerning the weaning diets of the poor as mothers who are poor themselves.

3. Next, other key individuals should be contacted and interviewed. Health-

care professionals and other individuals whom the community recognizes as having expertise can provide valuable information on (1) general child-feeding practices and beliefs concerning both sick and well children and (2) the prevalence of malnutrition and various illnesses among weaning-age children. Such local experts may include traditional birth attendants, curers, and female village elders.

General information on weaning as well as the factors that influence weaning patterns and practices should be sought from appropriate key people (Tables 3 and 4). Storekeepers, for example, may provide valuable information concerning food availability and usage. Other key individuals, such as health-care professionals, midwives, and schoolteachers may also be able to provide the names of mothers of children of weaning age.

Based on the information obtained from key informants, project members should develop a checklist of factors that probably have a strong influence on weaning diets and practices in the community. It is easiest to use a checklist of factors if it is constructed with spaces in which "yes" or "no" can be written after each factor. This checklist will be useful in interviews with mothers. Figure 1 provides an extensive list of possibly important factors.

4. To supplement the information on food availability and usage provided by key individuals in the community, members of the project should visit community markets and stores, which in many areas are more important to a family's food supply than its own production. Project workers should also document the availability and usage of any foods from complementary feeding programs (Chapter VIII).

The field team should visit local markets to catalog the kinds of foods available in the following key categories and their prices:

Protein sources: vegetable and animal, for example, beans, lentils, bean curd, nuts, and eggs

Energy sources: oils, fats, sugars, starches

Grains: for example, rice, wheat, and corn

Milk: powdered, canned, fresh (or milk substitutes)

Commercial weaning preparations

Commercially made drinks, including fruit juice, Kool Aid, and Coca Cola

Snack foods eaten by children

Vegetables and fruits

The field team does not need an encyclopedic catalog of the contents of local stores and markets. If they find that, of the key-category foods listed above,

good energy and protein sources and milk are available in stores, but are not used as complementary foods for children, then the team needs to know:

Do vegetable and animal protein sources (e.g., beans, nuts, eggs) used in family meals come from stores or markets or from a family's own production?

How much and what kinds of protein sources were bought from a store and used in family meals in the last 24 hours and in the past week?

Does the family buy milk (powdered, canned, fresh) and, if so, how much?

Does the family purchase sugar and oil?

What are the locations of markets and stores in an area?

How close are they to population centers?

Is transportation required to get to them?

Which foods are limited to certain seasons? Do prices fluctuate with the season, and, if so, by how much?

It is important for project workers to keep in mind that only small amounts of complementary foods need to be consumed by babies.[10] Therefore, redistribution of foods from the family diet will probably not be prohibitively costly in most communities. All that is usually needed is knowledge of how to use the foods and the effort of mashing or straining them for feeding to infants.

5. After collecting all the background information, including the names of mothers of children of the appropriate ages, as described above, fieldworkers are ready to conduct interviews with mothers. The number and selection of mothers or caretakers for interviewing depends on the size and homogeneity of the community. As a general rule, a *minimum* of 12 to 15 mothers should be interviewed in a small farming community to get a good sense of the range of variation in feeding practices. Interviews should be conducted with a random sample of mothers if there are more than 12 to 15 of them. If the target community is larger than a few hundred people, more caretakers should be interviewed; if the community is stratified into different economic, ethnic, and/or religious groups, representatives of each segment of the population should be interviewed.

Interviews with Mothers

Because a large amount of information is sought from mothers, as is described in the sections that follow, they should be interviewed in two separate stages, that is, in two separate rounds of interviews. A single interview would be

[10] See Chapter IV, Table 2.

excessively long and tiring for most mothers of young children who have many competing demands on their time and energy.

1. **The first round of interviews with mothers.** In the first set of interviews with mothers, interviewers should obtain information on the general questions concerning diet and feeding practices listed in Table 3. The techniques of informal interviewing, observation, and conversations should all be used in collecting these data. The information from mothers will be more specific than the general or normative information provided by local experts and professionals. Data from mothers can be used to supplement and cross-check information from key individuals. In addition, data from mothers will give the

Table 5

Examples of How to Probe for Information on Determinants of Weaning Practices

Factors	General Questions[1]	Probing Questions
1. Inadequate food preservation and storage facilities and inadequate knowledge concerning contamination and ways to prevent it.[2]	1. What are the ingredients used in complementary foods? How are they prepared and stored?	1. Are cooked foods kept covered and stored in a cool place?
		2. Does the caretaker wash her hands before handling foods and/or feeding utensils?
		3. If there is no refrigeration, how frequently are foods prepared? How much food is prepared at one time? Are leftovers discarded?
		4. Are containers for foods cleaned with soap or detergent? Are they rinsed in drinking water or salt water? Are they dried in the sun? Are dried empty containers kept covered?
2. Harmful food beliefs and practices	2. Who decides why baby is being fed particular foods?	1. If baby is receiving only sugary liquids as complementary food, does the caretaker believe that semisolid or solid foods are harmful?
		2. Why are legumes and other sources of protein not being fed to baby?

[1]See Table 3.

[2]Chapter IV provides guidelines for food preservation and storage techniques that prevent contamination.

project members a sense of the range of variation in how specific children are being fed in a community. Some of these variations from general practices may be positive ones and may provide fieldworkers with very valuable lessons concerning, for example, nutritious adaptations of common traditional foods. Mothers whose weaning diets and/or practices are exemplary may be willing to help the team both by advising it concerning the project's strategies and by teaching other mothers.

The information provided in the sections, "Probing to Answer the General Questions," and "Diet History," respectively, should be useful to fieldworkers in conducting their first round of interviews. In addition, Table 5 presents some examples of how to probe for information concerning the social, economic, and other factors that influence weaning diets and practices. From their interviews with key informants, fieldworkers will have received information that will provide guidelines as to which factors are probably the most influential in a given community. Interviewers should attempt only to touch on these factors, however, in the first set of interviews. Because of the volume and complexity of the information needed by the team on weaning diets and practices, thorough questioning concerning factors influencing these diets and practices should not be attempted until the second round of interviews with mothers. For example, if interviewers discover from mothers in the first round of interviews that weaning foods are prepared with water that has not been boiled and that has come from uncovered wells, the fieldworkers can investigate whether the water supply may be contaminated in a second round of questions and observations. These questions could include: Is waste disposed of near the water supply? Do mothers understand measures to keep water used in food preparation sanitary, such as boiling it and frequently changing it? Is low-cost fuel available?

2. **The second round of interviews with mothers.** Using a checklist of influential socioeconomic factors developed from the interviews with key individuals in the community and from the information from mothers in the first round of interviews, fieldworkers can develop questions tailored to fit a community's specific conditions. Table 6 provides examples of such questions.

Formal Surveys and Participant Observation

Project resources determine whether a formal survey can be done. The purpose of a formal survey is to amplify and verify what appear to be patterns in information from informal interviews, that is, to increase confidence in the data. For example, a larger sample of mothers may be asked the same set of questions that appear in Table 3. The degree of care taken in the determination of sample size and its selection for a formal survey depend upon project resources.

Participant observation, as described in Table 2, can provide a project with very detailed information, but it is a time-consuming technique.

Table 6

Examples of Questions to Use for the Second Round of Interviews with Mothers[1]

SOCIAL AND ECONOMIC FACTORS RELATED TO DETRIMENTAL WEANING PRACTICES	QUESTIONS FOR MOTHERS
1. **Food availability and usage**	*For a rural area:* What kinds of legumes[2] are grown by the family? What kinds of grains are grown by the family? What kinds of tubers and other starchy vegetables as well as fruits are grown by the family? What kinds of legumes, grains, tubers, and other starchy vegetables as well as fruits are consumed by the family as a whole? How much, and how often? Are the above foods used in weaning preparations? How much and how often? *For an urban area:* How much and what kinds of protein sources were bought from a store and used in family meals in the last 24 hours and in the past week? Does the family buy milk (powdered, canned, fresh) and, if so, how much? Does the family purchase sugar and oil? How much? Are the above foods used in weaning preparations? How much and how often?
2. **Attitude and beliefs**	*If the environment is fecally contaminated and a child has diarrhea:* What do you feel is making your baby sick? What do you do to make him well? *If children are not fed when ill:* What do you think may happen to your baby if you feed her while she is sick? What do you believe is making your baby sick? *If children are weaned abruptly at a very early age:* What may happen if you fed your baby both breast milk and other foods at the same time?

[1]These questions are not meant to be exhaustive. They are intended only to serve as models and to provide direction on how to probe. In addition, these questions are not intended for application in every community. Project workers must devise their own questions depending upon the particular set of conditions prevailing in a project community.
[2]Beans and nuts.

Table 6 (Continued)

SOCIAL AND ECONOMIC FACTORS RELATED TO DETRIMENTAL WEANING PRACTICES	QUESTIONS FOR MOTHERS
3. **Acceptability and avoidance of foods**	*If soy beans are available, but not used for babies:* Why do you not use soy beans in your baby's food? *If only watery gruels are fed to babies by most mothers in a community:* What kinds of weaning foods are used in your community? Do you follow this practice? *If the answer is yes:* Why do you feed your baby only this kind of gruel?
4. **Influence of family and/or community members on weaning diets**	*If a young sibling is responsible for feeding the baby:* Who decides what foods will be given to your baby each day? Does Juanita (the sibling) make the food each day? Does she buy it? Do the ingredients come from the family plot?
5. **Fuel availability**	Is fuel expensive in your community?[1] How much does fuel cost in your community? How often do you cook each day? Could you cook more often? Are there ever shortages of fuel? If so, how often?
6. **Maternal employment, income, and availability of time**	Do you work outside the home? If so, where? How many days a week? How many hours a day?
7. **Cash incomes and food budgets**	Do you earn money in your job outside the home? Do you decide how much money will be spent on foods for your baby? How much money do you have available for food for your baby? Who purchases foods for your baby? *If more than one person buys food for baby:* how often?
8. **Degree of food sharing**	*For each food that may be useful in weaning preparations:* How often last week did the baby receive this food? How much did she receive? How often did the baby receive this food yesterday? How much? *Ask these questions of each family member.*

[1]The answer to this question will give the project workers a feel for whether a family can afford much fuel.

Chapter IV*

Nutritional Requirements and Food Options for Weaning Diets

Introduction

Scope and Purposes of Chapter

In many traditional societies the weaning-age child seldom receives specially formulated foods. The child is instead gradually introduced to adult foods, starting with softer, carbohydrate-rich varieties. Often such foods do not contain all the nutrients a child needs, or they are so diluted that the infant, whose stomach is small, cannot consume enough to supply the nutrients necessary for growth and development. In an attempt to solve this problem, food mixtures (multimixes), specially formulated for the weaning-age child, have been developed.

This chapter provides a general foundation for understanding when complementary feeding should begin, how to make high quality weaning foods, and what to advise mothers concerning sanitary measures and techniques for feeding children, both sick and well. Oral rehydration therapy for children with acute diarrhea is also discussed.

In addition, the chapter is intended to serve as a reference work on the following topics: amino acid requirements for infants and young children, recommended amounts per day of vitamins and minerals for young children, good food sources of protein, energy, vitamins, and minerals, and the scientific principles for formulating nutritious home-made weaning-food recipes or mixes. In combination with Appendix 2, this chapter is meant to be used as a resource for recipes and techniques of weaning-food preparation and feeding. The chapter also provides a basis for using other relevant literature both by explaining fundamental nutrition concepts and by including important definitions, which are also summarized in the Glossary. Finally, this chapter contains references

* The major contributors to this chapter are Heidi Van Arsdell, Nevin Scrimshaw, Abraham Besrat, and El-Fatih El Samani.

to works on a number of important subjects that could not all be covered here.

So many nutritionally satisfactory food combinations are possible that a project should focus attention on cost, availability, and acceptability of a food and its ingredients. The minimum goals of a weaning-food project should be to devise foods that contain adequate protein and energy density and are also acceptable to a community. This chapter in conjunction with Chapter VI provides guidelines for achieving these goals.

General Considerations Concerning Weaning Foods

The concept of weaning foods as complementary foods The purpose of a weaning food is to add to, or complement, mother's milk. For this reason the weaning process is sometimes referred to as "complementary feeding." Compared to supplementary feeding, the term "complementary" emphasizes the nutritional objectives of (1) prolonging breastfeeding and (2) adding to or complementing the nutrients provided by breast milk, when this becomes necessary, rather than replacing it. In this manual, the terms "weaning foods" and "complementary foods" are used interchangeably.

When should complementary feeding begin? The age when breast milk alone fails to completely satisfy nutrient needs for healthy growth varies widely among individual infants. For most infants breast milk alone is sufficient until four to six months of age. For most well-nourished mothers in favorable socioeconomic circumstances, breast milk may be adequate as the sole source of food beyond this time. For mothers in lower socioeconomic groups, even relatively well nourished, six months is a realistic limit. However, in some populations, mothers are so poorly nourished that, for most children, growth falls off as early as four months unless some complementary food is given, despite the increased risk of contamination that this entails. Moreover, in every population there are some individuals for whom it becomes inadequate much earlier.

Breast milk adequacy depends on many factors, including:

- the mother's individual capacity to produce breast milk for a prolonged period;
- the mother's work schedule and availability to nurse during the day and night;
- the infant's ability to suck (in impoverished environments babies frequently have a fungus condition in the mouth called thrush or other illnesses that compromise sucking);
- the infant's nutritional requirements, which vary greatly among babies of any one age.

References 6 and 10 in the bibliography provide more information on the subjects of maternal and young child nutrition and breast-milk adequacy.

Weight monitoring over a period of time is the most practical indicator for

mothers of whether their milk production and/or nursing schedule provides adequate nutrition.[1] Some infants, nourished only with mothers' milk, gain weight for about six months at rates equivalent to those for healthy reference babies. For others who need more nutrients or who do not receive enough mothers' milk, weight gain slows before four months of age. However, giving traditional complementary foods to an infant younger than four to six months old who lives in impoverished circumstances is controversial for the following reasons:

a. Some traditional weaning foods may not be readily digestible by very young infants.

b. Foods are likely to become contaminated in the unsanitary conditions often characteristic of developing countries. Even if the foods are not contaminated, the utensils used for storage and feeding are likely to be dirty. Babies are often fed with unwashed hands.

c. Foods may interfere with breast-milk production if they lessen the infant's motivation to suckle.

If slowed weight gain in a child less than four months old is the consequence of an inadequate supply of breast milk or of the mother's inability to breast-feed, fieldworkers should offer educational assistance. Methods for preserving nursing capacity when mothers are employed outside the home and during periods in which breast-feeding is temporarily suspended are described in the bibliography in references 2 and 3. If an infant's breast-milk intake is grossly insufficient, recommendations for complementary diets and preparation techniques can also be found in references 2 and 3.

Nutritional requirements and age We cannot say precisely how much complementary food individual infants require. We can, however, make general statements concerning group requirements and advise regular growth monitoring[2] and frequent feeding of nutritionally balanced recipes. Nutritional needs vary widely among individuals and change rapidly as an infant ages. Moreover, the quantitative contribution of breast milk to an individual infant's diet can vary greatly.

Despite the difficulties involved in making precise quantitative recommendations for an individual's complementary-food intake, we are able to make useful generalizations about the patterns of infant nutritional requirements relative to age. Some textbooks indicate that infant requirements for nutrients, such as protein and energy, decrease with age. This statement is true only if we express requirements per infant weight: these do indeed decrease as the infant grows. However, this concept should not be confused with the fact that *the total amount the infant must consume to grow normally (the absolute requirement) increases with age.*

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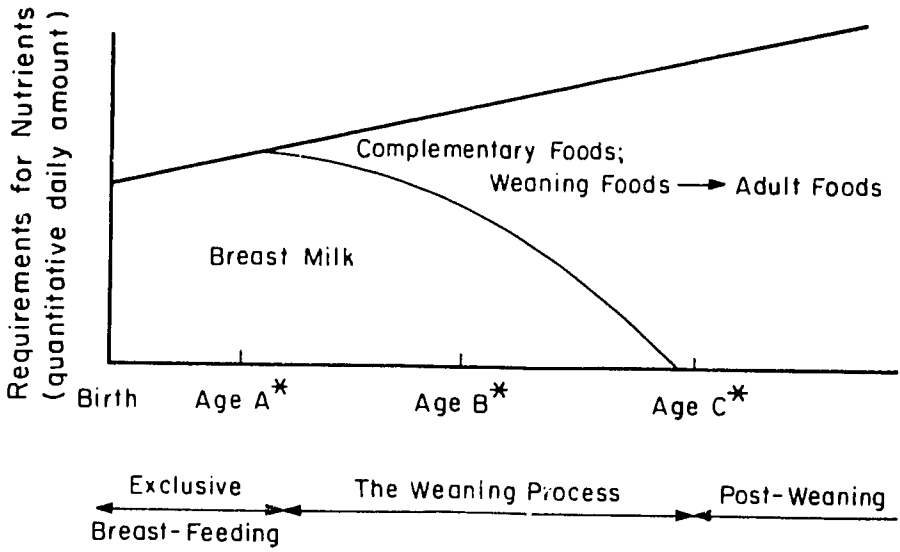
[1] Chapter V presents detailed information on this subject.

[2] See Chapter V.

Figure 1

Schematic View of Nutritional Adequacy During Weaning: Relationship of Breast-Feeding and Complementary Foods



*Weaning begins at Age A and breast milk is tapered off between Ages B and C. Weaning ends at Age C.

A model for complementary feeding A model for combining breast milk with other foods to achieve adequate nutrition as an infant ages is schematically illustrated in Figure 1. This figure shows the relative amounts of the foods needed to satisfy most infants' total nutritional requirements at different ages.

As a child ages, the categories of foods that comprise an adequate diet gradually change. From birth to Age A (Figure 1), a diet composed entirely of breast milk satisfies a child's total nutritional requirements. By Age A breast milk supplies slightly less than the infant's total nutrient needs, and weaning foods are necessary to complement breast-milk nutrients to satisfy all of the requirements. At this early stage of the weaning process, complementary foods are fed in small amounts relative to breast milk and do not have to be nutritionally complete. By Age B, breast milk satisfies a much smaller proportion of the child's nutrient needs. Moreover, the child's requirements have increased so that complementary foods are given in larger amounts. At the end of the weaning process, near Age C, weaning and family foods must be given in amounts sufficient to supply all nutrient requirements. In addition, the total requirement is greater.

Summary

It is difficult to formulate strict rules for the precise age to begin weaning. As a general rule, nearly all nursing infants require some complementary foods by at least six months of age. Mothers should be aware that some infants need weaning foods before they are six months old. Health workers and mothers should be taught to use growth charts to monitor adequacy of food intake.[3] Whether to give infants complementary foods before they are four months old should be determined on an individual basis, keeping in mind such factors as the digestibility of the food, risks of contamination, and possible interference with breast-milk production. The primary goals of infant feeding are to provide diets as nutritionally adequate and as contamination-free as feasible.

Policymakers must recognize the circumstances in which adequate breast-feeding is impossible: an infant's mother may either be dead, absent, or unable to breast-feed, and wet nurses may be culturally inappropriate. Resources and information concerning the feeding of nonhuman milk or gruels made from local staples must be available to health workers. (A sample recipe is presented in Table 1, and references 2 and 3 in the bibliography provide additional information.)

(Photo by Ruth Angove)

[3] See Chapter V.

Table 1

Gruels For Infant Feeding

Recipes For Gruels That Satisfy 100% Requirements for Energy and Protein*

EXAMPLE #1 Basic Cereal Gruel
(*NPU = approx. 75*)

The basic cereal gruel will not provide 100% of the protein requirements without the addition of appropriate amounts of protein-containing foods. See list below.	**Quantities needed per day (g) 7 kg infant (approx. 5 months of age)**
Cereal flour	150
plus oil	25
or sugar	50
plus water	1000**
ADDITION OF ONE OR MORE OF THESE TO THE BASIC CEREAL GRUEL IS NECESSARY TO PROVIDE SUFFICIENT PROTEIN:	
Milk products (add before cooking):	
Dried whole milk	20
Dried skimmed milk	10
Evaporated milk (reduce water)	50
Whole milk, cow, goat (reduce water)	150
Whole milk, buffalo, ewe (reduce water)	75
Condensed milk (reduce water and omit oil/sugar)	50
Yogurt, leben (reduce water)	150
Unsalted cheese, white	40
K-Mix 2	20
Other animal proteins:	
Egg (add raw to hot gruel)	40
Fish flour (cook with gruel)	8
Vegetable proteins (add before cooking):	
Ground peanuts or sesame seed (omit oil)	20
Peanut butter (omit oil)	20
Ground beans (cook longer)	25
Ground peeled pumpkin or melon seeds	20
Coconut milk	100
Soybean milk (reduce water)	200
Vegetable proteins (add after cooking):	
Cooked strained lentils or chickpeas	65
Cooked skinned mashed beans	65

***Supplement both gruel #1 & gruel #2 with sources of vitamins A and C from fresh mashed fruits and vegetables. To protect against contamination, fresh gruel should be prepared at least twice a day.**

**The amount of water can be increased or decreased up to 20%, depending upon the type of flour used, to give the proper consistency.

Table 1 (Continued)

	Quantities needed per day (g) 7 kg infant (approx. 5 months of age)
EXAMPLE #2 Basic Root Tuber Gruel* (*NPU = approx. 70*) **To satisfy 100% of protein and energy requirements, appropriate amounts of protein-containing foods must be added to this gruel. See instructions below.**	
Fresh root tuber plantain or	450
root tuber flour	140
plus oil	25
or sugar	50
plus water	750-1000**
ADDITIONS TO BASIC ROOT TUBER GRUEL NECESSARY TO PROVIDE PROTEIN:	
Use double the quantities of protein foods given in "ADDITIONS TO BASIC CEREAL GRUEL NECESSARY TO PROVIDE PROTEIN."	

***Supplement both gruel #1 & gruel #2 with sources of vitamins A and C from fresh mashed fruits and vegetables. To protect against contamination, fresh gruel should be prepared at least twice a day.**

**The amount of water can be increased or decreased up to 20%, depending upon the type of flour used, to give the proper consistency.

Nutritional Requirements of the Infant and Young Child

The intakes of energy, protein, and fluids recommended by the joint Food and Agricultural Organization (FAO)/World Health Organization (WHO)/ United Nations University (UNU) Expert Committee on Protein-Energy Requirements are given in Table 2. The values for daily energy requirements are slightly lower than recommendations made by the FAO/WHO in 1973 (see reference 5).

Energy Requirement

The energy[1] requirement is about 100 kcal/kg/day for an infant three to six months old, the age range when weaning is usually begun in most developing countries. If an infant weighs close to the median of the reference population,

[1] Calories can be supplied by fat, carbohydrates, and protein in the diet. Fats provide the most energy per weight.

the energy requirement is 700 kcal/day.[5] By the time an infant of this weight is 24 months of age, breast milk is no longer its principal food, and the requirement has risen to 1350 kcal/day.

Recommended Protein Intake

Table 2 shows that the recommended protein intake for an infant progressively decreases when it is expressed in terms of body weight, from about 2.43 g/kg/day at three to six months of age to 1.57 g/kg/day for a three-to-five-year-old child. However, as was stressed earlier, the *absolute* requirement increases with age. The values for safe levels of protein intake in Table 2 are adjusted to diets relying on plant sources of protein.[6]

Recommended Intakes for Vitamins and Minerals

Tables 3 and 4 give recommended intakes for vitamins and minerals for children less than one year old; from one to three years of age; and from four to six years old. Dietary sources are also given in these tables.

Meanings of the terms "Safe Levels" and "Recommended Intake" and "Advisable Intake"

The protein, energy, vitamin, and mineral recommendations made in Tables 2, 3, and 4 are approximate because there is great variation among individuals. In addition, the values for protein, vitamins, and minerals attempt to ensure safe levels of intake for the entire population and may sometimes be too high for individual infants.[7]

In developing countries, where parasitic, viral, and bacterial infections are the rule, increased needs for nutrients during infections may partially counterbalance the possibility that most individual requirements are less than the "safe allowance." For example, parasites may use up part of the nutrients

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[5] The breast milk of average, healthy, well-nourished mothers in affluent settings can satisfy a maximum of 490 to 560 kcal of the daily requirement. In the developing world mothers have highly varied and generally lower breast-milk outputs when their nurslings are infants (270 to 430 kcal/day). Lactation performance and influential factors are discussed in reference 10 in the bibliography.

[6] Plant and animal proteins are equivalent when plant protein is combined to form complete protein as is discussed later in this chapter. However, more plant protein is required because complementation is not exact (that is, excess amino acids – protein units – are lost in matching) and because the plant protein sources that are consumed by most people in the developing world are not as highly digestible as those of animal origin.

[7] The requirement of an individual for a specific nutrient is defined as the least amount of that nutrient that will support an optimal state of health. *Because of the variability of individuals and the uncertainty of the estimate of some requirements, it is desirable to recommend intakes, or safe levels, in excess of the estimated requirement.* Setting this value involves some personal judgment of experts as well as the current state of knowledge regarding the requirements. Therefore, recommendations of official groups (FAO/WHO/UNU; US Food and Nutrition Board) and experts may be inconsistent and change over time.

Table 2

Daily Average Energy and Fluid Requirements and Safe Level of Protein Intake for Infants and Children Three Months To Five Years, Sexes Combined (FAO/WHO/UNU, 1983)

	Months			Years		
Age	3-6	6-9	9-12	1-2	2-3	3-5
Approx. Weight(kg)[1]	7	8.5	9.5	11	13.5	16.5
Energy Requirement[2]						
(kcal/kg/day)	100	95	100	105	100	95
(kcal/day)	700	810	950	1150	1350	1550
Safe Level of Protein[3]						
(g/kg/day)	2.43	2.22	2.07	1.72	1.64	1.57
(g/day)	17	19	19	18.5	22	26
Water Requirement[4]						
(ml/kg/day)	130-155	125-145	120-135	115-125	—	100-110
(ml/day)	900-1100	1050-1250	1150-1300	1250-1400	—	1650-1800

[1]Approximate NCHS median weights at midpoint of age range.

[2]The FAO/WHO/UNU Expert Group (Geneva: WHO, in press) set requirements for infants at 5% above average observed intakes. These values are 10% to 15% lower than those recommended by the 1973 FAO/WHO Expert Group. The recommendations for children one to five years of age are based on observed intakes of children in developed countries and affluent groups of developing countries, increased by 5% to allow for a desirable level of physical activity.

[3]The values presented here for safe level of protein intake have been adjusted according to the assumption that protein quality of the diet in poor communities is about 70% of the FAO/WHO/UNU standard.

[4]Range of average water requirements of children under ordinary conditions adapted from Nelson et al., *Textbook of Pediatrics*, W. B. Saunders: Philadelphia (1969) p. 128. Healthy infants consume fluid equivalent to 10% to 15% of their body weight, compared to adult consumption of 2% to 4% of body weight.

(Photo by Miriam Krantz)

MOTHERS RECEIVE INSTRUCTION in nutritional requirements.

Table 3

Recommended Daily Intake of Vitamins Up To Six Years of Age

VITAMIN	Recommended Amount[1] Age (yrs.) <1	1-3	4-6	DIETARY SOURCES
WATER-SOLUBLE				
VITAMIN B-1 (THIAMINE) (mg)	0.3	0.5	0.7	Pork, organ meats, whole grains, legumes
VITAMIN B-2 (RIBOFLAVIN) (mg)	0.5	0.8	1.1	Widely distributed in foods
NIACIN (mg)	5.4	9.0	12.1	Liver, lean meats, grains, legumes (can be formed from tryptophan)
VITAMIN B-6* (PYRIDOXINE) (mg)	0.3-0.4	0.6	0.9	Meats, vegetables, whole-grain cereals

consumed by an infant or alter nutrient content or cause physiologic damage that impairs a child's ability to absorb and metabolize ingested food. Disease may decrease a child's appetite and increase the needs for metabolic fuel, as happens during fever. Also, the rapid passage of food through the intestines in diarrhea limits absorption of nutrients.

The Composition of Weaning Foods

General Concepts

The combination of breast milk and complementary food should provide all the nutrients required for growth and development. The concept of an adequate complementary food is illustrated in Figure 2. The food square illustrated in this figure is useful for teaching mothers and fieldworkers how to choose ingredients for weaning recipes. Breast milk appears in the center of the square to indicate that, as a complete food, it is the principal part of the diet. Breast-feeding is depicted as concentric circles of decreasing sizes to indicate that its contribution to the total dietary intake decreases with age. Even when the daily intake of human milk is small compared to weaning foods, it is a valuable source of high quality protein, energy, and other nutrients.

In general, weaning foods should be soft so that they are easy for babies to chew, swallow, and digest. They should not be irritating to babies' digestive tracts and they should be free of contamination. Weaning foods should be

Table 3 (Continued)

VITAMIN[1]	Recommended Amount[2] Age (yrs.) - 1	1-3	4-6	DIETARY SOURCES
WATER-SOLUBLE				
FOLIC ACID (μg)	60	100	100	Legumes, green vegetables, whole-wheat products
VITAMIN B-12 (mg)	0.3	0.9	1.5	Muscle meats, eggs, dairy products (not present in plant foods)
BIOTIN		Not established		Legumes, vegetables, meats
CHOLINE		Not established		All foods containing phospholipid (egg yolks, liver, grains, legumes)
VITAMIN C (ASCORBIC ACID) (mg)	20	20	20	Citrus fruits, tomatoes, green peppers, salad greens
FAT-SOLUBLE				
VITAMIN A (RETINOL) (μg)	300	250	300	Provitamin A (beta-carotene) widely distributed in dark-green leafy vegetables and yellow fruit. Retinol present in milk, butter, cheese, fortified margarine
VITAMIN D (μg)	10	10	10	Cod-liver oil, eggs, dairy products, fortified milk and margarine
VITAMIN E* (TOCOPHEROLS) (I.U.)	4-5	7	9	Seeds, green leafy vegetables, margarines, shortenings, vegetable oils
VITAMIN K** (PHYLLOQUINONE) (mg)	20	20		Green leafy vegetables. Small amount in cereals, fruits and meats

[1]VITAMINS are organic substances the body requires in small amounts but cannot make for itself. Thus, they must be provided by the diet. Vitamins are classified into two groups: water-soluble vitamins, which in general are not dangerous when taken in excess of recommended daily intakes; and fat-soluble vitamins, which can be toxic in excess.

[2]Advisable or recommended daily intakes are set at levels higher than estimated requirement levels for the purpose of providing for nutrient needs of nearly all individuals in a population. The values in the above table are those recommended by FAO/WHO Expert Groups, *Handbook on Human Nutritional Requirements*, Geneva: WHO, 1974; by the US Food and Nutrition Board, Committee on Amino Acids, National Research Council, *Improvement of Protein Nutriture*, A.E. Harper and D.M. Hegsted (eds.), Washington, DC: National Academy of Sciences, 1974 (marked with an *); or by S.J. Fomon, *Infant Nutrition*, Philadelphia: W.B. Saunders, 1974 (marked with **). The format of the table is adapted from N.S. Scrimshaw and V. Young, "The Requirements of Human Nutrition," *Scientific American* 235(1976):50-73.

Table 4

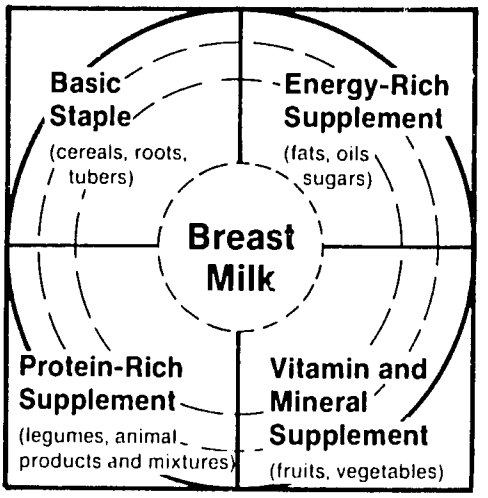
Recommended Daily Intake of Minerals Up To Six Years of Age

MINERAL	Recommended Amount Age (yrs.) < 1	1-3	4-6	DIETARY SOURCES
CALCIUM (g)	0.5-0.6	0.4-0.5	0.4-0.5	Milk, cheese, dark-green vegetables, dried legumes
PHOSPHORUS* (mg)	240-400	800	800	Milk, cheese, meat, poultry, grains
SULFUR		Provided by sulfur in protein		Sulfur amino acids (methionine and cystine) in dietary proteins
POTASSIUM** (meq)	6-7	6-8		Meats, milk, many fruits
CHLORIDE** (meq)	6-7	7-10		Common salt
SODIUM** (meq)	6-8	6-8		Common salt
MAGNESIUM* (mg)	60-70	150	200	Whole grains, green leafy vegetables
IRON (mg)	5-10	5-10	5-10	Eggs, lean meats, legumes, whole grains, green leafy vegetables
FLUORIDE** (mg)	0.5	0.5	0.5	Drinking water, tea, seafood
ZINC* (mg)	3-5	10	10	Widely distributed in foods
COPPER (μg)	80	80	80	Meats, drinking water
SILICON, VANADIUM, TIN, NICKEL		Not established		Widely distributed in foods
SELENIUM		Not established		Seafood, meat, grains
MANGANESE		Not established		Widely distributed in foods
IODINE*	35-45	60	80	Marine fish and shellfish, dairy products, many vegetables
MOLYBDENUM		Not established		Legumes, cereals, organ meats
CHROMIUM		Not established		Fats, vegetable oils, meats
COBALT		Required as constituent of vitamin B-12		Organ and muscle meats, milk

Human beings require minerals that are in the body in large amounts (sodium, chloride, potassium, calcium, phosphorus, magnesium and sulfur) and in trace amounts. Estimated requirements are often difficult to determine, so advisable intakes are set at considerably higher levels.

Values are taken from FAO/WHO *Handbook on Human Nutritional Requirements*, Geneva: WHO, 1974; or the US Food and Nutrition Board, Committee on Amino Acids, National Research Council, *Improvement of Protein Nutriture*, A.E. Harper and D.M. Hegsted (eds.), Washington, DC: National Academy of Sciences, 1974; (marked with an *); or S.J. Fomon, *Infant Nutrition*, Philadelphia: W.B. Saunders, 1974 (marked by **). The latter does not give values up to six years.

Figure 2
Use of the Food Square to Plan Weaning Diets and Mixes



cheap, culturally acceptably, made of locally available foods, and easily and quickly cooked. Solid weaning foods should be as concentrated in energy and good quality protein as is practical, and should contain adequate iron and other essential nutrients as well.

Weaning foods can be divided into two categories: (1) common household foods (for example, bananas, yogurt, and rice) and (2) mixtures specially formulated for infant and toddler nutrient needs. There are several names for these mixtures: gruel, basic mix, and multimix. Gruel is a thin staple porridge. A basic mix contains only staple ingredients. A basic mix with appropriate supplements added is called a multimix.[8]

Weaning Foods Made From Adult Foods

Where fuel limitations prevent preparation of separate foods for children, suitable foods from the family pot can generally be selected and prepared for this purpose by grinding, mashing, or in some countries by premastication. In addition, foods already cooked in the family meal are more convenient to use than separately prepared weaning foods, such as the multimixes discussed below. The food-square concept can be used to create weaning diets from family-pot recipes. Adapting family foods using this concept is discussed in Appendix 2.

[8] Examples of basic mixes can be found in the appendix to this chapter (Appendix 2), Tables 1 and 2. Sample multimixes for a child approximately five months of age are presented in Appendix 2, Tables 5 and 6.

Multimixes[9]

To make an adequate infant multimix, the following four components (Figure 2) are needed: a basic staple, an energy-rich supplement, a protein-rich supplement, and a mineral and vitamin supplement.

Basic staples Basic staples vary from culture to culture. A cereal flour is best because it provides both energy and protein, but starchy roots, tubers, or plantains can also be used as energy sources. In general, noncereal staples provide more energy per unit of weight than cereal staples. The calories per 100 grams are as follows for some of the major noncereal staples: approximately 90 for boiled potato without skin, 115 for baked sweet potato, and approximately 100 for cooked yam. For some cereal staples the number of calories per 100 grams is: 110 for cooked brown rice, 50 for cooked rice cereal, 65 for cooked wheat or barley, and 75 for cooked whole-wheat cereal. More detailed information concerning the protein concentrations of both cereal and noncereal staples is given later in this chapter.

The reader is cautioned that cassava and sago are low in all essential nutrients, but may be suitable as energy sources in weaning foods if properly complemented.[10]

Energy-rich complements Most weaning-age children in developing countries suffer from energy deficits. The traditional practice of feeding two to three meals a day is insufficient. More frequent feedings, such as five meals a day, are preferable. However, simply increasing the number of meals a day will not satisfy a child's nutritional needs unless weaning foods are appropriately dense in calories and protein. Often the nutrients in a basic staple are too dilute for a very small child to consume in adequate amounts to meet his or her needs. Adding a food dense in calories to a staple will provide the necessary energy in quantities suitable for an infant's small stomach. Oils, fats, and butter are appropriate energy-dense foods. Fats, whether derived from plant or animal sources, have twice the energy content of carbohydrates. Animal fats are present in meat, fish, eggs, milk, and milk products, such as butter, cream, and cheese. Animal fats may also contain vitamins A and D. Vegetable fats are obtained from groundnuts (peanuts), soybeans, olives, palm oil, nuts, seeds, and some plants. These fats usually contain vitamin E.

The addition of fat to a multimix not only increases energy density, but also makes staple mixtures easier to swallow. The role of fats and oils is discussed in more detail in reference 4 in the bibliography for this chapter.

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[9] D.B. Jelliffe uses the term "multimix" to refer to a combination of a staple (cereal or noncereal) and any additional item(s) (see reference 7 in the bibliography). He uses the terms "double mix," "triple mix," or "quadruple mix" to refer to the number of items in a multimix. Jelliffe's system places more emphasis on noncereal staples and animal proteins than the system developed by M. Cameron and Y. Hofvander, which is used in this chapter and in Appendix 2 (see reference 2 in the bibliography).

[10] Chapter VI contains a reference to a circumstance in which cassava may be an appropriate weaning-food ingredient.

Because starch-rich staples that have been neither malted nor fermented bind large amounts of water when boiled, their nutrient densities are inadequate to satisfy the needs of a weaning-age child. Malting, a process in which grains are sprouted before they are dried, dehusked, and ground, produces grain products that are easier to digest and bind less water when boiled.[11] Mellander and Svanberg have found that adding even small amounts of malted cereal (as little as 5%) to cereal-based gruels will increase their energy density significantly.

The addition of table salt (NaCl) to cereal flours during boiling makes them bind more water. On the other hand, potatoes cooked with salt will bind less water.

Protein-rich complements Human beings need protein to build and maintain body tissues. Because traditional weaning preparations in developing countries are often inadequate sources of protein, protein-rich complements should be devised as part of the weaning diet. A protein complement may be of plant or animal origin. In order of ease in meeting protein needs, the principal sources are: milk or a milk product, especially cheese, yogurt, and buttermilk; an animal food or product (meat, fish, or eggs); legumes[12], oil-seeds, or nuts; and mixtures of cereals and vegetables. Some protein-rich complements, made from foods available in developing countries, are given in Table 5.

In most nonaffluent communities, a mixture of plant proteins is the most economical complement and can be nutritionally quite satisfactory. Plant proteins are just as good as those from animals if they are mixed together in appropriate combinations and consumed in sufficient quantities. Legumes are the richest in protein, typically containing at least 20% before cooking as do chickpeas and lima beans. Peanuts contain 26%. Of all the legumes, soybeans contain the most protein (34%), but they are, like other legumes, difficult to digest unless they are soaked, skinned, and cooked until soft enough to be easily chewed. Mashing with a fork or spoon, pounding with a mortar and pestle, or grating are other methods to make legumes chewable and digestible. Cereal grains, containing from 6% to 14% protein before cooking, are the next best plant sources. Dark green leafy vegetables such as spinach, cassava leaves, beet greens, and many indigenous, edible greens may contain from 2% to 6% protein. Leaves are an underrated source of plant proteins (reference 8 in the bibliography at the end of this chapter).

The protein in one plant food eaten alone, such as legumes, cereals, and vegetables is incomplete, that is, it does not contain all the amino acids necessary for human growth and metabolism. However, a mixture of appropriate

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[11] "Compact Calories, Malting, and Young Child Feeding" by Olof Mellander and Ulf Svanberg in *Advances in International Maternal and Child Health*, vol. 4, edited by Derrick B. Jelliffe and E.F. Patrice Jelliffe (Oxford: Oxford University Press, 1984) discusses the nutritional advantages of malted grain products and how to prepare and use them at the home and village level.

[12] The legume family includes beans and peas.

foods of vegetable origin in the correct proportions will provide all the essential amino acids. How to mix plant proteins effectively is a somewhat complicated topic and will be discussed in detail later in this chapter.[13]

Minerals and vitamins Vitamins and minerals are provided by fruits, fruit juice, and vegetables. Green leaves, mashed or boiled for infants, can be an important source of nutrients for families who do not have access to vitamin-mineral preparations. Obvious fiber, such as the prominent veins in beet leaves, should be removed from green leaves. The nutrients supplied by leafy vegetables can be found in Tables 3 and 4. It is advisable to cook leaves fed to young children to drive off the potentially toxic factor, hydrocyanic acid, and, in the case of cassava leaves, cooking is essential. There are limits to the amounts of some leaves that can be fed because of the possibility of mildly toxic reactions, such as nausea and itching tongue, due to the oxalic acid content, but such reactions are rarely a problem (reference 8 in the bibliography).

It is the fieldworker's responsibility to devise the best combination of ingredients from low-cost foods available locally. The most successful procedures for developing diets and recipes involve mothers and local community workers. Pretesting more than one possible recipe with local mothers and children before making a final selection is a crucial step.[14]

Guidelines for creating a multimix based on the food-square concept are given in Appendix 2. Examples of ingredients in a weaning multimix are also presented in Appendix 2.

Recipes for basic mixes are given in Table 1. This table also illustrates how to add protein supplements to staple foods. Table 6 gives the weights of household measures of some foods used in previous gruel recipes.

Assessment of Safe Levels of Protein Intake

Foods vary in amino acid quality, in digestibility of protein, and in the amount of protein they provide. The term "protein quality," defined simply, refers to how well the amino-acid content of a food satisfies human needs. If the protein in a given food does not have the appropriate mixture of essential amino acids, a child's protein needs will not be met adequately by merely feeding it large quantities of this food. In addition, the value of food protein to the human body is influenced by its digestibility. Digestibility is affected by several factors: differences in the cellular structure of the food; the presence of obstructive substances in the diet, such as fiber; and chemical reactions determined by the overall composition of the diet.

Thus, the nutrient value of protein is determined primarily by two factors: (1) how thoroughly it can be digested and (2) the extent to which it provides the amino acids necessary for human beings to synthesize the nitrogen compounds

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[13] Examples of weaning mixtures made in Thailand from plant proteins can also be found in Chapter VI, Tables 1-3.

[14] For additional information on pretesting, see Chapter VI.

Table 5

Examples of Protein-Rich Supplements

Milk Products:

- *Amasi:* A soured milk used in southern Africa.
- *Acid milks:* One teaspoon of 85% lactic acid or white vinegar (4%), or 4 tablespoons lemon juice is added to 1 litre whole milk.
- *Cottage cheese:* Rennet is added to boiled, cooled milk from cows, ewes, goats, or camels. To preserve, salt is added and the cheese soaked in milk whey.
- *Kareesheh:* Similar to cottage cheese. Can also be made by adding a few drops of lemon juice to boiling milk and straining the resulting curds through muslin or cheesecloth.
- *Lebneh:* Yogurt is strained through muslin to reduce water content, and salt is added. Keeps well if salted and kept covered by olive oil.
- *Leban (yogurt):* Milk is boiled and cooled to blood temperature. A little stirred yogurt is added and the mixture stirred and then well wrapped to keep warm. It is then left undisturbed for 5 to 6 hours. Yogurt becomes sourer the longer it is kept. It can be used for feeding young infants.

Soybean Products:

- *Natto:* Soaked, boiled soybeans are fermented for two days wrapped in straw or pinewood.
- *Tofu:* Soaked soybeans are ground to a paste and heated. Water is added. The liquid is filtered and gypsum added. The resulting curd is moulded into cakes that are eaten fresh, dried, smoked, or fermented.
- *Miso:* Fermented rice and soybean.
- *Tempeh:* Thin slices of fungus-digested soybean.
- *Tahu:* Soft, white cottage-cheese like soybean curd.

Other Products:

- *Kishk (kishkeh):* Bulgur wheat is soaked for several days in yogurt and sour milk. It is then sun-dried and milled to a flour. This is fried in fat for a few minutes, water is added, and the gruel simmered for a few minutes.
- *Wheat-bread gruel:* Slices of brown wheat bread are soaked in water overnight, then mashed and cooked for a few minutes with sugar and a little water.
- *Ketjap:* Fermented preparation of rice and wheat.
- *Coconut milk:* The coconut is grated and mixed with about one-half litre of hot water and sieved to remove the fibrous residue.

This table was adapted from a report of the COMYN, adopted at its meeting in Rome, 5-7 November 1979, and published in *Food and Nutrition Bulletin*, Vol. 2, No. 3, 1980.

needed to build body tissues. These concepts are fundamental for understanding all terms used to describe protein quality.[15]

Digestibility The amino acids making up dietary protein must be absorbed if they are to be utilized. Digestibility of a protein food is expressed as the percent of ingested protein nitrogen that is absorbed. Digestibility is now recognized to be the principal factor determining the variations in the protein

[15] United Nations University Expert Group, *Protein-Energy Requirements Under Conditions Prevailing in Developing Countries: Current Knowledge and Research Needs.* Japan: United Nations University, 1979.

Table 6

Weights of Household Measures of Some Foods Used in Previous Gruel Recipes

Equivalent weights and measures for various foods are given below. Because commonly used utensils vary in size, the weights are only approximations. The actual weights of local foods measured with utensils available in a given locale should always be checked.

	Cup	Tablespoon (level)	Teaspoon (level)
	200 ml	10 ml	5 ml
Fresh milk, yogurt	200 g	10 g	5 g
Evaporated milk	200 g	10 g	–
Condensed milk	275 g	9 g	–
Dried whole milk	110 g	8 g	1.5 g
Dried skimmed milk	85 g	7 g	2 g
Cereal flour	170 g	8 g	3 g
Bean flour	–	12 g	2 g
Peanut (powdered)	110 g	6 g	2 g
Sugar	205 g	10 g	5 g
Oil	–	10 g	5 g

value of mixed diets consumed by various populations. Therefore, when protein is supplied primarily by one or two sources, as in some weaning diets, the utilization of the absorbed amino acids must be taken into account. The percent of absorbed protein that is retained by the body gives the biological value of a protein or diet. It can be predicted reasonably well by comparing the amino-acid pattern of the food or diet with a reference amino-acid pattern based on the requirements of the young child as is discussed in reference 9 in the bibliography. Combining the figure for biological value and that for digestibility gives the net protein utilization (NPU). The way in which the safe level of protein in the diet can be adjusted to both the amino acid score and the digestibility of the protein in a food or diet is shown in Figure 3. An example of the calculation of a safe level of dietary protein is given in Table 7.

The amino acid score To synthesize the proteins it needs, the human body must have *essential* amino acids, that is, those amino acids the body cannot synthesize in adequate amounts in a specific pattern and an additional quantity of nitrogen from either essential or other dietary sources. Estimates of the requirement pattern for essential amino acids are given in Table 8. The amino-acid score (AA score) is calculated as a percentage of adequacy for each essential amino acid as follows:

$$\text{Amino Acid Score} = \frac{\text{mg amino acid in 1g test protein}}{\text{mg amino acid in requirement pattern}} \times 100$$

Figure 3

Correction of Dietary Protein for Digestibility and Quality[1]

Calculation of Safe Level of Protein Intake: Correcting the Requirement

$$\text{Safe level of protein (protein with the reference amino acid pattern and 100\% digestibility) (g/kg/day)} \times \frac{100}{\text{Digestibility of dietary protein}} \times \frac{100}{\text{Amino-Acid Score of the diet}} = \text{Safe level of dietary protein intake (g/kg/day)}^{2}$$

[1]The correction for protein quality (the amino-acid score and digestibility) can be applied to either the requirement or the diet.

[2]The dietary protein intake should be equal to or greater than this amount.

AA scores are calculated for each essential amino acid, and these scores are compared to identify the lowest. The quality of the protein is that of its lowest AA score. The lowest score gives an approximate index of how efficiently a food's protein can be used by children.

Each amino acid score is evaluated relative to the WHO/FAO/UNU pattern of amino-acid requirements for children from birth to two years of age. This new reference scoring pattern is preferred to using egg or milk protein as the reference pattern.

Requirements for both essential amino acids as a percent of total protein and for total dietary protein fall with age. A child's needs for good quality protein, high in essential amino acids, is proportionately greater than an adult's. The pattern changes with age because the body's needs and metabolic capacities change with age.

Animal Versus Vegetable Protein

Animal proteins are generally of higher quality than vegetable proteins from single sources because animal bodies contain essential amino acids in very much the same proportions that our own bodies require, and their digestibility is usually high. Much of the protein in plants is storage protein and is quite different in composition from that of human body cells. For households coping with poverty, even an occasional egg is desirable, but may be too expensive to give to a young child. Dried animal-protein foods, for example, dried milk powder and fish-protein concentrate, have the advantage of not spoiling easily. Nevertheless, if they must be imported at high cost, these animal-derived proteins should not be recommended for the everyday diet.

For most households in developing countries protein from plants must serve as the main source, or the only source, of the child's protein intake. The protein score of a diet composed of more than one vegetable-protein source and/or of animal-protein sources is considerably higher than that of the basic

Table 7[1]

Example of Calculation of a Safe Level of Dietary Protein Intake[2]
(Rural Tunisian Diet)

Amino-acid score[3]: Preschool child = 53

Digestibility: If unknown, assume 85

A. Calculation of safe level of dietary protein as consumed.
Preschool child:

Safe level of reference protein = 1.04 g/kg/day

$$\text{Safe level of dietary protein} = 1.04 \times \frac{100}{85} \times \frac{100}{53} = 2.32 \text{ g/kg/day}$$

B. Calculation of effective amount of protein consumed in terms of reference proteins (milk, egg).
Preschool child:

$$\text{Corrected protein intake} = \text{actual intake} \times \frac{85}{100} \times \frac{53}{100} = \text{intake} \times 0.45 \text{ g/day}$$

[1]This table was taken from the FAO/WHO/UNU, *Expert Committee Report on Protein-Energy Requirements*, Geneva: WHO, in press.
[2]The safe level of protein intake is that level sufficient for nearly all the population. The correction for protein quality (the amino-acid score and digestibility) can be applied to either the requirement (Example A) or the diet (Example B).
[3]The reference amino-acid pattern for the preschool child is different from that of the infant.

staple alone because of the important complementary effect of the amino acids in even relatively small amounts of other vegetables and from animal-protein sources. Well-processed soy protein concentrates are essentially interchangeable with good protein sources of animal origin.

Increasing Plant Protein Quality

Limiting amino acids In plant-storage proteins the concentration of at least one, and up to four, essential amino acids is disproportionately small for infant requirements. Because the amino-acid pattern in these proteins is not the same as that needed by the human body, they are called *incomplete proteins*. The amino acids that are in less than optimal proportions are called the *limiting amino acids* of a given protein source. For example, for wheat and rice proteins, like other cereal grains, lysine is the limiting amino acid. The other essential amino acids likely to limit the protein quality of mixed human diets are: the sulfur-containing amino acids (methionine and cystine), threonine, and tryptophan.[16]

[16] See Table 7 in Chapter VII.

Table 8

Estimates of Amino-Acid Requirements at Different Ages (mg/kg/day)

Amino acid	Infants[1]	Two-year-old children[2]
Histidine[3]	28	?
Isoleucine	70	31
Leucine	161	73
Lysine	103	64
Methionine and cystine	58	27
Phenylalanine and tyrosine	125	69
Threonine	87	37
Tryptophan	17	12.5
Valine	93	38
Total Essential Amino-Acid (EAA) Requirement[4]	714	352

[1]FAO/WHO, *Energy and Protein Requirements: Report of a Joint FAO/WHO Ad Hoc Expert Committee, WHO Technical Report Series, No. 522*, Geneva: WHO, 1973

[2]FAO/WHO/UNU, *Expert Committee Report on Protein-Energy Requirements*, Geneva: WHO, in press.

[3]Histidine is an essential amino acid for the infant and, under extreme conditions, for the adult.

[4]Without histidine.

Complementary proteins Some plant foods have generous amounts of the essential amino acids in which others are deficient. Therefore, mixing two or more foods that have complementary proteins can increase the net protein quality of both foods. Weaning diets and multimixes can be devised so that one food or ingredient balances the amino-acid deficiency in another food.

Inexpensive complementary protein combinations can be devised from foods available in almost any locale. In general, combinations of a cereal and either a legume or an oilseed are the most appropriate plant proteins for a growing child. For example, maize, which is low in the amino acids lysine and tryptophan and relatively high in methionine, can be combined with beans, which are lower in methionine and higher in lysine and tryptophan. This mixture is more nutritious than any of its parts consumed separately. Devising plant mixtures of optimum protein quality is discussed in greater detail in reference 1. Dietary protein quality can also be increased for children by using small amounts of animal-food products and by using foods as complements to breast milk.

The protein characteristics of each of the major categories of plant foods are discussed briefly below.

- **Cereal grains**

The protein content of cereal grains varies from 6% to 14%. The amino acid most limiting in cereals is lysine. Maize is also deficient in tryptophan. The

amino acid pattern of wheat and rice is relatively good, compared to other cereals, although both are deficient in lysine and threonine. Most cereal proteins are well balanced with respect to other essential amino acids.

- **Legumes**

The protein content of edible species of legumes varies from 20% to 34%. Legumes are generally deficient in sulfur-containing amino acids but high in lysine. Most legumes contain antinutritional substances of various kinds and concentrations and must be cooked until easily chewed to assure the destruction of these substances.

- **Oilseed protein concentrates**

Oilseed protein meals, depending upon how they are processed, may contain as much as 50% protein. The most concentrated forms, usually called presscakes, are the residues remaining after the oil has been extracted. Unfortunately, in many developing countries oilseed presscakes are usually exported or used locally for animal feeding. Some vegetable-protein concentrates that can be mixed with a cereal to provide a satisfactory weaning food are given in Table 9.

Vegetable-protein concentrates, especially those made from peanuts or cottonseeds, may become contaminated with aflatoxins produced by the mold *Aspergillus flavus*. Storage in a cool, dry place to prevent this mold is essential.

- **Noncereal staples**

The protein concentration of two boiled noncereal staples—potatoes and cocoyams—is similar to that of boiled cereal grains, which absorb much more water than noncereal staples, thereby diluting their protein density. In general,

Table 9

Some Vegetable Protein Concentrates

Flour after Fat Extraction	Percent Protein	Amino Acid: Main Deficiency	Amino Acid: Good Source
Soybean	50.0	Methionine	Lysine
Cottonseed	50.0	Lysine	—
Peanut	50.0	Methionine, Lysine	—
Sesame	50.0	Lysine	Methionine
Sunflower			

noncereal staples, such as cassava and other tubers, have very little utilizable protein. Cooked yams and sweet potatoes contain about 2% protein. Boiled cereals are comparable in protein concentration (brown rice—3%, white rice—2%, corn—1%, rolled wheat—2%, and bulgur wheat—6%), although the quality of potato protein is not quite so good as that of cereals. Roots and tubers as energy sources must be combined with either animal protein or good plant protein sources to provide an adequate weaning diet. Even potatoes must be combined with more concentrated protein and energy foods to be adequate.

Procedure for Devising Vegetable Protein Mixtures

To develop vegetable protein mixtures of high nutritional quality, the following basic steps are necessary:

1. **Understand the quality of the diet that is to be improved, identify the limiting amino acids of the commonly eaten plant proteins, then formulate a mixture using complementary patterns that best approach the ratio of amino acids in the most recent FAO/WHO/UNU reference pattern** (Geneva: WHO, in press). The amino-acid-scoring method can be used to estimate the limiting amino acid and formulate the appropriate mixture.

2. **Conduct trials under strictly controlled conditions first with adult human beings and then children to be sure that the mixture is well tolerated.** Toxicological studies in experimental animals may be required to evaluate novel protein sources before they are fed to children.

3. **Before recommending a recipe for preparation at home or before marketing a village or industrially processed mix, pilot-testing must be done for taste and factors such as seasonal availability and problems in distribution.**[17] The purchasing power of the target population must be investigated when appropriate.

Appendix 2 contains further information important for formulating multi-mixes, including allowances to make for water absorbed by cereals and legumes during cooking and additions of energy-rich ingredients, as well as vitamins and minerals.

Feeding Techniques and Sanitary Practices

How to Introduce Weaning Foods

The following guidelines for introducing weaning foods are recommended by experts and people experienced in the field:

1. Introduce the complementary food *after* the baby has suckled. The reasons for doing so are that if the baby eats the food before breast-feeding, it may be less hungry and not want to suckle so much. Because breast milk is the most nutritionally complete baby food, nothing should be done to *reduce* its intake.

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[17] Chapter VI gives guidelines for pilot testing of weaning mixtures.

2. To train the baby to accept the taste and texture of something in addition to breast milk, first give foods mashed into a smooth paste, such as tubers or fruit. These foods can also be cooked until soft and then mashed; make certain they are tepid or at room temperature. Sometimes it can be helpful initially to express a little breast milk over the food so that the odor and flavor are familiar.

Several weeks later, the baby can be fed basic mixes and then multimixes, which are more nourishing. By the time the infant is nine months old, it will accept coarser foods, such as cooked and chopped and mashed vegetables. At two years of age, the child should accept most adult foods. Before this time, mixes and multimixes as described earlier in this chapter and in Appendix 2 are most useful because they are nutritionally dense and palatable.

3. Do not attempt to introduce many new flavors or textures at one time. Let the child become accustomed to one food at a time. Once the child has accepted a food, give it more frequently so that the baby will become familiar with it.

4. After the baby is familiar with a food, increase the amounts of a complementary food gradually.

5. When the baby has sufficient coordination, allow it to feed itself, but be certain to supervise the baby while it does so. In a contaminated environment, the unsupervised baby is very likely to get its food dirty. For example, bananas given to the baby to hold as playthings may be dropped onto a dirt floor and then eaten. In addition, supervision helps to assure that the baby actually consumes its complementary food.

6. Force-feeding is not recommended. On the other hand, mothers in societies where the perspective on life may be passive, may not persist sufficiently in encouraging a child to eat a new food. When a baby spits out or plays with food, the mother may not scrape the food off the baby's mouth and put it back in. Mothers should be encouraged to be persistent and patient in feeding a baby so that it swallows as much food as possible.

7. By the time the child is two years old, give it its own portion of the family food and let it eat by itself under supervision.

Sanitary Practices

To minimize the risk of infections resulting from contaminated foods, careful attention must be paid to sanitary procedures in food preparation and handling.

Frequency of Preparation

In a hot climate cooked foods should be prepared frequently and in small amounts, and leftovers discarded or given to other family members. This rule may be modified if cooked foods can be stored in a cool place and kept covered

to protect from contamination by dirt, flies, and other insects. Perishable foods should not be kept overnight in warm climates unless they are stored at refrigerator temperatures.

Frequency of Feeding

Begin weaning the child by feeding it a complementary food once a day. Gradually increase the frequency, so that at six months the child is fed two to four times a day as a complement to breast feeding. Children older than six months should be fed four to six times a day in addition to breast-feeding or should be fed three meals a day and two nutritious snacks. It must be emphasized to mothers that the small child needs more meals than an adult because its small stomach can take less at one time. Hofvander reports that a child one to three years of age can eat only one to one and a half teacups of food at a sitting. Therefore, for the child to get enough nutrients, frequent feeding of appropriate, calorically dense foods is necessary.

Appropriate Utensils

Cup and spoon are the recommended utensils for introducing and feeding complementary foods, even if the substance is a liquid. Where hand-feeding is common, washing of hands should be especially stressed. Bottles are not recommended, but if they must be used in a special circumstance, glass, not plastic, bottles should be chosen because of ease of cleaning. In this case, the mother should be taught clearly how to clean the container with available resources.

How to Clean Utensils

Hands are, in the most general sense of the word, utensils. Both mother's and child's hands should be washed before food is handled. It is best to wash utensils immediately after use because they will be easier to clean. The steps necessary to keep other utensils clean include (1) scrubbing and washing with soap or detergent; (2) rinsing in drinking water or salt water; (3) drying in the sun; and (4) keeping the dried empty containers covered to protect them from insects and dirt. Cold water is acceptable, although hot is preferable. It is ideal to boil utensils used for young infants for five to ten minutes.

Other Sanitary Practices

1. Only peeled, washed, or recently cooked foods should be used to feed a baby. Because fruits and vegetables in their skins are protected from contamination, only the part a baby will eat at one sitting should be peeled. Leave the rind or skin intact on the remainder.

2. Gruels should be boiled for several minutes to reduce bacterial contamination.

3. Food should be kept covered to prevent contamination from insects and dirt.

(Source: UNICEF)

ORAL REHYDRATION THERAPY (ORT) may prove to be the only means of saving a child severely dehydrated by diarrheal disease, which interacts with malnutrition. Each disorder sometimes contributes to causing, and sometimes aggravates or worsens, the other.

Feeding During and After Illness

General Guidelines

An inaccurate idea held by many people is that human beings need less food during illness than when they are well. *Theoretically babies should be fed more during illness because their nutritional losses are greater then,* but this is generally impossible because of loss of appetite. Therefore, special attention must be given to adequate food during the recovery period (see the last section in this chapter). In addition, if the disease produces diarrhea, the food a baby consumes is less well digested and absorbed and the degree of nutrient and fluid depletion correspondingly greater.

Although appetite will be reduced, on no account should food be withdrawn because the child is ill. On the other hand, food should not be forced. The following are general guidelines for feeding babies who are ill.

1. Breast-feeding should be continued during illness and the child offered the usual complementary foods.

2. Adequate fluids must be fed and can include juices, tea, and clean water. For dehydration, fluids and electrolytes must be supplied (see the following section, "Oral Rehydration Therapy").

3. During infections, vitamin A-rich foods, which have been cooked, such as papaya, pumpkin, and egg yolks are particularly important. Cooked, mashed and strained leaves can also be fed in small amounts.

4. Since illnesses are accompanied by conditions that affect the ability and desire to eat, such as loss of appetite, fungus in the mouth, sore throat, or cough, infants should be given special encouragement to eat foods with higher nutritional value than usual, and these foods should be continued during the recovery period.

Oral Rehydration Therapy

Oral rehydration therapy is used in the treatment of short-term bouts of diarrhea that are not severe.[18] Therapy involves the replacement of water and body salts with a specially prepared solution in order to prevent potentially dangerous dehydration. It is important to realize that oral rehydration therapy will not necessarily reduce the volume of diarrhea. In fact, diarrhea frequently increases for a brief period precisely because a baby's fluid loss is being replaced by the therapy. However, oral rehydration therapy often prevents dangerous net fluid loss and leads to improving a baby's appetite. Breast-milk

[18] Severe diarrhea is defined as not more than one stool every two hours or more than 5 ml of stool per kg body weight per hour ["Oral Rehydration in the Treatment of Diarrhea: Issues in the Implementation of Diarrhea Treatment Programs" by R.A. Cash in *Diarrhea and Malnutrition*, edited by L.C. Chen and N.S. Scrimshaw (NY: Plenum Press, 1983)]. This volume contains detailed discussions of important issues related to oral rehydration therapy and the treatment of diarrhea in babies.

feeding and feeding of foods should be continued; feeding contributes to reducing the harmful effects of the illness on a baby's nutritional status even when stool volume is increased. Controlled studies have conclusively demonstrated the value of making food available to children with diarrhea even though actual food intake will be reduced by loss of appetite.

The solution used for oral rehydration therapy requires no special equipment to prepare and can be made from inexpensive ingredients and locally available, unboiled drinking water. The ingredients recommended by the World Health Organization are as follows:

TABLE SALT (NaCl)	3.5 grams
SODIUM BICARBONATE	2.5 grams
POTASSIUM CHLORIDE	1.5 grams
GLUCOSE	20.0 grams
(or SUCROSE	40.0 grams)
WATER	1.0 liter

Because spoon sizes vary so much, spoon equivalents must be locally determined.

Instead of glucose, table sugar, which is more common, may be used, but twice as much table sugar must be substituted for glucose. Sodium bicarbonate or potassium chloride can be eliminated, although the solution will not be so effective. Recent unpublished data from the International Center for Diarrheal Disease Research, Bangladesh, indicate that cereals are even better than sugars as carbohydrate sources. However, *some carbohydrate source, either a sugar or a starch (e.g., 30 g of rice powder), is absolutely necessary for water to be absorbed to correct the dehydration.*

The World Health Organization recommends that oral rehydration therapy solution should be disposed of after 24 hours if it has been made from drinking water that has not been boiled. Using boiled water in the solution has not been shown to improve rates of recovery from diarrhea; moreover, in many areas of the developing world, the fuel needed to heat water is not available. In addition, boiled water may be culturally unacceptable for use in the treatment of sick babies in areas in which foods are categorized as hot and cold.

The addition of 1 gram of alum to a liter of contaminated water will reduce the degree of contamination when boiling is impossible. This .01% solution kills *V. cholerae* and *E. coli* within one hour; a .005% solution (500 mg per liter) kills bacteria within one to two hours. Alum is nontoxic at concentrations as high as .1% to .5%, although ingestion of a concentrated solution containing as much as 2.0% may cause a burning sensation in the mouth and diarrhea.[19]

[19] The use of alum to decontaminate drinking water is described by K. Ahmad, K. Jahan, and I. Huq in "Decontamination of Potable Drinking Water by Alum for the Preparation of Oral Rehydration Solution", *International Food and Nutrition Bulletin*, Vol. 6, No. 2, in press.

Feeding after Illness

Mothers must also make special efforts to encourage baby to eat *after* illness. In the days immediately following illness, it is very important to give a baby energy-dense foods more often than usual. The net amount of extra food required during recovery is greater than the amount not eaten during the illness because of extra metabolic losses during the infection. The need for extra food persists for three to four times the duration of the illness. Immediately after an illness, a baby's appetite is increased, and if sufficient appropriate food is offered, considerable catch-up growth occurs, making up for nutritional losses and growth failure during the acute illness episode. Infections usually do not have permanent effects on the growth and development of well-nourished children, but can be devastating to those who are malnourished and deprived of sufficient food for maximum recovery afterwards. Energy density of foods should be increased by adding oil, fats, and sugar.

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Chapter V

Monitoring Growth of Young Children

The Importance of Growth Monitoring

A child's body responds to moderate nutritional deficiencies by absorbing and utilizing its nutrients better and by growing more slowly. In addition, the moderately malnourished child limits his or her physical activity. However, if nutritional deficiencies are severe and of long duration, the child may stop growing altogether. Beyond this stage, the body's tissue reserves will be used to provide energy and nutrients for vital processes. Clinical signs of severe dietary deficiency, such as excessive thinness, will appear. The risk of death will increase dramatically as the nutrient reserves dwindle and the child becomes emaciated.

A child who is growing poorly is, therefore, a child with a nutritional or other health problem that needs correction.

The measurement of growth velocity, defined as the direction of movement of the weight curve over time (Figure 1), should be viewed as an early warning system rather than as a diagnostic tool. Physical growth will slow down long before signs of nutritional deficiencies appear and usually long before the child is in immediate danger of dying. The monitoring of growth is particularly important in the first three years of life when growth rates, nutritional requirements per kilo of body weight, and susceptibility to infections are all at their highest.

Scope of Chapter

This chapter describes techniques for monitoring growth in weaning-age children, emphasizing the diagnostic tool of weight-for-age charts. The strengths and limitations of the following methods are discussed: weight-for-age monitoring, the expected-weight gain method, length-and-height-for-age

* The primary contributor to this chapter was Reynaldo Martorell.

measurements and arm-circumference measurements. Factors that predispose an infant to nutritional inadequacy are also discussed.

One-Time Examinations

The nutritional status of the individual child is often evaluated in developing countries by means of a single anthropometric examination, for example, measurement of arm circumference or of weight-for-height. Two kinds of valuable, but limited, information can be obtained from a one-time assessment. First, one can determine whether a child is unusually small for his age. Although a small size is often found to be a risk-indicator, in some cases it need not be a matter of concern. The small size of the child may be the result of nutritional problems that began and ended months or years earlier, or the child's small size may be genetically determined. The second and most important kind of information a single examination will yield is whether a child is unusually thin or unusually fat. Wasting or excessive thinness is a sign indicating the existence of severe, chronic problems. The greatest advantages of one-time measurements are that they require less time, money, and fewer personnel than serial measurements. The uses of one-time measurements including weight-for-age, weight-for-length, weight-for-height, and arm circumference are discussed in greater detail later in this chapter.

Serial Examinations

Serial measurements of weight-for-age or height-for-age have the following advantages over a one-time examination: they can reveal a slowing down in a child's rate of growth, before he or she has become wasted. In addition, once children are under care, only serial measurements can provide the data to assess whether there has been positive response to the treatment.

Weight Compared To Height

Weight is the measure of choice for monitoring short-term changes in growth of young children. As mentioned above, with periodic measurements of either weight or length one can detect children who are slowing down in growth. Weight changes, which can reflect body-tissue wasting, can alert a health worker to a nutrition problem sooner than changes in length. Wasting is the extreme loss of fat and muscle tissues. Length or height is a measurement of skeletal growth, a dimension that, in children, can increase but not decrease as can weight.

Measurement of weight is already the most widely used method for monitoring the growth of children. Besides providing more information than height concerning a child's nutritional status, the measurement of weight has the additional advantage of being more easily taught. The measurement of length or height in young children is difficult, requiring two people for accurate results. In addition, length boards, which are sliding boards commonly used for

the accurate measurement of small changes are inconvenient to carry when moving from house to house. In contrast, simple beam or spring scales are easy to transport. Finally, weight is a familiar measure worldwide, and the significance of monitoring the weight of young children is readily understood by mothers in developing countries. The appendix to this chapter (Appendix 3) lists sources for a number of growth monitoring tools and gives brief descriptions of their advantages and disadvantages.

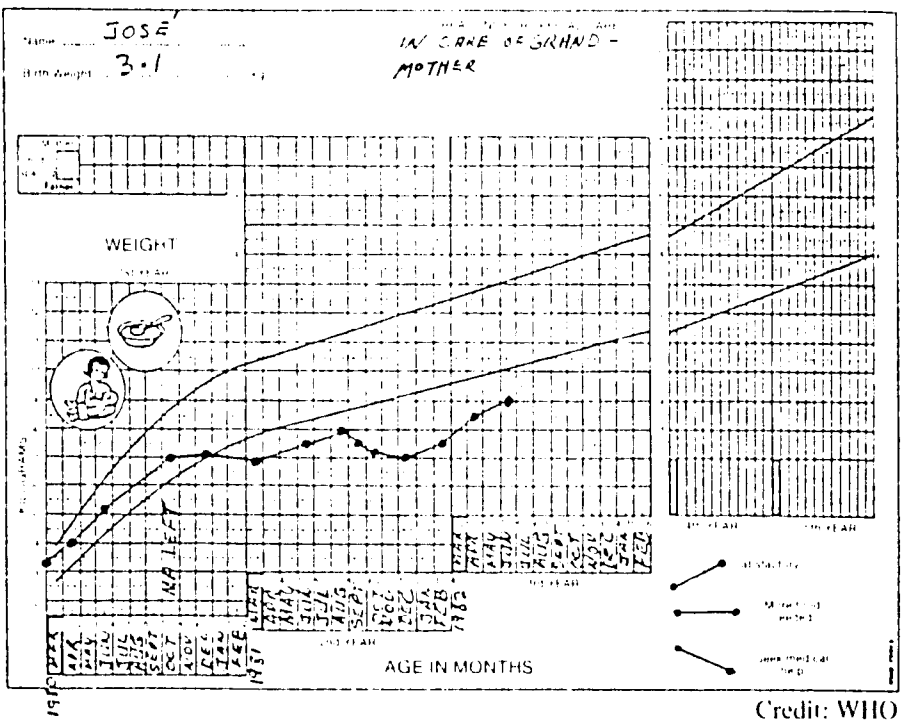
The Weight Growth Chart

The World Health Organization (WHO) is promoting simple charts for use in developing countries. The charts (Figures 1 and 2) were originally developed by Dr. David Morley from his experience in the Nigerian village of Imesi and have been used successfully around the world.

Principles of Interpretation

The child's growth curve, indicating change in weight, is drawn on the front of the WHO growth chart shown in Figure 1. The growth curve is the broken

Figure 1
The front of the weight chart



Credit: WHO

line connecting the closed circles, which represent weight changes in kilograms as the child ages. The vertical axis of the chart is divided in kilogram gradations and the horizontal axis is numbered in divisions, each representing one month and further divided into stair-step segments representing years. The other two smooth curves depict the growth of well-nourished children: the top line represents the 50th (see Glossary) centile for boys and the bottom line the third centile for girls. By definition, 50% of well-nourished boys are above the 50th centile value of weight-for-age and 50% are below it; 97% of the girls are, by definition, above the third centile value and 3% below it. The primary importance of these two growth curves is to illustrate the shape of a well-nourished child's growth curve. (A detailed interpretation of the shape of the growth curve of the child used as an example in Figure 1 will be given later in this chapter.)

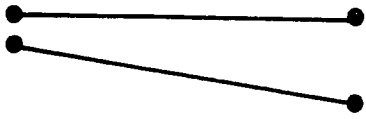
The weights used to determine the third and 50th centiles are from the National Center for Health Statistics and were recently obtained from nationally representative samples of children in the United States. The question has been raised whether these growth lines are appropriate for populations in developing countries. In answer, there is considerable evidence to support the position that they are appropriate as indicators of potential differences. Alleged ethnic differences in the growth potential of preschool children are minor relative to the effects produced by malnutrition and infection. In a well-nourished population, whether from industrialized nations or from the elite in developing countries, most children will have weights situated above the third centile line. In populations typical of the rural areas of developing countries, half or more of the children will have weights below the third centile line.

Unlike ethnic differences, individual differences in genetic make-up are important in interpreting the position of a child's curve on the growth chart. A child whose weight, for example, is below the third centile line is very likely to be malnourished if he or she has the genetic potential to be a big child; however, if he or she is genetically a small child, the child may be normal or only slightly malnourished. Therefore, in assessing an individual child's nutritional status, the decisive indicator is the direction of the growth line, not whether the child's weight is above or below the bottom line.

Growth Chart Modifications

Countries have modified the growth chart in various ways to suit local needs. In Indonesia, rather than two lines, a rainbow pattern consisting of colored channels, the width of each being five percent of the standard weight, is used. This growth chart also shows the three possible directions of the growth line; simple instructions to mothers are printed next to them:

Graph going up:
Food is good. Continue.



Graph level:
Give child more food.

Graph going down:
Add more good food.
Take child soon to health center.

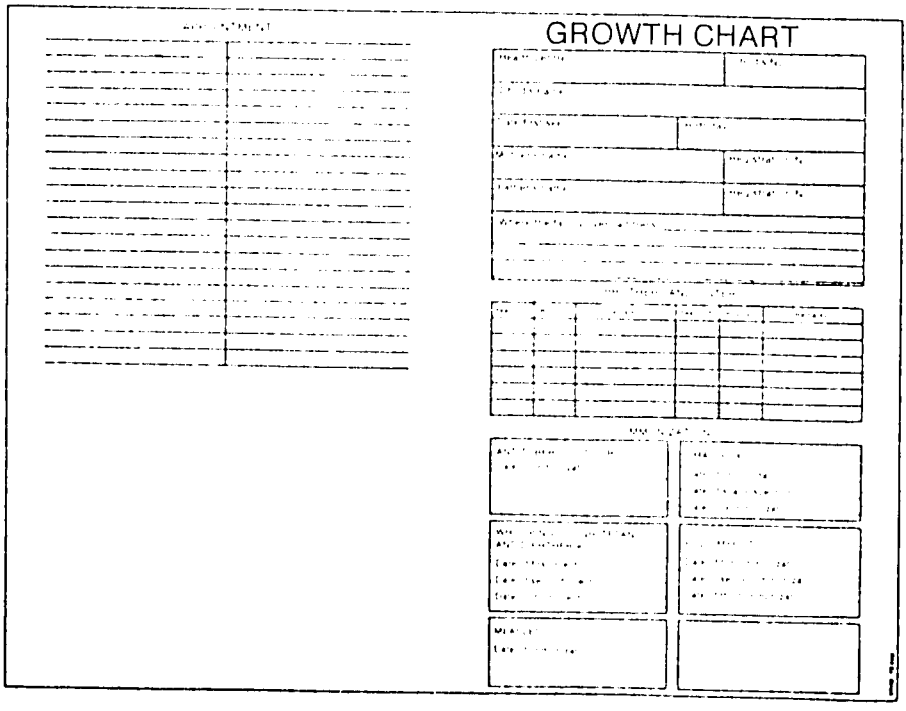
These simple instructions illustrate how growth charts can be the basis for action in weaning food projects. Failure of a child to gain weight, for example, could indicate that the mother should be assisted with advice on food preparation or with food supplies, depending upon the nature of the program. Regardless of the exact form, all growth charts should have such a simple guide for mothers. Finally, the Indonesian growth chart also carries simple instructions on how to prepare a sugar-salt solution to give to children with diarrhea.

The Back of the WHO Growth Chart

The back of the growth chart is for recording information on the child and the family (Figure 2). The name of the locality, the child's name and birth date,

Figure 2

The back of the growth chart for the collection of information on the child and the family



the child's and the family's identification numbers, the address, and general information about siblings should be noted. The full history of immunizations should be detailed. Finally, a list of appointments and the actual weights recorded on each visit should be kept. Depending upon the local setting, the back of the growth chart should be redesigned to allow for important information to be written. For example, in some areas it would be advisable to note the family's ethnic group, language, or caste.

Determining the Age of Children

The age of the child is needed for growth monitoring. It is sufficient to know the month and year of birth. At the first examination of the child, the healthworker should fill out the first box on the WHO growth chart with the year and month of birth. In the example in Figure 1, the child was born in March, 1980. The second box is, therefore, for April, the third for May, and so on. Each segment of twelve months always begins with the child's birth month and corresponds to one year of the child's life.

In some areas of the world mothers will not be able to recall the child's birthdate. In such cases, the year of birth may be determined by asking the mother whether the child was born earlier or later than village children of known ages. A local events calendar showing the dates on which important events took place during the past three-to-five-year period may prove useful in determining the month of birth.

The greatest *rate of increase* in weight occurs in the first year (Figure 1), although, of course, the body weight of a normal child continues to increase until after puberty. It is important to know the age of babies less than one year old to the nearest month to assess whether they are growing normally. On the other hand, *discrepancies of even several months will not matter much for interpreting the growth line of older children*, since growth velocities are nearly constant after infancy. In situations in which there are no clues as to the child's age, a rough guess should be made, and the assigned birthdate should be used consistently thereafter. What is most important is whether or not the child is gaining weight. Not knowing the correct age of the children, therefore, should never be an impediment to growth monitoring.

Measuring Weight

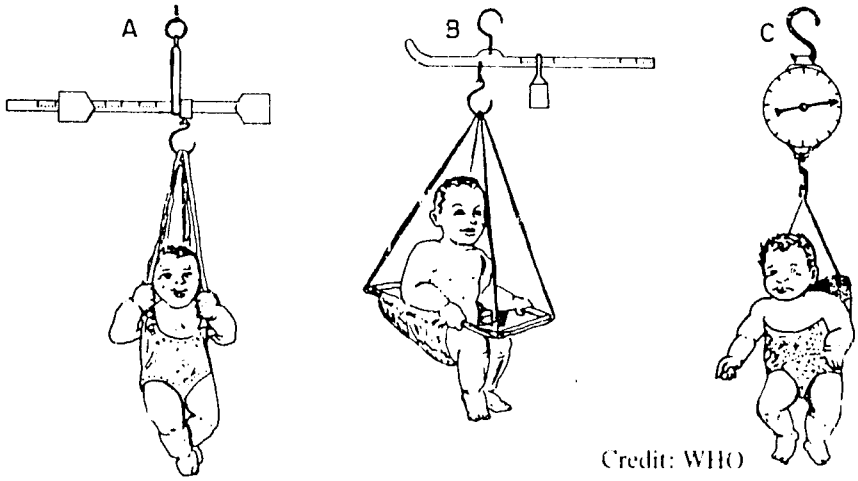
Children should be weighed with clothing as light as possible. Most important is to deal consistently with the weight of clothing. Scales suitable for weighing preschool children can be of the beam or spring type. One of the most widely used scales suitable for fixed locations, such as a clinic, is the Detecto baby scale, which can weigh babies as heavy as 16 kg. Other kinds of beam scales, commonly used in markets in developing countries, are also appropriate

(Figure 3), provided the same scale is used for serial weighings. Suitable for use in house-to-house visits is the British-made Salter scale, a spring scale with a weight limit of 25 kg, which can be hung from a tree branch or a house beam (Figure 3). One can choose an easy-to-read dial of either 100 g or 500 g gradations for this scale.

As shown in Figure 3, the child is placed in a sling or a basket. Imaginative alternatives for the sling were successfully used in Indonesia, where it is

Figure 3

Types of beam balances (A and B) and spring balance (C)



Credit: WHO

Table 1

Procedures for Weighing Children with a Suspended Scale*

1. Maintain the scale and the apparatus for holding the child in good working condition.
2. Calibrate the scale, using an object of known weight.
3. Remove all heavy objects, such as shoes or jacket, from the child. If it is too cold to do so, weigh an equivalent amount of clothing at each weighing and/or note on the growth chart exactly what articles the child is wearing.
4. Suspend the scale so that it is free-hanging and the child cannot hold on to anything and cannot touch the ground.
5. Record the weight only when the scale is steady or the needle has stopped swinging. If the needle is moving slightly, use the midpoint of the swing as the child's weight.

*This table has been adapted from a protocol for weighing and measuring children published by the American Public Health Association International Health Programs. For further information on this subject, see *Growth Monitoring of Preschool Children: Practical Considerations for Primary Health Care Projects* in the *Primary Health Care Issues Series 1, No. 3*, October, 1981, pp. 69, 70. (Write: Director, APHA/IHP, 1015 Fifteenth St. NW, Washington, DC 20005, USA.)

SIMPLE SCALES THAT WORK. Pictured here and on the facing page are examples of inexpensive locally made beam balance scales. Weighing children regularly and accurately is critically important in determining whether they may be malnourished. Yet, the provision of suitable weighing scales to nutrition programs all over the world continues to be a problem. Many of the best-known manufactured scales are expensive to buy and ship and are often difficult to repair. Accurate locally made scales are one answer to this set of problems.

reported that, "woven baskets or wooden boxes painted to look like an animal, an airplane, or a car suspended under the scale made weighing an interesting and fun game even for shy children."[1]

It is likely that durable and reliable digital electronic scales will soon be available at low cost. The advantages of such scales are indicated in Appendix 3.

Health workers can easily learn to weigh children with great accuracy. Learning this task, however, does take time and a desire to be precise. When making measurements, the health worker must remember that the health of a child may depend upon the accuracy of the weighing.[2] Measurers should rigidly adhere to the techniques listed in Table 1. Standardization exercises should be held periodically, and the scales should be checked frequently for accuracy. Standardization can easily be done by filling plastic containers with water to specified levels (one liter of water weighs one kilogram) and checking to see that the correct weight registers on the scale. If water is not readily available, calibrated weights from the market or a rock of known weight can be used. Scales used on the ground should be checked for levelness with a good quality carpenter's level.

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[1] J. E. Rhode, D. Ismail, and E. Sutrisno, "Mothers as Weight Watchers: The Road to Child Health in the Village," *Environmental Child Health* 21(1975):295-297.

[2] See Chapter IX for a discussion of the effects of measurement errors on evaluation.

BABY IN SUSPENDED SCALE

Interpreting the Growth Curve

Weights are recorded in the growth chart as shown in Figure 1. Clearly marked large dots should be used. In this figure, José's weight was 9.0 kg in June, 1982, and 8.5 kg in April of the same year.

Key Concepts of Interpretation

Interpreting the information entered into the chart and using it to make appropriate decisions about the child's condition are critically important steps in the health-care process. The health worker must carefully examine this information. The health worker must be certain that he or she is interpreting the data correctly; in this regard, discussion with experienced health-care personnel can be helpful.

The following are **key concepts** for interpreting weight information:

1) **The direction of the growth curve, not its position relative to the standard curves, is of primary importance.** In the example drawn in Figure 1, José grew well during the first eight months. His growth curve during this time was parallel to the 50th and third centile lines on the growth chart, indicating that he was progressing as well as normal children. Pertinent information about the child should be entered in the chart, as in Figure 1, where it is noted that in October, 1980, José's mother migrated to the city and left him in the care of his grandmother. As might occur in children who are suddenly weaned, José did not grow at all during the next six months.

2) **A flat growth curve**, as shown from October to March, **is a danger sign.** At the time the health worker first observes that an infant's growth has ceased, he or she should attempt to improve the child's diet. In José's case, encouraging the grandmother to feed José appropriate weaning foods in adequate amounts and enrolling José in feeding programs would have been appropriate measures.

3) **An upward direction in the curve is a good sign.** The example continues with José growing well from 13 to 18 months of age. At this stage, health workers might have taken the opportunity to congratulate José's grandmother.

4) **A downward direction in the curve implies a very dangerous situation.** From August through December, the example shows a period of weight loss as might result from a further disruption in José's eating pattern, for example, his grandmother might have died, and he might have had to live with a neighbor, or he might have had chronic diarrhea or another infection.

The example ends with a successful intervention by the health workers, as evidenced by a satisfactory upward direction in the curve.

Kwashiorkor

Children with kwashiorkor will exhibit edema or swelling caused by water retention. Health workers who weigh children should know how to check for edema.[3] Edema may mask weight losses in the child. The presence of edema is itself a danger signal, requiring immediate medical attention. An effort should be made to weigh the child after the edema has subsided to track his/her progress during the recuperation period.

Weighing Children Regularly

Because children are so vulnerable and grow so fast in infancy, growth charts are only useful if the infant is examined at frequent intervals. Monthly visits are ideal for detecting poor growth. Some research workers have proposed that a weight gain of less than 0.5 kg in a month be considered a danger signal in the first three months of life and that one of less than 0.25 kg in a month be considered dangerous in the second three months. Monitoring child growth in this manner overcomes a limitation of monitoring the direction of the growth curve. Growth-curve direction will not always reveal that a child is undernourished. *A child's growth curve may be moving in an upward direction, but the child still may not be gaining enough weight.*

The recommended-weight-gain method is a more complicated technique than growth-curve monitoring and requires familiarity with mathematics. Many health workers have found that this method is too complicated to use, and that involving mothers in the evaluation process is more difficult than with growth-curve monitoring. The method has a further limitation: the health worker must have a scale accurate to 100 g rather than 500 g. Despite its complexity, the sensitivity of the method has made it attractive to some health workers. To analyze weight gain with this method, each weight must be subtracted from the weight at the next weighing to determine the difference. The difference must then be divided by the number of months between the two weighings, and this will yield the amount gained per month between the two weighings. A practical means for estimating how much weight a child should be gaining has been developed by the Nutrition Center of the Philippines, but will not be discussed in this chapter.

Measurements during the second and third years of life should be made every two to three months. During these years children are going through the dangerous period of weaning. During the fourth and fifth years, those children who have survived the weaning years generally grow adequately, and the spacing between measurements can be increased to four to six months or abandoned entirely. These general recommendations, however, will not be appropriate if a child is severely malnourished, if it is impossible to visit a community frequently, and if personnel and other resources are scarce.

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[3] See Chapter II.

Measures of Wasting

Limitations of Weight-For-Age Classification

The Gomez classification of malnutrition is still widely used in developing countries. According to this method, the child's actual weight is expressed as a percentage of the standard weight, that is, the weight at the median or the 50th centile of the reference population, for the age in question. A well-nourished child is one whose weight is equal to or greater than 90% of the 50th centile weight. First degree malnutrition is indicated by a weight in the 89% to 75% range, second degree by a weight in the 74% to 60% range, and third degree by a weight less then 60% of the ideal weight.

In theory, this classification scheme has a drawback as an indicator of a child's current health status. It will not detect a very tall child who is malnourished, but such children are far too uncommon to be of public health significance in underprivileged populations. Health workers must remember that although the value delineating serious malnutrition is 60% of the standard weight-for-age, those children who are tall and whose weights are over that value may still be undernourished. The health worker must be very attentive to the need such a child may have for more adequate nutrition. Another limitation is in the case of an older child whose growth has been stunted at some time in the past and whose weight is, therefore, low with respect to age, but adequate for his height. For such a child a recommendation of immediate nutritional treatment would be incorrect. The key concept in evaluating adequacy is that the child must gain weight consistently over time.

In the following situations the weight for age alone should not be used for decisions concerning feeding:

- The child is being examined for the first time;
- The previous weighing was a long time ago.

In both cases, low weight-for-age may reflect past malnutrition in a child now growing satisfactorily. In these situations, two measurements, weight-for-length and arm circumference, are useful. Both measure the extent of body wasting and allow one to use a low or high risk category to describe a child.

Weight-for-Height

Measurements of body length lying down are used for newborns and for children less than three years of age. Standing-height measurements can be made if the child is from three-to-five-years old, and are easier to make than length measurements, which require two people. The calculation of weight-for-height or length percentages requires some practice in mathematics, which has limited the use of this measure in rural clinics in developing countries.

One easy-to-use method for evaluating weight-for-height is a chart devised by the staff of the Nepal children's organization, Save the Children Fund. The child is weighed and made to stand against a wall chart at the column

Figure 4

The prototype wide-column wallchart painted on the wall of the Dhankuta Central Clinic being used to assess the weight-for-height percentage of a 13 kg boy. Note the floor-markings in front of the chart. The boy's weight is between 80% and 90% of the standard weight for his height. (D. Nabarro and S. McNab, "A Simple New Technique for Identifying Thin Children," *Journal of Tropical Medicine and Hygiene*, 83:21, 1980.

corresponding to his weight, that is, one column for each half kilogram value from four to 20 kgs (Figure 4). Zones corresponding to different ranges of weight-for-height are marked as follows: red (70% to 80%), yellow (80% to 90%), and green (90% to 100%). A flat, straight wall is required, and children must stand still while the measurement is taken.[4] Field testing of the wall chart has been encouraged.

[4] Further details are available from D. Nabarro and S. McNab, "A Simple New Technique for Identifying Thin Children," *Journal of Tropical Medicine and Hygiene* 83 (1980):21-23 or Save the Children Fund (UK), 157 Clapham Road, London SW9 OPT; or the Tropical Child Health Unit, Institute of Child Health, Guildford Street, London, EC1.

Arm Circumference

A rough measure of arm circumference is easy to obtain. This technique is useful for identifying children with severe malnutrition, particularly in emergency situations, such as refugee populations. It can also be used in preliminary screening of communities but it is not sufficiently accurate to classify mild to moderate degrees of malnutrition or to identify changes in status of individuals. The measurement must be taken midway between the elbow and the shoulder. An advantage of arm circumference is that it remains fairly constant from one to five years of age; therefore, one does not have to use age-adjusted standards. The disadvantage is that it is sensitive only at the extremes of nutritional status and is not a substitute for weight-for-age measurements.

A number of tape measures are available commercially and, if necessary, tape measures can be easily made from nonstretching material. For example, old x-ray film has been used successfully to make measuring strips. Colors can be added to represent three categories of children. Those with values greater than 13.5 centimeters (cm) are in the green or safe category; values between 13.5 cm and 12.5 cm are in the yellow zone and denote caution; and values below 12.5 cm fall into the red or danger zone. Colors should be carefully selected to be consistent with cultural beliefs: red does not signify danger in all cultures.

Summary

The uses of arm circumference and weight-for-length measurements are listed below. In general, for infants and children of weaning age neither measure provides as much diagnostic information as do serial weight-for-age measurements.

1. **Arm-Circumference Advantages**

- Simpler technique than weight-for-length measurements.
- Useful for rapidly selecting severely malnourished individuals in need of immediate attention.

2. **Weight-For-Length Advantages**

- More useful than arm circumference in assessing nutritional status of mild to moderately malnourished children.

Children at Risk

Factors predisposing a child to malnutrition vary from region to region and may include biologic, cultural, and environmental variables. For example, Table 2, which has been adjusted from the International Union of Nutritional

Sciences' (IUNS) report on the concept of children at risk for malnutrition, indicates most of the factors found to be important for the individual child in rural Bombay. The use of weight-growth charts and of arm-circumference values will, as noted, yield valuable and immediately relevant information for assessing risk. National studies are required to identify the other indicators of importance and undoubtedly the principal factors will vary somewhat across countries or regions within a country.

The important risk factors for each child should be noted at the top of the front of the WHO growth chart (Figure 1) under the heading "Reasons for Special Care." Risk factors could be used to target nutritional interventions to needy families or individual children. Targeting an intervention to a population at risk for malnutrition must be weighed against the costs and the logistic difficulties of identifying this group.

Table 2

At-risk Indicators[1]

Factors Indicating High Probability of Severe Malnutrition in Infants	Factors Predisposing to Severe Infant Malnutrition	Factors Predisposing to Inadequate Infant Nutrition	Factors Predisposing to Faltering Weight Gain in Infants
• Weight 65% or less of standard	• Failure to gain weight in early infancy	• Birth order greater than 3	• Measles, whooping cough, recurrent diarrhea
• Arm circumference smaller than 14 cm	• Difficult breast- or bottle-feeding in early infancy	• Death of either parent or broken family	
	• Poor economic background	• Illiteracy	**Factors Predisposing to Fetal Malnutrition**
	• Sibling with malnutrition	• Serious disease of mother	• Birth weight of 1.5 kgs of less
	• Mother working away from home	• Low intelligence of mother	• Low maternal weight
	• Death of more than 4 siblings	• Blindness of either parent	• Twinning
		• Stepmother caring for child	• Low weight gain during pregnancy

[1]These indicators were based on studies in rural Bombay. For further details, see the International Union of Nutritional Sciences (IUNS) Guidelines on the at-risk concept and the health and nutrition of young children in the *American Journal of Clinical Nutrition* 30:242-254, 1977.

Teaching Mothers About Nutrition, Health, and Growth Monitoring

The regular weighing of children offers an excellent opportunity for health workers to discuss child nutrition and health with mothers. An effort should also be made to teach parents about the significance of the information collected in the growth chart. In some areas, it may be possible to teach mothers general principles of interpreting a growth chart. Complicated explanations should be avoided and only concepts concerning the importance of good growth should be taught.

Experience in a number of areas around the world shows that, *if mothers are allowed to keep the charts themselves, they will feel more involved and responsible for the child's health.* Using plastic envelopes will protect the records, and keeping them at home will avoid the complications of maintaining a filing system. *Evidence indicates that mothers will bring the records to the clinic and that they are less likely to lose the information than the clinics themselves. Moreover, most mothers are able to comprehend the significance of the weight chart and are motivated by it.*

Conclusion

Growth monitoring is highly desirable for identifying children who are at risk of developing severe malnutrition and for assessing the effectiveness of remedial measures. Unfortunately, the proportion of children whose growth is being monitored in developing countries is still small. Growth monitoring should be initiated at the village level in every underprivileged population. This requires well-trained, dedicated health-care personnel located in areas where the poor and the malnourished live for growth monitoring to be an effective component of primary health care. Nevertheless, growth monitoring is no panacea, particularly because it will not uncover micronutrient deficiencies. Moreover, in some countries where growth monitoring has been introduced, it has not been used as a tool for helping a mother understand why her child is malnourished. Too often growth monitoring has been perceived by program personnel at all levels as an end in itself. The most effective use at the village level of growth monitoring data is in conjunction with a weaning-food project that promotes nutrition education and basic health-care measures. Chapter VI describes such projects.

Chapter VI

Home- and Village-Level Weaning-Food Projects

Introduction

Home- and village-level projects are designed to assist families to devise acceptable and nutritious weaning diets from locally available resources. Ideally, they aim to free families from dependence on larger market forces, so that food consumption is not affected by regional shortages and price increases. In reality, home and village projects often rely on items not produced locally. For example, some projects have obtained an important ingredient of a weaning mixture, such as rice or wheat flour, from a source other than local production, such as a market.

Home- and village-level projects have the potential for reaching a wider range of low income families than the other two principal weaning-food strategies—donated food aid and centrally processed foods. Food-aid projects are frequently targeted to children at risk of severe undernutrition during acute food shortages. These projects are seldom intended to reach all, or even most, low income families. Processed foods sold in the market may be too expensive for the lowest income families, unless they are subsidized. In addition, subsidized processed foods do not always reach markets with their packaging intact, so that the supply of such foods is not always adequate. Moreover, many families in developing countries live too far from markets to rely on them regularly.[1]

Although the phrase "home- and village-level projects" implies that the target communities are rural, projects promoting nutritious weaning foods made from ingredients usually found in the home are also needed in low income urban areas. Marketed and donated foods often reach only middle- and upper-class

* The primary contributors to this chapter were Aree Valyasevi, Susan Colgate, Robert Morgan, and Karen Mitzner.

[1] See Chapter X for a detailed discussion of each strategy, including the resources each requires.

urban families or families with children considered to be especially at risk of malnutrition. Therefore, the majority of low income urban families can only be helped by community-level projects.

Project Structures

Most home- and village-level projects aim to help mothers to prepare weaning foods at home. However, some projects may be organized essentially at the village or community level. For example, an organization of local entrepreneurs may produce and distribute weaning foods, or a group of mothers may meet regularly to prepare the essential components, e.g., grind grains into flours, and then combine and distribute them. The mothers preparing the foods may sell small packets at low cost to other mothers. They may be paid by the village, or they may sell the foods on the street or in market stalls. In many developing countries, open-air food vendors are common even in small rural villages. There is a general trend for an increasing proportion of the work force to be engaged in farm-support activity, such as trading or transport, rather than farming itself. The preparation and sale of weaning foods by street vendors, who are common in cities in many developing countries, is a viable method of distribution and often provides work for women.

The Role of the Government

The government can play a primary role in home- and village-level weaning projects by enacting supportive legislation, by providing resources for administration and operation, and allocating funds for other supportive programs, such as primary health care and education, which are necessary for the success of village-level projects.[2] Sometimes the government can also play a secondary role in relation to these projects. For example, a distribution or subsidy program may provide a project with an ingredient for a weaning diet or a government grant may make it possible to purchase a piece of capital equipment, such as a hand mill.

The Essential Steps in Developing Home- and Village-Level Projects

A home- and village-weaning-project team must make a commitment for a sufficient period of time to develop a sound proposal and submit it to field trials. Because weaning foods are most needed where prevailing conditions are characterized by severe economic deprivation, disease, illiteracy among women, lack of sanitation and water purification, and inadequate food preservation and

[2] For a discussion of the government's role in weaning strategies, see Chapter X.

storage techniques, weaning programs directed toward meeting these needs are difficult to initiate and maintain.

To succeed, a home and village food program should be developed systematically with attention to the following components: analysis of food usage and weaning practices; information gathering on food availability; determining the acceptability and nutritional value of new weaning foods; pilot testing of weaning foods in the field; and project implementation.

Analysis of Food-Usage and Weaning Practices

The following information should be obtained on food-use and weaning practices in the project area:

1. the amount of time mothers have available for child care;
2. beliefs and values associated with food;
3. how foods are obtained, prepared, and fed to children;
4. intrafamilial relationships and activities affecting weaning diets;
5. family incomes.

If accurate cultural, social, and economic information is not obtained, a project is likely to fail. For example, a project team has designed an intervention in which buffalo milk is a principal weaning-food ingredient because the target community produces it in large quantities. The project fails, however, when the team attempts to introduce the weaning food and discovers that most of the buffalo milk is demanded by adult males to make cheese, a favorite adult food seldom given to children.

Techniques for gathering data include interviews with prominent community members, observations of family behavior patterns, questionnaires administered to a few selected persons in the target area, and large-scale surveys of random population samples. Data on market prices of foods and seasonal fluctuations in prices and availability are essential for the evaluation of weaning-food costs and feasibility. A complete discussion of the kinds of data that projects must collect and collection techniques can be found in Chapter III.

Information Gathering on Food Availability

The types of food required to produce adequate weaning diets are described in Chapter IV. The project team must assess the quantity and quality of the foods the community has available and seasonal fluctuations in their availability. If ingredients essential for a nutritious weaning diet are not available, or are available only in limited amounts, the team must explore the possibilities of increasing production or introducing new foods.

Projects have come to grief because they failed to anticipate the results of increased demand for key weaning-food ingredients. For example, one project

team promoted a weaning mix composed of both a traditional ingredient, rice flour, and chickpea paste, a new ingredient. After mothers had adopted the weaning mix, the supply of chickpeas became inadequate and the price tripled in the local market.

When excellent sources of protein are scarce and dependable supplies cannot be created, the project team may find it necessary to use ingredients of lesser nutritional value. The following examples illustrate this point:

- In a country where rice is sold for export, cassava, which is not used as a cash crop in any country, may be a better weaning-food base despite its inferior nutritional value.
- Although soy beans are a better source of protein than cowpeas, the latter can be grown in greater quantity than soy in most developing countries.

Determining the Acceptability and Nutritional Value of New Weaning Foods

First, the team must identify potentially adequate mixtures.[3] Second, these mixtures should undergo preliminary testing for taste and acceptability. Third, mixtures selected for pilot testing should be analyzed in the laboratory for their nutrient content before pilot testing is begun.[4]

Pilot Testing of Weaning Foods in the Field

A food that is not consumed has no nutritional value. After a weaning food has been promoted throughout a country, it is too late to discover that the taste is unacceptable; the food turns gummy in the mouths of children; mothers find the preparation requirements too arduous or time-consuming; or the food as packaged becomes rapidly infested with mold or weevils.

A new weaning mix must, therefore, undergo pilot testing in representative households for:

- taste
- palatability
- ease of preparation
- shelf-life
- general popularity

Laboratory, preliminary, and pilot tests may take a year or more. To assure

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[3] Chapters III and IV provide guidance on collecting information relevant to this task and on formulating weaning diets.

[4] Most nutrition institutes and universities with departments specializing in human nutrition perform tests. The Hoviprep project, which has sponsored this manual, has its mixtures analyzed by Dr. Peter L. Pellett, Professor of Nutrition, Department of Food Science and Nutrition, University of Massachusetts, Amherst, MA 01003.

success, nutritional planners must overcome their eagerness to launch a project before all necessary preparations have been completed.

Implementing the Project

Community participation Projects that are imposed on a community seldom are successful initially and are even less likely to endure. To obtain not merely the cooperation of a community but its active whole-hearted participation, a systematic and patient approach, first to its leaders and as rapidly as possible to the entire community, is required. The project should then continue to involve the community so that eventually the project becomes self sustaining with only modest external support or none at all.

The project must be fully explained over and over until all questions have been answered and clear potential benefits to the individuals and the community recognized. These benefits may be the primary objective of the program but there may also be secondary benefits which make it more acceptable. Among the most popular will always be medical and dental assistance beyond that already available. Where this is impractical, other collateral benefits should be found. For example, there may be activities for which the community is seeking assistance or other felt needs that the intervention project can help meet. Even the collection of information may be well accepted if the participants are convinced that this may help them to get more government help or better government policies in the long run. However, such possibilities should not be presented in unrealistic or overly optimistic terms.

Introduction of new weaning practices It is extremely important to train people how to introduce new weaning practices and diets. The most effective change-agents are community residents, for example, health workers, agricultural extension workers, or mothers. To achieve a project's goals, change-agents must usually expect to work for a long time in the community.

Obstacles to change Because of space limitations, this chapter will only mention some of the major obstacles to the adoption of new weaning practices by mothers in developing countries. The following cultural and natural factors impede changes in old habits:

1. *Illnesses that interfere with the benefits of improved nutrition.*[1] Mothers may not see a relationship between improved health and sound nutrition because of the high incidence of diarrheal and other diseases in developing countries, attributable in part to a lack of personal hygiene and to

[1] This list has been drawn in part from observations reported in "Cultural Influences and Reinforcement Strategies" by G. Guthrie, H. Guthrie, T. Fernandez, and N. Estrera in *Behavior Therapy* 13(1982):624-637. This article includes more intensive discussion of factors 1 through 4 mentioned above and of other impediments to success in a field experiment in the Philippines.

poor environmental sanitation and contamination of water supplies.

2. *Delay between improved nutrition and growth.* This factor, coupled with the first factor mentioned above, may cause mothers to feel that their efforts to improve diet are not affecting their children's growth or health.
3. *Explanations for poor growth that are unrelated to improved nutrition.* Mothers may believe that heredity and or illness, not nutritional deficiencies, are causing poor growth.
4. *Conflicting belief systems.* Mothers may believe that children should not be fed while they are ill or their concepts concerning the prevention of illness through improved nutrition may be limited.
5. *The social importance of existing weaning behaviors.* Weaning behaviors that are detrimental may be reinforced by their cultural importance, for example: sexual identity is enculturated by differential weaning practices in some cultures.[6]
6. *Superior attitudes of interviewers or other project members.* Superior attitudes of project members may cause mothers to resist changes project members suggest.

Caveats for change Some apparently harmful or erroneous traditional beliefs may have beneficial functions. Postpartum sexual abstinence, for example, may mistakenly be thought necessary to keep mother's milk fresh; nevertheless, refraining from sexual relations is a failsafe method of birth spacing, which may contribute to the health of both mother and child. The project team, therefore, should devise weaning interventions that do not interfere with the potentially positive effects of such traditional practices.

Means of change The most effective means of change are strategies grounded in a people's own motives and priorities. Moreover, educators accepted and revered by a culture, such as a native healer or a medicine man, are more likely to effect (or prevent) behavioral changes than outsiders.

In Chapter III, we have indicated those attitudes in fieldworkers that are the most important ones for long-term project success. They include open-mindedness, a spirit of humility, and an attitude of respect toward the community. We have also stated that without warmth, sensitivity, and compassion, fieldworkers will be far less likely to achieve the trust of community members, to learn what they need to know from the community, and to help bring about changes in weaning practices and diets.

Community and institutional support for new weaning diets A project has the greatest chance of success if community groups and social institutions promote

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[6] For a discussion of the reinforcement of weaning patterns by cultural rules, see Chapter I.

[7] See Chapter I for an example of such a tactic.

a new weaning diet. These groups may include health-care personnel, such as family planning and public health workers, agricultural workers, social and religious groups, and trade unions. Especially important in past projects have been local mothers' clubs. If there are none in an area, a project team can organize them.

The role women can play as promotional agents must be defined on a case-by-case basis. Social status, quality of education, and professional educational standards vary greatly for women from one country to another. The following examples illustrate these considerations:

- Most Moslem women in Arab countries have low social status relative to men and, therefore, are severely limited in changing community practices except those that strictly involve only other women. However, they can adopt new practices in their own homes.
- Nurses in some regions, such as Latin America and tropical Africa, are excellent promotional agents because they are well trained and their status is high.

Throughout the world, successful promotional agents have included traditional birth attendants, family planning workers, village dispensary attendants, and community development workers.

A SUCCESSFUL PROMOTIONAL AGENT for a new weaning diet may be a traditional birth attendant.

Case Studies

The following case studies illustrate the process of introducing new weaning diets.

Nepal

Information on nutritional status There were three principal sources of information concerning the nutritional status of weaning-age children in Nepal:

1. Widespread observations of kwashiorkor suggested that other diseases related to malnutrition were probably also present throughout the country, although data concerning other diseases were not available.

2. Data from two sample surveys in the mid-1970's using weight-for-age measurements in preschool children indicated that the vast majority of children were malnourished. One of these, a study sponsored by the World Health Organization (WHO), reported that of 1,044 children in 17 sites, 70% were malnourished.[8] Another study, cosponsored by the Nepalese government and the Agency for International Development (AID), found nearly the same level of malnutrition using the Indian Academy of Pediatrics standards.

3. Collateral data from several sources showed high levels of diseases related to malnutrition other than kwashiorkor, including nutritional anemia, goiter, and xerophthalmia.

Donated food aid In the early 1970's the government and voluntary groups promoted distribution of donated foods, such as dried skim milk, corn-soy-milk, and wheat-soy blend.

In a district outside Kathmandu, the staff of a community health program distributed donated foods. The staff encountered problems often associated with food-distribution projects, including difficulties of transportation over rough terrain, spoilage, mothers' resentment of food-distribution priorities, and the lack of development among the mothers of initiative and self-reliance.

The distribution of powdered milk was particularly problematic, since it was consumed by adults or sold for profit without aiding the children. In addition, some mothers terminated breast-feeding earlier than was advisable because the powdered milk was available.

Home-made weaning foods In response to the problems caused by donated foods, the health-program staff decided to develop a home-made weaning food substitute for the donated foods. In the process, they carried out each of the five

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[8] The WHO study used Harvard standards to designate children as malnourished if they were less than 80% of the standard weight for age. By the Gomez classification, children weighing less than 90% of their weight-for-age are considered malnourished, so that even more than 70% of the children surveyed would fall into this category.

steps outlined above, which are imperative for the success of home and community level projects.

Analysis of food-use and weaning practices The staff made observations on cultural patterns and practices related to weaning, the most important of which were as follows:

1. the work patterns of Nepalese families, including the practice of imposing greater work loads on women than men;
2. the ritual weaning of five-to-six-month-old infants with complementary foods;
3. the low nutrient content of the complementary foods, which contained a bland rice porridge;
4. traditional restrictions on foods thought to have a negative influence on a person's behavior.

In 1973, the staff conducted a nutrition survey for a year in two villages in the district to identify foods used in homes and to define infant-feeding practices. General findings were that breast-feeding continued for an appropriate period and complementary foods were introduced at appropriate times. These complementary foods, however, contained insufficient calories, so that protein available in the diets was being used to produce energy.

The study also found that some valuable traditional foods were being replaced by less nutritious ones, such as polished rice, causing vitamin B deficiency diseases. Finally, the study reported that advertising campaigns were promoting the use of imported milk formulas and feeding bottles, resulting in a rise in diarrhea.

Food availability The survey revealed that during the greater part of the year most families had adequate food available, including cereal and legumes, which were grown at home or bought at affordable prices from local markets.

The nutrition workers observed that older community residents prepared a popular snack by roasting cereals and legumes, grinding them into a powder, and mixing it with milk or water. The staff decided the mixture might be an excellent model for a weaning food. The community clearly accepted it. Further, its ingredients contained complementary proteins[9] and were roasted to destroy toxic components. Therefore, they evaluated the nutrient values of several combinations of these ingredients, using international food tables.

Laboratory testing The mixtures having the highest nutritional values were sent for testing to the Food Research Laboratory in Kathmandu, the National Institute of Nutrition in Hyderabad, India, and the Central Institute for Nutrition and Food Research in the Netherlands. The laboratories confirmed the staff's computations. The weaning mixture providing the best protein and

[9] See Chapter IV.

calorie levels at a relatively low price was composed of two parts roasted legume (preferably soybeans) and one part each of two cereals (often roasted wheat and corn, with rice as a possible substitute). One hundred grams of the mixture would provide 350 to 375 calories at the cost of about US $.03 in 1982.

Pilot testing The mixture, called Super Flour (*Sarbottam Pitho*), was introduced on a pilot basis using an ingenious method of substituting the mix for powdered milk. The phase-over began with letting the donated Corn-Soy-Milk supply run out. Mothers were told that they could make a similar product by roasting corn or wheat and grinding it and that the clinic would add the nonfat dry milk to the flour. To receive the free nonfat dry milk, a mother had to bring 600 g of flour to the clinic. A nurse then added 200 g of nonfat dry milk and thoroughly mixed it into the grain flour. This mixture was a supply adequate for one week.

The nurse also gave careful instructions to the mother concerning how to prepare and give the food as a porridge to her young child.

When the nonfat dry milk supply ran out, mothers were taught to enrich their home-made flour with roasted soybean flour. The clinic staff told mothers this product was more beneficial than the Corn-Soy-Milk or the milk powder. Because they saved time from no longer having to distribute food, the clinic workers could then do follow-up home visits to ensure that mothers were properly preparing the *Sarbottam Pitho* and feeding it to their children.

Project implementation Based on the success of the pilot project, a number of interventions were begun in the country with support from the Nepalese government, the United Nations International Children's Emergency Relief Fund, and other agencies. These programs integrated the new weaning diet with other nutrition and health activities, such as growth monitoring. Nutrition education programs promoting child-feeding practices, basic health measures, oral rehydration therapy, immunizations, child-spacing, and home hygiene also fostered use of the new diet in conjunction with breast-feeding.

The Ministry of Health in Nepal is now working toward an integrated program of health and nutrition services and is training primary health workers to promote the new weaning diet.

Evaluation A comprehensive up-to-date evaluation of the Nepal project has not been carried out. However, in the districts where trained staff were used, striking results have been recorded: the number of children in the normal nutritional range has doubled after three years, and infant mortality rates have decreased by more than half. In areas where government educational posters alone were used, progress has been much slower. The following assessment of the program was made in a 1978 study. Of the health facilities surveyed, 32% were giving demonstrations of the new diet, 22% of the households sampled

knew about the diet, and of these, 4% said they had used it. Evaluation data more recent than 1978 are not available, although several studies suggest that a smaller-than-expected number of mothers are continuing to prepare the *Sarbottam Pitho*. Seasonal food shortages, scarcity of resources, and limitations on mothers' time have been given as reasons for this finding.

Thailand

Nutritional status and diets In 1976, a research team from the Institute of Nutrition at Mahidol University in Bangkok evaluated the nutritional status of a random sample of 202 preschool children in a village in Northeast Thailand. Weight-for-age measurements indicated that more than half of these children were undernourished. By asking village mothers to recall their children's diets over the last twenty-four hours, the research team discovered that the children's food contained only 60% to 80% of the standard energy requirement as established by the Food and Agricultural Organization (FAO) and World Health Organization in 1973. Of the total energy in these foods, 80% to 85% was supplied by carbohydrates, 4% to 8% by fats, 8% to 12% by protein. Rice and vegetables supplied about two-thirds of the protein. The research team concluded that the diet could be substantially improved by increasing the amount of fat and improving the quality of protein.

Weaning-food recipes The formulation of seven supplementary food mixtures was based on the Thai Standard for Infant Foods.[10] All contained a rice cereal base. Four combined the base with legumes (soybeans, groundnuts, sesame, or mung beans) and three with fish meal (Table 1).

Laboratory testing The Institute of Nutrition at Mahidol University and Ramathibodi Hospital Research Center in Bangkok tested the seven recipes. The nutrient composition of each recipe is shown in Table 2, and the amino acid scores for Formula I are presented in Table 3. The food mixtures prepared from these recipes may be kept for six to eight weeks without evidence of spoilage or overgrowth of microorganisms.

Preparation of the formulas and pilot testing The Figure shows how the weaning recipes containing rice, beans, and groundnuts or sesame were prepared. Either electrical or manual grinders can be used for grinding the ingredients. Electricity and an electric grinder were available in the village where the first pilot test was conducted. After the ingredients had been ground, the mixtures were packed and sealed in small plastic bags in amounts of either 100 g or 250 g. The ground mixture could be cooked by boiling in three times its volume of water for 10 to 15 minutes.

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[10] According to the Thai Standard for Infant Food, protein should not be less than 2.5 g per 100 available kcal of standard protein, and the amino-acid score should not be less than 70% of the FAO/WHO reference pattern. Linoleic acid should be not less than 300 mg per 100 available kcal and fat, not less than 2 g nor more than 6 g per 100 available kcal (Ministry of Public Health, Thailand, 1979).

Table 1

Ingredients and Composition of Seven Thai Weaning Recipes

Formula	Ingredients		Composition per 100 g		
			protein (g)	fat (g)	energy (kcal)
I	rice, soybeans, groundnuts	(70-15-15)*	16.5	10.6	437
II	rice, soybeans, sesame	(70-15-15)	14.8	11.0	448
III	rice, mung beans, groundnuts	(60-15-20)	14.5	11.9	443
IV	rice, mung beans, sesame	(60-20-15)	13.2	13.2	451
V	rice, fish meal, groundnuts	(70-10-20)	18.5	11.8	454
VI	rice, fish meal, sesame	(70-10-15)	17.2	10.4	444
VII	rice, fish meal, oil	(70-10- 8)	14.4	9.2	437

*Numbers in parentheses indicate the proportion of the individual ingredients.

Table 2

Nutrient Content of Thai Weaning Recipes, Per 100 kcal

Formula	Protein (g)	Fat (g)	Linoleic acid (mg)
I	3.77	2.43	1216
II	3.30	2.46	1232
III	3.34	2.69	1340
IV	2.92	2.22	1108
V	4.01	2.59	1300
VI	3.87	2.34	1171
VII	3.41	2.11	1054

Table 3

Amino-Acid Scores of Thai Weaning Recipe (Formula 1)

Ingredients	Protein (g)	Amino Acids (mg)						
		Iso-leucine	Leu-cine	Ly-sine	S-AA*	arom AA**	Threo-nine	Val-ine
rice (70 g)	4.7	207	407	178	181	398	164	286
soybeans (15 g)	5.7	283	485	398	162	504	240	299
groundnuts (15 g)	4.3	99	188	104	70	260	76	122
total	14.7	589	1080	680	413	1162	480	707
per g protein		40.1	73.5	46.3	28.1	79.0	32.6	48.1
AA score		100	105	84	80***	132	82	96

*S-AA = sulfur-containing amino acids

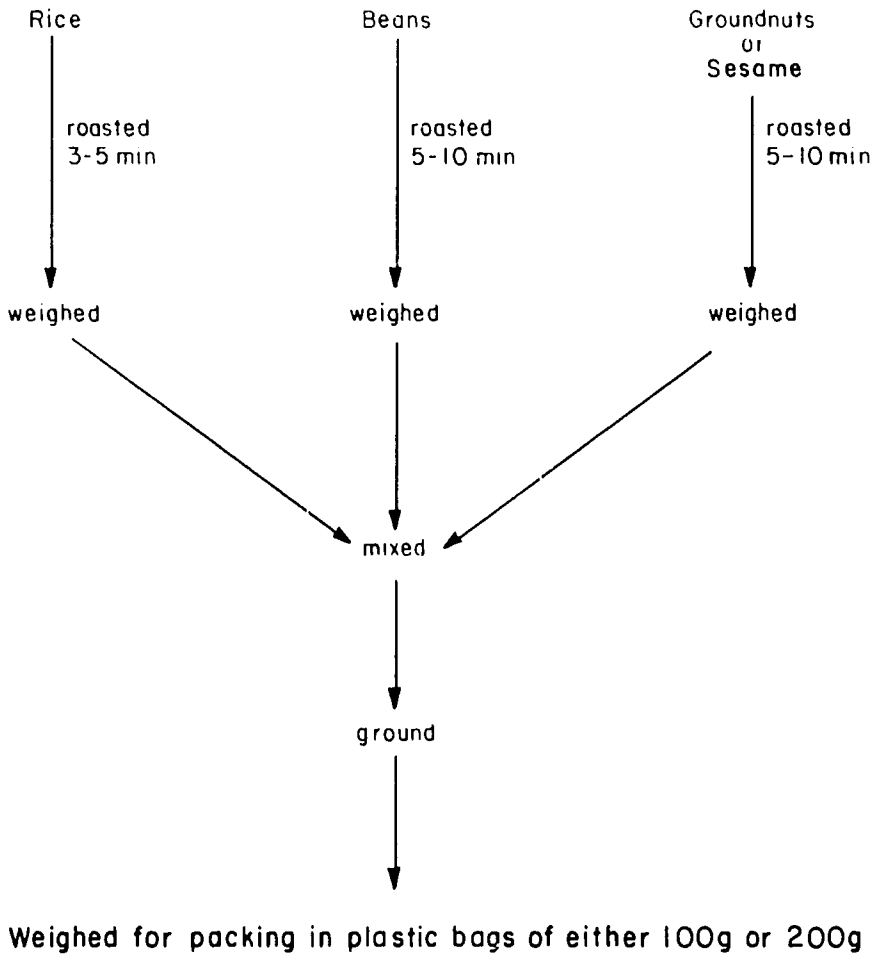
**arom AA = aromatic amino acids

***AA score of Formula 1 is 80.

Preliminary tests in six villages showed Formulas I-IV (Table 1 and Figure 1) were acceptable to mothers and well tolerated by weaning-age children. In two villages of Nong-Khai the nutritional status of the 202 infants and preschool children who were tested improved significantly. The proportion of children who were normal and healthy according to weight-for-age measurements increased from 45% to 79% within a period of 18 months.

Project implementation After the pilot tests were completed, the World Bank provided support for the introduction of the weaning formulas in 90 villages. The pilot program was co-directed by the Ministry of Health and the

Figure 1
Preparation of Thai weaning recipes



Institute of Nutrition at Mahidol University with support from the Department of Agriculture and Education Extension.[11]

In Bangkok the mission of the United States Agency for International Development later provided support to enable the Ministry of Health to extend the project to an additional 1200 villages over an 18-month period, with another 600 villages to be covered in the following year. The expanded projects followed the principle of community self-reliance and were carried out by villagers under the supervision of local offices of health, agricultural extension, community development, and education. The Royal Thai government has also provided villages with grants to be used as revolving funds. Commodities and plastic bags are purchased initially with the small grants, and the money from the sale of the mixes replenishes the funds. The extent to which this system will prove to be self-sustaining has yet to be determined.

For a project to succeed, effective nutrition education is essential. Educational activities have received support from private sources.

Weaning-formula production and distribution The most distinctive feature of the project was that nutrition cooperatives were successfully organized by village leaders and local health workers to produce and distribute the mixes. Villagers were both able and motivated to prepare, mix, and package the formulas themselves. In a typical village, from three to seven villagers, men and women, meet once every one to two weeks to roast, grind, and package the weaning formulas. The packets are either distributed free to other mothers of malnourished children or sold at a low price. The project, therefore, has the potential to generate income.

Integration with other projects In most villages the intervention has been integrated with related activities, including basic health services, growth monitoring of young children, nutrition education, promotion of home gardening, family planning, and environmental sanitation. In most villages, health cooperatives were also established to provide essential medicines at low cost and to initiate preventive measures. In some, agricultural cooperatives have also been established.

The extent to which activities such as basic health services, growth monitoring, and nutrition education have actually been integrated varies considerably. Although it was originally planned that raw ingredients would be grown locally for the preparation of the complementary foods, in practice raw ingredients have usually been purchased. Buying ingredients appears to be a more practical solution where these raw materials are available.

Evaluation No formal evaluation has as yet been conducted. However, two

[11] See Chapter X for a discussion of joint efforts between government and private agencies and universities.

years of field experience seems to indicate the fish meal mixes were used less than the other weaning mixes because fish is not so widely available as legumes. One of the factors that will determine the project's success is whether the revolving fund system continues to work so that village cooperatives remain self-sustaining and relatively independent of larger economic forces.

The initiatives of villages not in the program to establish their own cooperatives is most encouraging.

Indonesia

In 1978 a study issued by a private foundation reported that one-third of preschool children (about 22 million children) suffered malnutrition. About 600,000 of these were severely malnourished. Anemia was also found to be widespread among women of child-bearing age.

Food-use and availability studies To obtain information on food use and availability, interviews were held with key informants, such as village leaders, village health workers, and older mothers. Baseline studies showed that adequate food was available, but that it was inadequately used. Other findings were as follows:

1. The fathers and adult males received the largest portions of the daily meals;
2. Children received reasonably adequate meals one to three times a day;
3. Traditional customs prohibited the use of fish products by women and children, although fish was widely available;
4. Locally produced foods of high nutritional content included cereals (rice and maize), legumes (principally soybeans), papaya, carrots, potatoes, yellow squash, and a number of green leafy vegetables, and eggs;
5. Animal milk was not widely used, but soy products were available, including soya milk and tahu.

Nature of the project From 1974 to 1977, the Indonesian Family Nutrition Program fostered training the mother herself to fill the role of principal change agent instead of the healthworker or clinic personnel. The project team organized and trained volunteer mothers to promote both the use of existing foods to make nutritious weaning formulas and also regular growth monitoring of children's weight-for-age.

Weighing scales At first, imported scales were used in Indonesia for growth monitoring in weaning-food projects. They were difficult for villagers to read and repair. Later, local market scales were used successfully because they are found in most villages and their owners were usually willing to weigh the children. Now, locally produced, inexpensive balance scales are used and reported to be adequate.

Interagency cooperation The Ministry of Health, the Ministry of Agriculture, and the Ministry of Religion have all participated in the weaning-food interventions in Indonesia. These agencies have formed institutional linkages throughout the country, but this network has suffered from the weakness of conflicting administrative orders, particularly concerning nutrition education and growth monitoring techniques.

Evaluation The Indonesian program is nearly ten years old and has not yet been formally evaluated on a national scale. Day-to-day monitoring of area project activities, however, has been well maintained with volunteer village workers recording the number of weaning-age children, the number weighed, and the number who have gained weight over the previous month.

(Photo by Miriam Krantz)

IN GENERAL, PROCESSED WEANING FOODS should be used as complements to breast-feeding, not as replacements for it.

Chapter VII*

Processed and Packaged Weaning Foods: Development, Manufacture, and Marketing

Introduction

The idea of developing local low-cost processed foods, rich in protein and energy and suitable for feeding to young children and other vulnerable groups, arose in the early 1950's.[1] Grains, legumes, and oilseed meals produced within a given country could be formulated into nutritious mixtures and distributed through commercial channels. The idea was that availability on the commercial market should have the advantages of greater outreach to populations in need than would availability through food distribution programs. Children between the ages of six months and two years of age and pregnant and lactating mothers would be the principal targets. Low-cost commercial foods based on nonanimal ingredients would also be more accessible to consumers with little purchasing power than relatively expensive products containing milk.

Processed weaning foods are also alternatives to home- and village-prepared products. Although both are typically made from raw materials grown within a country, packaged foods save a mother time and labor. On the other hand, packaged weaning foods are more expensive and, unlike home- and village-prepared foods, require subsidizing if they are to reach those unable to afford them at commercial market prices. When affordable, these products are particularly useful to urban mothers who must work outside the home.[2]

Additional advantages of a processed weaning-food project are that it can

* The primary contributors to this chapter were Ricardo Bressani, Jud Harper, and Bo Wickström.

[1] As is discussed in Chapter IV, *complementary foods* are those used in addition to breast milk. Foods used as replacements for breast milk are not recommended unless a mother cannot feed her baby adequately with her own milk, for example, because she works outside the home, or her own milk supply is inadequate, or her baby's ability to suckle is compromised by illness.

[2] See Chapters X and VI for more extensive comparisons of the major weaning-food strategies.

serve as a stimulus for local agriculture and the domestic food-processing industry, as a nutritional model for other processed foods, and as an educational vehicle when foods are appropriately promoted and packaged.

International Experience

In the 1960's a number of processed weaning-food projects were begun in Latin America, Africa, the Middle East, and Asia. Some were sponsored by governments and the United Nations; others were organized by food industries. Only a few of these projects achieved a significant sales volume measured against their market potential. These experiences indicate that careful project planning and implementation are required for success.[1]

Among the surviving projects are: Incaparina in Guatemala, Colombiharina and Duryea in Colombia, Superamine in Algeria and Egypt, Faffa in Ethiopia, and Pronutro in South Africa. Recently, projects such as Thriposha in Sri Lanka and Cerex in Guyana, using low-cost extrusion for the local production of nutritious foods, have been successful (Table 1).

The Two Principal Types of Processed Foods

There are two major varieties of industrially produced weaning foods: traditional foods, enriched or supplemented to improve their nutritional content, and specially developed new foods of high nutritional quality. To develop supplemented products, a country must already have an ongoing food manufacturing industry. Foods are selected for fortification and specific nutrients added during manufacture. This alternative may be less expensive than producing a new weaning food, which requires either modifying or developing an industry capable of processing blends of cereals and protein-rich ingredients into human food.

For readers already familiar with the various food processing options, criteria useful in selecting among various processing systems are presented in Table 2. These criteria include capital and operating costs, time and cost for maintenance; and energy, skill, and sanitation requirements. For readers who desire background information and a general orientation, the following sections contain guidelines for food fortification and discussion of some of the considerations involved in planning a commercial weaning-food project, including: setting goals, selecting and refining product concepts, selecting and testing ingredients, product testing, processing alternatives, and marketing.

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[1] Elizabeth Orr of the Tropical Products Institute in London has made two evaluations of protein-rich food projects: *The Use of Protein-Foods for the Relief of Malnutrition: An Analysis of Experience* (1972) and *The Contribution of New Food Mixtures to the Relief of Malnutrition* (1976). Both reports are available from the Tropical Products Institute, 127 Clerkenwell Road, London EC1R 5DB, England.

Table 1

Some Information on Selected Processed Weaning-Foods

Product	Ingredient	Processing Method	Product Form	Marketing Method	Packaging	Size of Package	Years on Market
Incaparina (Guatemala)	Processed corn and cotton seed flour, vitamins and minerals	Mixing of ingredients	Mixed Processed	Free and Government	Paper Plastic	460 g 75 g	22
Maisoy (Bolivia)	Corn Whole Soy	Extrusion	Flour Flakes	Free and Government	Plastic Box		7
Bienestarina* (Colombia)	Rice Soy Milk	Extrusion	Flour	Government	Plastic	kg	10*
Chicolac (Bolivia)	Rice Milk	Spray drying	Flour	Free	Plastic	500 g	1
Torti-Rice (Costa Rica)	Lime-treated corn Soy	Mixing	Flour	Free	Plastic		7
Thriposha (Sri Lanka)	Corn Whole Soy	Low-cost Extrusion	Flour	Free and Commercial Sales	Plastic	454 g	6
Cerex (Guyana)	Corn grits Rice Soyflour Oil Nonfat dry milk	Low-cost Extrusion	Flour	Free and Commercial Sales	Plastic	454 g	3

*Bienestarina is no longer on the market.

Table 2

Comparison of Alternative Processes for Weaning-Food Production

Process	Production Capability Range MT/hr	Capital Cost/MT[1] $ × 10-[3]	Operating Cost $/MT[2]	Type of Food Product
Extrusion				
1. Low Cost	0.5 - 1.0	200 - 250	125 - 200	Precooked, coarsely ground flour for preparing gruels by adding water
2. Other	2.0 - 4.0	250 - 400	100 - 200	Precooked, coarsely ground flour for preparing gruels by adding water
Roller-Drum Drying	0.3 - 1.0	400 - 500	300 - 500	Precooked, instant soluble flakes for gruel or liquid supplement
Spray Drying	0.3 - 1.0	400 - 500	300 - 500	Precooked instant soluble powder for preparation of liquid supplement
Baking	0.5 - 4.0	150 - 250	200 - 300	Cookies, crackers, and biscuits. Product can be broken and mixed with water or milk to make a gruel
Liquid Processing	1.0 - 4.0	80 - 150 (wet product)	150 - 250	Liquid beverage in either diluted or concentrated form
Milling	0.5 - 5.0	75 - 125	50 - 125	Raw, ground meal that may be fortified. Preparation requires cooking with boiling water.

[1]Includes equipment, installation, and building.
[2]Includes labor, depreciation, energy, and utilities.

Table 2 (Continued)

Comparison of Alternative Processes for Weaning-Food Production

Type of Package	Max. % of Local Equip.[3]	Maintenance Time/Cost[4]	Energy[5]	Processing Moisture	Skill[6] Requirements	Sanitation Requirements[7]	Stability[8]
poly/paper bag	70%	M/M	M	<18%	L	L	H
poly/paper bag	50%	M/L	M	20 - 30%	M	M	H
poly/paper bag	40%	M/H	H	70 - 90%	H	H	H
poly/paper bag, can	40%	M/L	H	70 - 90%	H	H	H
paper bag/box	30%	L/M	H	25 - 35%	M	M	H
paper carton, can, bottle	0%	M/H	M	80 - 90%	H	H	M**
poly/paper bag	90%	L/L	L	<15%	L	L	L

[3]Maximum percentage of required equipment that may be purchased from local manufacturers.
[4]Maintenance time: L - 10% of time M - 20% of time H - 30% of time
Maintenance cost: L - $2/MT M - $2-5/MT H - $5/MT
[5]Processing energy used.
[6]Level of operator skill required: L - unskilled with mechanical ability; M - mechanic; H - machinist.
[7]Indicates the level to which wet sanitation procedures are required: L - none; M - some; H - high.
[8]Stability in package (*becomes low once package is opened).

Fortification of Traditional Foods

Food fortification is the addition of nutrients to a food. In most cases, the nutrients added should not affect how the food is prepared or used or how it tastes or smells. An example of fortification is the addition of soybean protein to corn for tortillas. As Table 3 illustrates, protein supplements are typically added in very small quantities.

The choice of a traditional food to fortify must be made carefully: one criterion is that the food be an important part of the diet. Another is that the food must already be produced at a central location or locations.

Guidelines for fortification that assure nutritional quality, acceptability, and consumer access are:

Quality

- Nutrients should be added in proportions that improve the nutritional quality of the *whole* diet.
- New ingredients should not interfere with efficient utilization of other nutrients in the diet.
- The effect of traditional food-preparation methods on the biological utilization of the added nutrients must be considered.
- In case of doubt, the nutritional value of the fortified food can be assessed with chemical and biological assays.

Acceptability

- The added ingredients should not change the flavor, texture, color or

Table 3

Minimum Amounts of Various Protein Supplements That Will Improve the Nutritional Quality of Cereal Grains and Starchy Foods

Cereal grains and starchy foods to which protein is added	Minimum proportions of protein supplements (% of mixture)									
	Egg (%)	Casein (%)	Meat (%)	Fish (%)	Soy protein (%)	Soy flour (%)	Cottonseed flour (%)	Yeast (%)	Beans (%)	Milk (%)
Corn	3	4	4	3	5	8	10	3	20	10
Sorghum	-	-	-	-	-	8	-	-	-	-
Rice	-	6	-	6	-	8	12	8	15	12
Whole wheat	-	4	-	-	-	6	10	4	-	6
Wheat flour	-	6	-	-	-	10	12	6	-	10
Plantain	-	-	-	-	-	-	-	-	30	-
Cassava	-	-	-	-	-	-	-	-	30	-

Table 4

Mixture by Weight of Two Ingredients for Weaning Foods That Give Maximum Improvement in Protein Quality

Rice/Beans	40/60	Maize/Milk	50/50
Oats/Beans	60/40	Opaque-2 Corn/Milk	65/35
Wheat/Beans	50/50	Corn/Soybean	70/30
Wheat Gluten/Beans	60/40	Corn/Cottonseed	56/38
Bread/Beans	60/40	Soybean/Beans	40/60
Egg/Beans	50/50	Sesame/Yeast	80/20
Sesame/Peas	40/60	Cottonseed/Yeast	60/40

method of preparation in an unacceptable way. This general guideline should not be interpreted to mean that change is necessarily bad. There are numerous examples of foods with foreign flavors that became popular for this very reason.

Access

- The cost of the supplemented product must be similar to that of the traditional product.

Development of New Weaning Foods

The principles for formulating new industrially processed weaning foods are the same as for those made in the home.[4] The basic ones are to provide (1) energy density, (2) good quality dietary protein from the complementary effect of combining two or more lower quality sources (Table 4), and (3) appropriate vitamins and minerals.

Weaning-Food Specifications

PAG Guideline No. 10 is the best recognized standard for the composition of commercial weaning foods.[5] Nevertheless, their protein contents are quite

[4] Chapter IV and Appendix 2 contain discussions of this topic. Energy density can be provided by fats, oils, and sugars and can be increased by using malted grains. The appropriate mixing of protein sources, usually from plants – a cereal grain and a legume or oilseed – can provide all of the amino acids in the proportions necessary for the synthesis of human body protein. Vitamin and mineral fortification should be based on the needs of the target population. In Egypt, for example, a large percentage of preschool children are anemic. Iron would, therefore, be an important ingredient in weaning foods for Egyptian children.

[5] Protein-Calorie Advisory Group of the United Nations System, "PAG Guideline No. 10, Marketing of Protein-Rich Foods in Developing Countries," in *PAG Compendium* 14/10:G, NY: John Wiley & Sons, 1975, pp. 405-500.

variable, ranging from 16% to 28%. As a general rule, when protein concentration is lower, it should be of higher quality. Nutrient density is an important consideration for weaning foods because the amount of food an infant can consume at one feeding is limited by his small stomach.

Table 5 contains typical specifications for nutrient content and quality and bacteriological quality. In addition, physical characteristics, such as consistency, dispersion properties, flavor, texture, and the infant's ability to swallow, should be considered. An ideal product would not require refrigeration or special storage and would be easy to prepare as a gruel.

Planning a Commercial Weaning-Food Project

Careful planning can prevent problems in carrying out a project. At the outset of a project, goals, plans, budget, and a system for monitoring and evaluation should be determined.

Objectives

To set goals for a project, populations or communities most in need of improved weaning foods should be identified. Consumer needs should be determined at the outset. If there are several potential consumer groups with different needs, appropriate product variations should be developed. Expecta-

Table 5
Specifications for High-Quality Weaning Foods

Test	Minimum	Maximum
1. Bulk Density, g/cc	0.55	0.75
2. Proximate analysis:		
Moisture, %	—	10.0
Protein (N × 6.25), %	16.7	—
Fat, %	6.0	—
Fiber, %	—	2.0
3. Energy, Kcal/100g	375	—
4. Total bacteria/g[1]	—	50,000
5. Aflatoxin ppb	—	20
6. Particle size distribution:		
% Pass[2] - U.S. No. 6 screen	99%	—
% Pass - U.S. No. 30 screen	—	92%
% Pass - U.S. No. 60 screen	—	60%
7. Sensory properties: normal color, aroma, flavor and texture		

[1]No salmonella, *E. coli*, or coagulase-positive Staphylococci should be present.
[2]% Pass refers to the particle size of the substance in terms of its tendency to pass through screens with grids of standard size.

tions for sales and sales growth, market share (if applicable), return on investment, net income, and cash flow should also be delineated. Overall, the aims must be flexible so that they can be continually reassessed and revised as necessary.

Goals can be stated either in general or quantitative terms. The following are examples of general objectives, which can be translated into specific measurable terms:

1. Improving diets and nutritional status of groups with greatest needs
2. Increasing nutritional awareness and improving dietary habits
3. Stimulating growth of new crops
4. Serving as a role model for the food industry in terms of food production, composition, packaging, and labeling.

A statement of project goals is not only important for planning but also for evaluation.[6]

Planning

It is essential to have a formal written business plan for a proposed project, even though the processed and packaged foods project may not be a commercial venture. This plan sets objectives; defines target consumers; assesses competition in the broad sense of alternative feeding practices as well as products; and outlines marketing strategy, distribution, sales, and pricing policy. It is tempting to shorten or omit this step, but a thoughtful realistic business plan is essential for the success and longevity of the venture. The strategy should be flexible so it can be refined as the project is actually implemented.

Budgeting

Resources and expenditures for the proposed plan must be estimated on an annual basis, taking into account inflation and possible changes in expenses over time.

Evaluation

A monitoring and evaluation system should be ongoing throughout the project to assess whether goals for sales, profits, and consumer impact are being achieved. In addition, evaluation of whether existing nutrition problems are being ameliorated should be ongoing.[7]

Preliminary Studies

The national setting of a processed weaning-food project should be appraised to determine if the project is compatible with the country's development goals.[8]

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[6] See Chapter IX and Appendix 4.

[7] See Chapter IX for a discussion of a project-monitoring and evaluation system.

[8] See Chapter X for guidelines for evaluating the relative strengths and weaknesses of several weaning-food strategies.

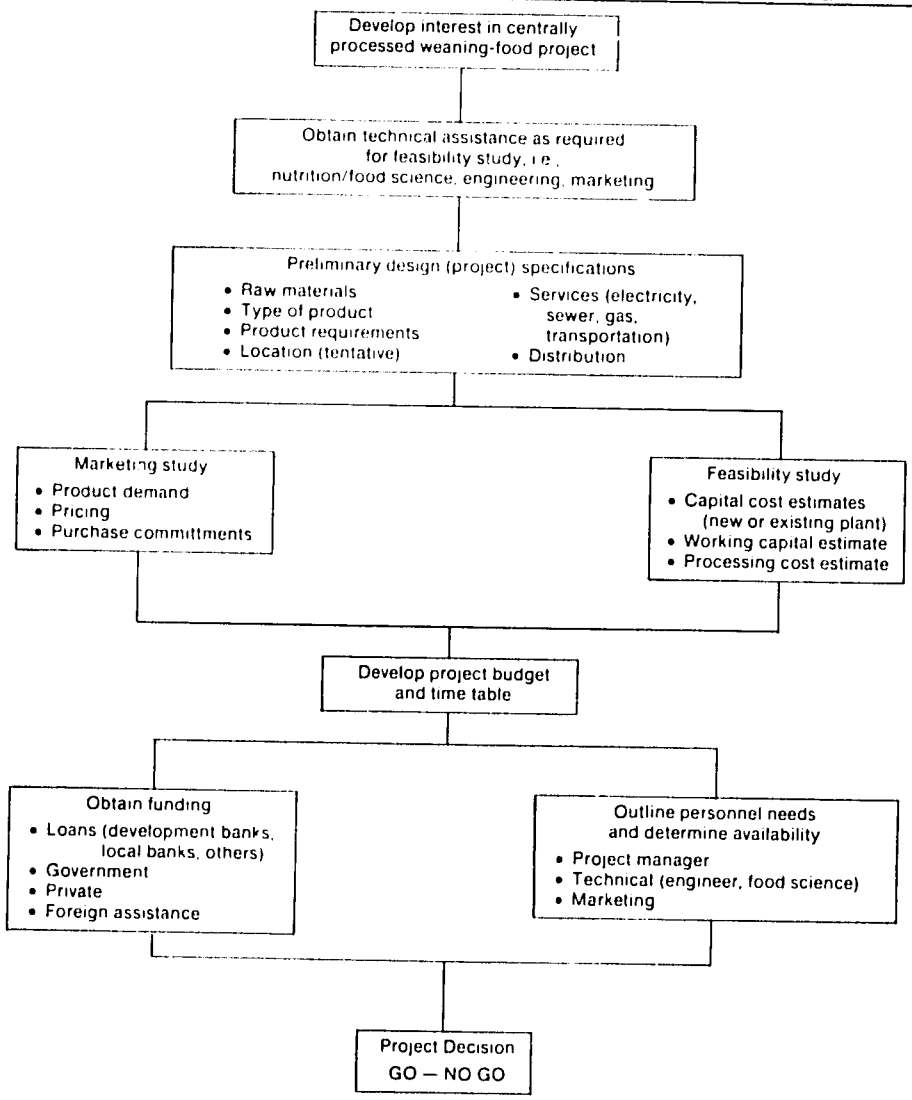
A comprehensive feasibility study to evaluate nutrition, marketing, and engineering problems is generally required.

Figure 1 illustrates the steps necessary to undertake a project successfully and shows the interrelationships between these activities.

Marketing and feasibility studies Management consultants should be engaged to analyze the market and competition and to perform a feasibility study, which will realistically estimate product demand, pricing, capital costs, and other

Figure 1

Preliminary study steps for planning production of processed weaning foods



factors (Figure 1). Such information is critical for project success because it is used to estimate the amount of capital that must be raised. A project will fail if capital is insufficient to sustain it. On the other hand, it may never be initiated if capital estimates are excessive.

Funding Sources of funds should be carefully examined. Bank and government loans, private voluntary agencies, and foreign assistance (Figure 1) are conventional sources. More innovative financing could involve utilizing resources of the recipients themselves. Such self-sustained financing has the advantage of involving participants in a meaningful way.

Staffing Manpower needs should be estimated, and key personnel lined up and ready for hiring even before the project is financed.

Product Selection and Development

Product Ideas

Tentative product ideas or product concepts are developed in the planning stage of a project. Development of a product concept entails describing the nutritional and sensory qualities of a product and then defining its uses, its target group(s), and the requirements for its preparation in the home. It is generally believed that product ideas must be based on consumers' existing food habits and values. However, many new convenience foods have become popular that were not similar to products traditionally used in a given country, for example, pasta in Guatemala. Mothers may be especially willing to try new convenience foods.

Product Candidates

Data on purchasing practices must be gathered to provide a basis for pricing policy. Modifications of products successful in other countries could be considered. A variety of product possibilities should be drawn up because only a few ideas will be marketable and not all marketable products will be successful.

Dietary surveys can be used for the purpose of gathering information concerning home food preparation and consumption practices. These data will provide a basis for understanding the role in the diet of acceptable foods and what flavors and consistencies would probably be desirable in new weaning foods. Environmental factors, such as water supply and home-cooking utensils, will also play a part in determining the characteristics necessary for a new weaning-food product.[9]

Raw Ingredients for the Product

Potential raw ingredient sources, standards of consistency, and supply factors must be considered in the process of selecting a product.

Sources There are three kinds of food ingredients suitable for formulating

[9] See Chapter III.

processed foods of high nutritional quality: indigenous agricultural products, by-products of agroindustrial processes, and new food sources.

Indigenous agricultural products Food consumption surveys can identify a country's main agricultural products so that potential ingredients can be selected. Imported ingredients are generally more costly than locally grown foods because of transportation, handling, distribution, and customs expenses. The use of local products is also more desirable because they stimulate the local economy and are more uniformly available. Typically in developing countries, the largest part of the diet of the poorest segment of the population consists of one cereal grain. Legumes are a much smaller part; they are more costly and are not so widely available as cereal grains.

In addition to the most common cereal grains, others can be considered as weaning-food ingredients. The choice depends upon the availability, cost, and feasibility of producing a grain over the long run within a country itself. Using cereal-grain alternatives to those produced in the largest quantities in a country has the advantage of increasing a people's total food base. Other ingredient candidates are products of animal origin, such as dried skim milk and even eggs, although these are usually too costly. Vegetable sources other than cereal grains include plantains, bananas, and potatoes.

By-products of agroindustrial processes The most important agricultural by-products for weaning foods are oilseed meals, which are good sources of protein when properly processed.

By-products also come from the cereal grain industry; of these, rice and wheat germ or lower grade mill fractions are especially attractive if handled in a sanitary manner. Such by-products can be good sources of vitamins, oil, and protein, and in general are low in cost.

New food sources Sometimes a variety of raw ingredient sources could easily be produced locally, but may be undependable at the outset of an intervention for any of several reasons. A country may not be familiar with the cultivation of potential raw ingredients, or it may not have knowledge of how to use them in weaning preparations or sufficient demand for them. Examples of such food ingredients include concentrations and isolates from legumes and oilseeds, corn-based sweeteners, and starch from root crops. If new weaning-food products can create a stable market, they can serve as catalysts for the expanded production of unconventional protein sources.

Standards For each raw ingredient to be used in a commercial weaning food, the source of the material and the technique for processing must be specified. Standards of identity must also be established to assure the ingredient's quality, consistency, and suitability for human food. Standards of identity include chemical analysis, nutritional value, physical properties (size, color), functional properties, and organoleptic (taste and smell) characteristics. Quality

control measures should be established before raw ingredients are used in manufacturing to assure that the ingredients meet the standards of identity.

Supply To assure a consistent and safe supply of raw ingredients for weaning foods, two factors other than agricultural production within a country itself are essential. One is storage facilities for agricultural products, which protect them from insects and molds. For example, in humid tropical regions, inadequate storage of beans causes losses in the number that are usable, a reduction in nutritional quality, and detrimental changes in taste, smell, and cooking characteristics.

The second critical factor in achieving an adequate supply of raw ingredients is a country's own capacity to produce uncontaminated by-products from cereal-grain milling, such as broken rice, rice polishings, and wheat and corn germ.

The protein source in most weaning foods is the by-product of oilseed processing, the primary objective of which is to produce oil. The processing facility, therefore, may pay little attention to the nutritional, organoleptic, or bacteriological quality of the protein meal that remains after the oil has been extracted. Even if a processing facility has the capacity to produce defatted protein flour[10] of a quality acceptable for human food, it may be economically unfeasible. For example, it may be difficult to achieve the strict control of the processing conditions for cottonseed flour necessary to meet quality specifications. If oilseed meals are to be used as sources for weaning-food ingredients, the project must make certain that a continuous and wholesome supply will be available.

Product Testing

Testing involves chemical analyses of amino-acid content, biological evaluation in experimental animals, evaluation of storage stability, tolerance tests, and acceptability trials. In addition, the capacity of the food to supplement deficiencies in the diet as a whole should be evaluated. Testing of ingredients that are not usually used in weaning foods is particularly important.

Chemical composition The number of raw food ingredients that have been used in weaning foods is relatively small. The cereal grains used are corn, rice, wheat, and sorghum. The legumes are soybeans, common beans, field beans, chickpea, and pigeon pea. Oilseeds include peanuts, cottonseed, and sesame. Starch-rich foods are cassava, yams, potato, plantain, and banana. Nutritional data on these foods can be found in standard sources such as the United States Department of Agriculture (USDA) Handbook No. 8[11] and the Food and Agricultural Organization (FAO) Handbook[12].

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[10] See Chapter IV, Table 9.

[11] B.K. Watt and A.M. Merrill, *USDA Handbook No. 8, Composition of Foods*, Washington, DC: USDA, 1963.

[12] *FAO Nutritional Studies No. 24, Amino Acid Content of Foods*. Rome, Italy: FAO, 1970.

For each food ingredient the amounts of moisture, protein, ash, crude fiber, fat, carbohydrate, energy, vitamins, and minerals should be calculated to assure that products meet the desired specifications.

Natural toxins and antinutritional factors in foods Many potential weaning-food ingredients contain physiologically undesirable factors that can be destroyed, inactivated, or reduced to acceptable levels by appropriate processing. Table 6 indicates some deleterious substances in some principal ingredients of weaning foods and shows how they can be inactivated or partially removed.

Protein quality: Amino-acid content Amino-acid analysis of potential weaning-foods provides information about protein quality that is used to calculate the amino-acid score.[13] Table 7 gives some information on the limiting amino acids of various weaning-food ingredients.[14]

Biological quality: Digestibility and toxicity Animal assays may be needed on product candidates to assess protein digestibility and other indices of protein quality. Corrections for protein quality are based on the amino-acid score and digestibility.[15] If novel protein sources are being considered, experimental studies may be necessary to evaluate long-term effects.[16] The biological evaluation should also include studies of the value of the food to make up for deficiencies in the diet as a whole.

Storage stability Because there can be a long interval between production, distribution, and consumption of manufactured goods, storage stability is essential. High relative humidity and high temperatures can cause product deterioration. Storage stability tests for caking, the development of off-flavors, insect contamination, molds, and toxic substances such as aflatoxins, are mandatory.

Antioxidants can be added to commercial products to lengthen their shelf life. Storage studies will determine whether these should be added to reduce or avoid the development of off-flavors or loss of vitamins.

Processing Alternatives

There are six principal methods for manufacturing nutritious commercial weaning foods. During the early stages of any project, the various features of each such as cost, product options, and sanitation, should be compared. The purpose of this section is to provide the background information necessary to make logical choices between them.

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[13] See Chapter IV.

[14] See Chapter IV.

[15] See Chapter IV.

[16] See the UNU/PAG Guideline No. 6, "Preclinical Testing of Novel Sources of Protein" in *PAG Compendium* 14/6:D, NY: John Wiley & Sons, 1975, p. 785.

Table 6

Antiphysiological Factors Present in Ingredients for Weaning Foods

Food	Antiphysiological Substances	Processing
Food legumes	Trypsin inhibitors	Inactivated by heat[1]
	Hemagglutinin	Inactivated by heat[1]
Soybean	Trypsin inhibitor	Inactivated by heat[1]
	Urease	Inactivated by heat[1]
Cottonseed	Gossypol	Reduced during oil extraction
Lupine	Alkaloids	Reduced during processing

[1]For dry processes, such as extrusion, temperatures of about 140°C for 20 to 30 seconds are required. If a wet process is used, steam treatment at 120°C for 30 minutes is required.

Table 7

Amino-Acid Deficiencies in Various Products used in Weaning-Food Preparations

	Amino Acid	
	Main Deficiency	Good Source of
Cereal grains		
Whole corn	Lysine - Tryptophan	Methionine
Degerminated corn	Lysine -Tryptophan	Methionine
Rice (White)	Lysine -Threonine	Methionine
Wheat flour	Lysine	—
Sorghum	Lysine	Methionine
Cereal grain by-products		
Corn germ	Methionine	Lysine
Rice polishings	Methionine	Lysine
Wheat middlings	Methionine	—
Oilseeds		
Soybean protein	Methionine	Lysine
Cottonseed flour	Lysine	—
Sesame protein	Lysine	Methionine
Peanut	Lysine - Methionine	—
Other		
Yeast	Methionine	Lysine
Leaf protein	Methionine	Lysine
Food Legumes		
All kinds	Methionine	Lysine

The Extrusion Process

The extruder is used to combine a variety of cereal and legume products and to cook them at high temperatures (150 to 180 degrees Centigrade). This form of processing requires a moisture content for the mixture of only 20% and a brief cooking time of 60 seconds to 120 seconds. The extruder, like a meat mincer, consists of a rotating screw that forces a mixture through a discharge die. The screw is turned by a large electric motor; most of the energy used to turn the screw is converted to heat by friction between the turning screw and the product. The extrusion procedure is depicted in Figure 2.

To begin the process, whole raw cereal grains and protein- and oil-rich legumes, such as soy, are stored either in bulk or in bags. Storage moisture must be controlled and the grains and legumes must be protected from insects and rodents. After the raw grains have been graded by size (*scalping*), and the stones

Table 8

Vitamin-Antioxidant Premix and Mineral Premix

Thiamin Mononitrate	2.8 g
Riboflavin	3.8 g
Pyridoxin Hydrochloride	1.6 g
Niacin	49.5 g
Calcium D-Pantothenate	27.5 g
Folacin	2.0 g
Vitamin B-12	39.6 mg
Vitamin A Palmitate	$16 \cdot 10^6$ I.U.
Vitamin D	$2.0 \cdot 10^6$ I.U.
Alpha-Tocopherol Acetate	75,000 I.U.
Butylated Hydroxy Anisole	22.0 g
Butylated Hydroxy Toluene	22.0 g
Ascorbic Acid (encapsulated)	400.0 g
Add enough soy flour or starch to make a total of	1.0 kg of mix
Total	**1.0 kg**
Ground Limestone	10.0 kg
Zinc Sulfate Hydrated	40.0 g
Ferrous Fumarate	460.0 g
Iodized Salt (0.007%)(I²)	6.5 kg
Total	**17.0 kg**

have been removed by gravity separation, a simple dehuller is used to loosen and aspirate (*winnow*) the hulls. Cereals are mixed with soy in a ratio of approximately 80 to 20 by weight and combined and cooked (*extruded*). A cooler/dryer then removes enough moisture to bring the product to within safe storage limits of less than 14%. When dry, the product is ground with a hammer mill, mixed with nonfat dry milk (optional) and vitamin/mineral (V/M) fortification mix (Table 8), and packaged in large bags or individual packages. The resulting precooked or partially cooked flour is normally prepared as a gruel by addition of potable water or with a short cooking step.

The Roller-Drum Drying Process

Roller-drum driers consist of two counter-rotating smooth-surfaced drums heated by steam. A precooked slurry, composed of about 80% water, cereal, and other suspended ingredients, is spread on the surface of the drums, and the thin layer dries quickly as they rotate. The finished dried product is scraped from the drums' surfaces before they are recoated with slurry. The roller-drum drying process is illustrated in Figure 3.

The raw ingredients normally used in this kind of processing include cereal flours, such as oats, wheat, or rice, or other starchy foods, such as banana or plantain, and proteins such as defatted soy flour. These ingredients are first blended in a cooking tank with water to bring the moisture content of the mixture to about 80%. The batch is then steam-heated to about 100 degrees Centigrade and stirred at that temperature for 20 to 30 minutes. Sometimes enzymes (*amylases*) are added to partially break down the starch. This is done so that the mixture is not too thick to easily coat the drying rolls and to assure that it will be both digestible and palatably sweet.

After cooking, the slurry is dried on the hot surfaces of the roller drum dryer. The resulting product is in the form of thin dry flakes that are soluble in water. The reconstituted (hydrated) mixture is similar in consistency to many infant cereals sold in the developed world. Vitamins and minerals can be added before packaging either in individual packages or bulk.

The Spray-Drying Process

Spray drying is another method for manufacturing highly soluble weaning foods (Figure 4). A spray dryer consists of a large chamber through which heated air is blown. The precooked product is sprayed (atomized) into the dryer where the droplets dessicate into spherical particles of powder. Because lower temperatures are involved in spray drying than in the other dry foods processes discussed above, spray drying yields improved flavor and increases the solubility of the protein ingredients.

The Fluid-Products Process

Variations of the technology used for processing fluid milk can be applied to liquid weaning-food products. Figure 5 shows the essential features of the

Figure 2

Schematic of extrusion process

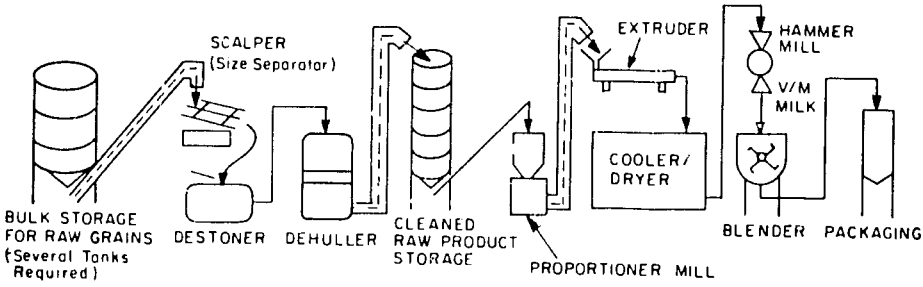


Figure 3

Schematic of roller drum drying process

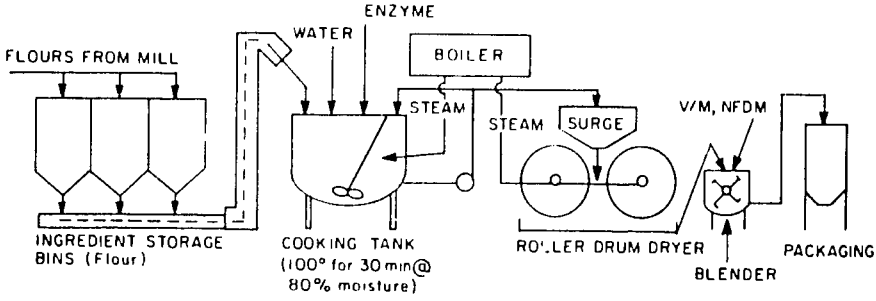


Figure 4

Schematic of spray drying process

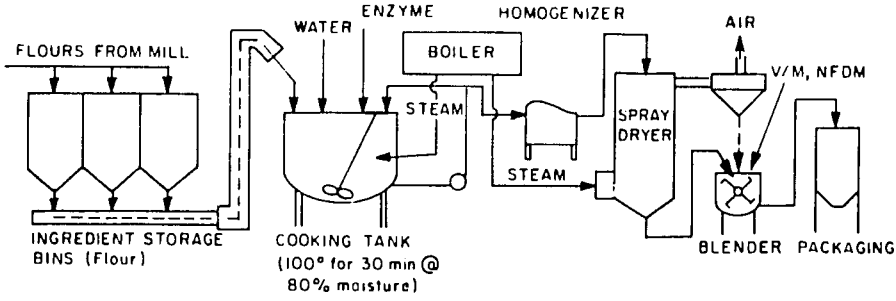


Figure 5
Schematic of fluid products process

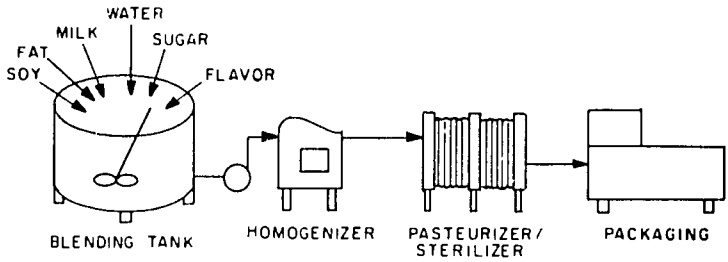


Figure 6
Schematic of baked products process

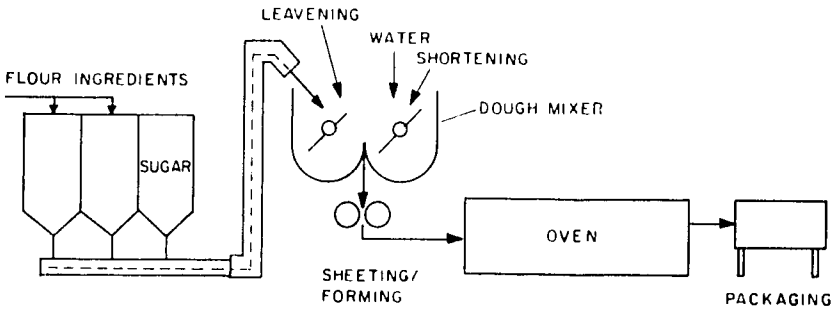
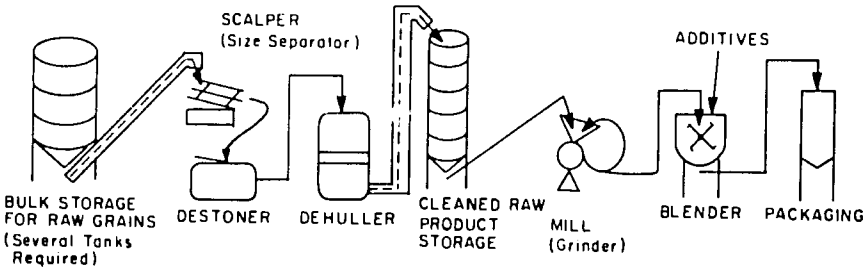


Figure 7
Schematic of simple milling process



process. Dry ingredients are mixed with water in a ratio of about 1/10 to 2/10. This mixture is then heated and homogenized or forced through a nozzle under very high pressure to suspend the solids in the liquid and to prevent the fat from separating upon standing. Heating the homogenized solution to temperatures above 80 degrees Centigrade and maintaining these temperatures for about 20 seconds *pasteurizes* it, that is, destroys pathogenic microorganisms. *Sterilization* can be accomplished either at higher temperatures or with longer holding periods. Pasteurized products must be refrigerated in either small tins or glass containers after packaging; properly packaged sterile products, on the other hand, may be stored at room temperature for extended periods of time. Once opened, sterile products must be refrigerated. Products processed and packaged as liquids are normally consumed in this form.

The Baked Products Line

Baked weaning foods can be in the form of a cookie, biscuit, or cracker. Figure 6 is a schematic of the processing line. Wheat and other cereal flours are made into dough by adding shortening (fat), water, leavening (baking powder or yeast), and sugar (flavor). The resulting dough, composed of approximately 25% solids, is developed in a paddle blender and formed with a sheeting device. The formed biscuits are then placed in either a batch or a continuous oven and baked for 20 to 40 minutes. The finished products can be crumbled and placed in milk or water to make a gruel or porridge.

Milling Processes

Simple milling processes as illustrated in Figure 7 can be used to manufacture weaning foods. The nutritional value can be increased with various additives. Products processed in this way require cooking. Since milled products depend on low moisture for preservation, the germ-bearing or oil-bearing portions of the grain must be removed to reduce rancidity (fat deterioration) that would otherwise occur in the products during storage.

All common cereal grains can be processed by milling; the steps include raw ingredient storage, cleaning, destoning, and dehulling/degerming. They must also be centrifuged at high speed in an *entolator* to destroy insects and insect eggs. To produce the desired fineness or quality, milling and grinding may require several steps in a series. Dry additives, such as vitamins and mineral preparations, can be blended into the product before packaging.

Selecting among Alternative Processes

Criteria useful in the selection of an appropriate processing system for the central production of weaning foods are summarized in Table 2.

Type of weaning food product In summary, the types of weaning-food products produced by the processing systems discussed above are: gruel or porridge by both extrusion and milling processing; highly soluble gruels or liquid supplements by both the drum and spray-drying methods; crackers, biscuits, and cookies by baked processing.

(Source: AID)

ROLLER MACHINES IN MADRAS, INDIA, PROCESS *BAL AHAR*, which in Hindi means "Children's Food." The mixture of local cereals and oilseeds, reinforced with vitamins and minerals, is manufactured by private Indian flour mills under the supervision of a government agency. The centrally processed weaning food was developed with US assistance as part of a famine relief program in 196[illegible] for the Indian State of Bihar. The *Bal-Ahar* project continues to produce food for children.

Cost of equipment It is desirable to purchase equipment locally, if possible. The advantages are: (a) the use of local sources generally facilitates repair and purchase of parts; (b) the training of equipment users may be simplified; and (c) cost is likely to be lower. Generally, the equipment for the milling and extrusion systems, such as tanks, conveyors, mills, and blenders, can be purchased in developing countries. Because of the nature of these processes, this equipment tends to require more maintenance than that used in other methods. Usually, equipment used in the spray drying and baked goods methods must be imported. With the exception of the drum dryer, all systems have moderate to low maintenance requirements.

Energy Systems in which the product is processed wet and then redried need a great deal of energy for processing. Drying is energy-intensive and requires about 2500 BTU (1000 kJ/kg.) to remove one pound of water. Dry extrusion and milling are more energy-efficient than the wet processing methods. Dry processes also require far less energy to destroy antiphysiological substances in weaning-food ingredients (see Table 6, footnote).

Skill requirements The level of skill needed in plant personnel varies with the process and the equipment used. Generally, a processing technique should not be chosen that requires a level of technical expertise that is beyond that available locally.

Sanitation Requirements

All of the processing alternatives discussed above can produce a sanitary and hygienic product. *Roller-drum drying, spray drying, and fluid products processing, however, require much more thorough sanitation measures in the processing area.*

To prevent contamination of equipment and of the products produced by wet processes, the equipment should be wet-cleaned after each run. Plants, in addition, should be shut down weekly for sanitizing, and all of the equipment should be disassembled and washed with the proper detergents.

Plant Ownership, Management, and Operation

Choice of the pattern of ownership, management, or operational technique depends upon the political, economic, and industrial characteristics of the country where the plant is to be located. Government development priorities and the existence of a national food processing industry are two such factors. Table 9 outlines the forms of ownership and operational and funding options available to planners.

Project Finances

After product candidates have been selected, production requirements have been developed, and a market plan has been formulated, cost estimates should

be made as they will be needed to obtain funding. Both capital and operating cost estimates must be realistically related to the number of consumers to be served.

Production Costs

The initial assessment of costs for plant operation is based on a single shift. As demand increases, it is practical to consider production on more than one eight-hour shift. Production costs for plant operation less than eight hours a day are higher than for longer shifts because equipment is not used so efficiently.

Capital Costs

Local purchases Purchase of land, construction or purchase of the physical plant, and installation of equipment require local currency. Equipment for dry processing systems can usually be purchased locally and has the lowest capital cost.

Table 9

Ownership, Operation, and Funding Options for Processed Weaning-Food Projects

Form of Ownership	Operational Options	Funding Options
Government: Usually Ministry of Health or Agriculture	1. Hire management team and work force for plant. 2. Contract to use resources of private firm.	Development loans and other government sources
Private: Individual or Corporation	Hire management team and work force.	1. Capital from private sector 2. Purchase contract with government and distribution financed by government
Private Voluntary Organization (PVO), for example, CARE	A private voluntary agency acts as a catalyst in initiating system operations and does not actually hire personnel.	1. PVO funds 2. Foreign assistance funds 3. Host government funds

Imported purchases Wet processing systems using dryers or systems that package fluid products are the most costly and generally require the largest amount of imported equipment.

Operating Costs

Operating costs can be divided into fixed and variable costs. Fixed costs include management, depreciation, debt costs, inventory, and sales costs. Variable costs are related to production and include raw materials, labor, utilities, packaging, and product losses.

Working Capital

Working capital is necessary for financing production through the initial production period until sales income is received. Typically, the amount of working capital necessary at the start of a project is estimated as equivalent to three months of plant operation. The total amount of money required to finance a project is the sum of capital costs and of working capital.

Production Facilities

Existing Industrial Plants

A weaning-food project may be able to use an existing industrial plant, such as a grain milling facility, to which it would add necessary processing, mixing, and packaging equipment. However, care must be taken to ensure appropriate quality control.

New Processing Facilities

If a project requires building new processing facilities, financial arrangements and hiring of key project personnel must be completed. Figure 8 indicates the steps necessary to complete a new processing facility. Typically, 15 to 18 months are required before production can begin.

Marketing

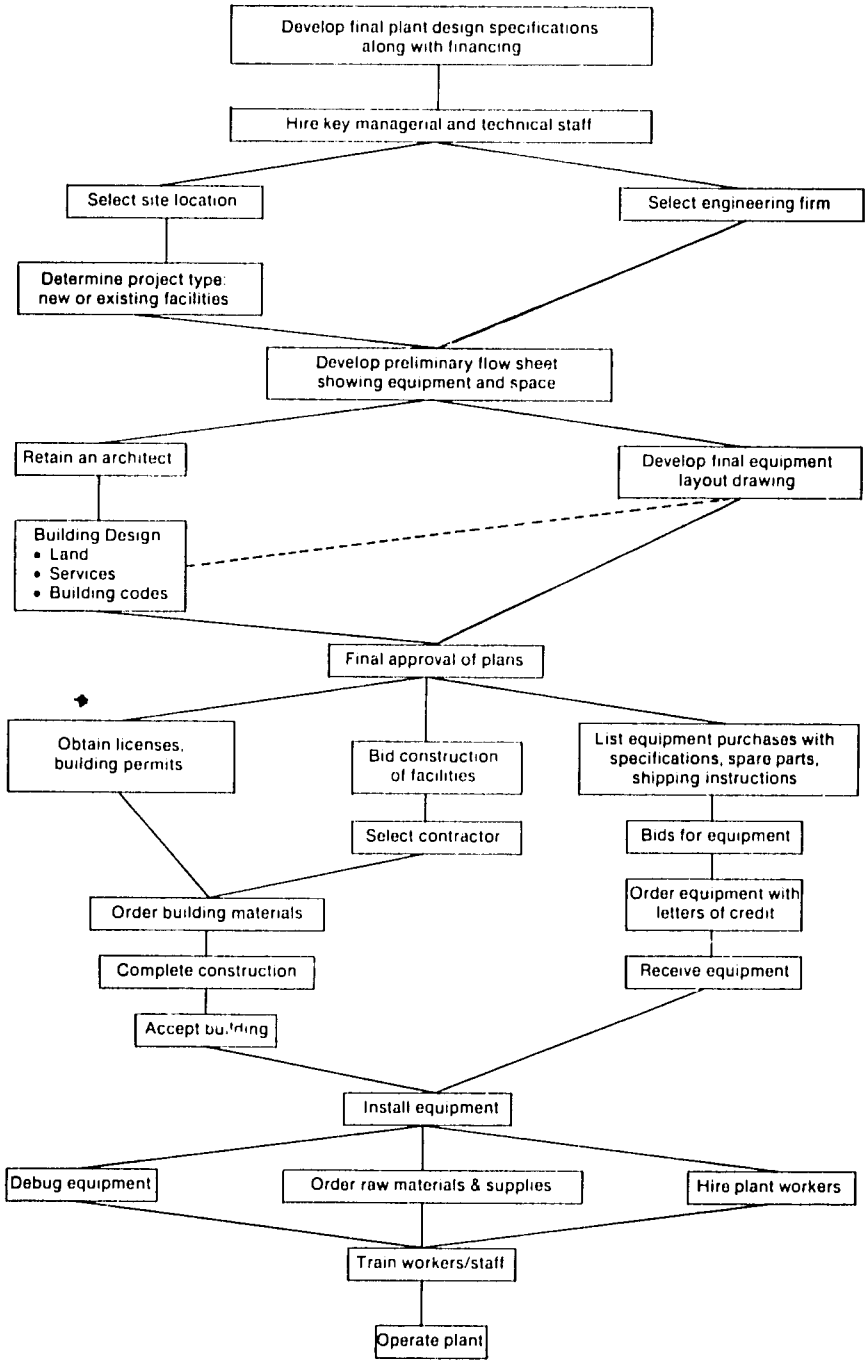
All phases of a commercial project are affected by marketing goals and market potential. Marketing goals will strongly influence the selection of product candidates and will provide a framework within which to develop the entire project plan, a timetable for accomplishing the plan, and an analysis of budget requirements.

Product Selection and Acceptability Testing

Earlier in this chapter an overview of the steps necessary for selecting product concepts was presented. These steps include assessments of the nutri-

Figure 8

Steps required to design, build, and operate a weaning-food factory



tional status of target groups, of the prices and range of distribution of products aimed at potential consumers, and of purchasing practices. The sources of raw materials and the reliability of supplies must be evaluated, and the product candidates may require various laboratory tests. In addition, the costs, product options, and sanitation requirements of various processing alternatives must be considered. The final step in the process of making product selections for manufacture is acceptability testing.

Acceptability tests need to be carefully structured to ensure the validity of the results. Experts should be hired to conduct these tests. For testing to be valid, test-site selection, choice of the number of recipients, test monitoring, and analysis of results must be done scientifically. In addition, information on product image, product use, demand, market potential, and pricing should be gathered from these tests.

Packaging

Acceptance of a product depends in part on packaging and the name of the product. Potential names should be pretested to avoid misunderstandings or inconsistency with cultural beliefs and taboos.

Materials Packaging materials should serve two functions: food preservation and transmission of appropriate messages to the consumer. The product should be packaged only after it is processed. If not, insect eggs can mature and off-flavors develop in packaged raw products. If insect eggs do mature, the insects may pierce through the packaging materials, exposing the product to further deterioration. Packaging materials commonly used include plastic, cellophane, cardboard, or paper with an internal layer of plastic. If a highly effective moisture barrier is required, special coating and packaging, such as polyethylene, must be used. Low-cost weaning foods are usually packaged in simple plastic bags, whereas products intended for a middle-income market and designed to compete with imported foods will have to be packaged in cartons or tins. Finally, packaging must be appropriate for a given type of product and provide sufficient protection during storage, transport, and use.

Size Packages should contain a convenient number of servings. The Faffa weaning-food project in Ethiopia used package sizes varying from 100 g, which provided one meal per day, to 500 g, a one-week supply. The single-meal size, which could be purchased at a low unit price, had to be purchased too often to be convenient and was replaced by the larger size. However, care must be taken not to choose too large a size because it can be too expensive for poor consumers and is more likely to have leakage problems.

Outer packaging may be necessary for transporting and storing products; cardboard cartons may be required in some locations, but jute sacks, which are reusable, are preferable. In making a choice between the two, price and availability are the criteria to use. Although cardboard has the advantage of providing structural protection for a product, it is a wood product that is more expensive in most countries and should, therefore, be avoided. Sometimes jute

bags can be an asset in and of themselves. In Egypt the success of a weaning-food project was related to the use of jute sacks. People bought the food and resold the sacks.

Label instructions At a minimum, the product label should contain a clear set of instructions for the product's use, including diagrams illustrating preparation procedures and indicating how much and how often to feed the product. Where it is appropriate, instructions should be given in more than one language, or, more importantly, in pictures, since much of the world cannot read. The pictures should contain background (or settings) familiar to the user so that the instructions make sense. For example, directions showing a housewife preparing the weaning food in her kitchen at the stove are clearly without meaning to a woman living in a one room hut who has an open fire instead of a stove and no running water. Other possible label messages include sanitary measures and multiple uses for the product. Label instructions should be thoroughly tested before they are adopted to assure that they convey the proper messages and are easily understood by consumers of all educational levels and cultural backgrounds.

The package label should also include an accurate listing of product ingredients. When a product includes milk, vitamins, minerals, and other essential nutrients, this list can give prestige to a product. Ingredients should be listed in order of percent composition.

Costs and Prices

This section is concerned with assigning costs accurately so that prices can be set that will generate sufficient surplus to assure the long-term viability of a venture.

Costing The first task in cost accounting for any project is to assess costs for raw material, labor, processing, and packaging. These costs are usually of a *variable* nature and change with production volume. There are also *fixed costs*, including those for production equipment and administration, which do not vary with volume. If only one product is produced, all fixed costs will be divided by the product volume to obtain the fixed cost per unit. The fixed cost per unit will go down with increasing volume because of *economies of scale*. The variable cost per unit is usually rather stable. If a project produces several products simultaneously, the productive, administrative, and sales resources will be shared and will constitute the common costs of the project. These *common costs* can be allocated to each product according to either a formula that expresses the extent to which a particular product utilizes a common resource or a simple ratio of the common cost to the tonnage or sales value of each product.

Full-cost accounting One problem in cost accounting is determining how much of the fixed costs should be allocated to the price of each product. The fixed costs of a project consist of the direct costs for administration, production (for example, machinery), and sales management together with costs from

other departments unrelated to production volume, such as product development and accounting. Other major fixed costs are interest on borrowed capital and depreciation. A project financed by a loan must pay annual interest. Depreciation is the loss of value of buildings and machinery as they gradually wear out. These fixed costs must be covered if the project is to survive.

Full-cost accounting consists of allocating the fixed costs to each product according to some rule and then adding the variable cost per unit. Full-cost accounting provides the basis for determining what price should be charged. If all the products are sold at their full cost, the project would, of course, break even. Often the full cost is not charged because the demand is insufficient or a lower price is desired for a specific market segment, such as those too poor to afford the full cost. If a project produces more than one product and prices them differently, the principle of contribution costing can be used to determine the prices.

Contribution costing Contribution costing may be used when more than one kind of product is produced. In contribution costing the fixed common costs are not allocated equally to each of the different products. Instead, the prices of different products can make varying contributions towards covering these costs. The contribution from each product is the *price* minus the variable cost per unit (labor, raw material, processing, packaging, and transportation). A higher price, of course, will provide a higher contribution. With a differential pricing system some products will contribute more towards the recovery of fixed costs than others. As production volume of a given product goes up, the contribution per ton needed to cover the fixed costs will go down.

Pricing In a social-marketing project, unlike a profit-making project, products are priced so that the project will just break even. A product should never be priced below its variable cost because every sale then yields a loss to the project. In multiproduct projects, a product can just cover its variable costs and make no contribution to covering the fixed costs, which will be met by the other products. A specific example of contribution costing in establishing pricing policies is given in Table 10. In the example, a two-product company makes a small profit. The average profit contribution per ton is $170; the fixed cost, before depreciation, is $406,000/4,100 or $99 per ton; depreciation is $254,000/4,100 or $62 per ton. The total fixed cost is $660,000 or $161 per ton. Gross contribution from sales is $170 per ton; therefore, the profit amounts to $9 per ton or a total of $37,000.

In the example in Table 10, product A does not even cover its own variable costs, but gives a direct out-of-pocket loss of $120 per ton, which represents a negative contribution of $72,000. If the sales of product A had been higher, for example 1,000 tons, the loss would have been $120,000 and then the contribution from product B would not have been enough to cover the fixed costs. In this case the project can absorb the negative contribution from product A, but the price should be set so that the product will pay for its own variable costs. That

is, the exfactory sales price should be increased by $120 to $620 per ton and the sales price accordingly, to $800 per ton.

Subsidies Even if products are priced so that they only cover the variable costs of production, the prices are likely to be too high for the poorest consumers. This group will either have to be reached through institutional channels or through subsidized prices. In addition, raw materials can be subsidized so that a project can decrease its base price for a product or food stamps can be used.

Markets, Sales, and Distribution

Markets There are usually two distinct markets for weaning-food products: the commercial market in which the distribution of product sales is managed by

Table 10

Example of Cost Analysis of a Two-Product Plant

	Product A	Product B	Weighted Average per Ton
Sales price to consumer, $/T	650	812	
Trade margin, 20%	(130)*	(162)	
Average transportation cost, $/T	(20)	(20)	
Exfactory sales price, $/T	**500**	**630**	**610**
Variable cost for raw material, direct labor, processing, and packaging	(620)	(410)	(440)
Contribution towards all fixed costs (production, administration, and depreciation)	**(120)**	**220**	**170**
Contribution as % of sale price	(24)	35	28
Sales in volume, in tons	600	3,500	4,100
Gross contribution from sales (contribution/ton · volume) in thousand $	(72)	770	698
Fixed costs for production, administration and sales, in thousand $			(406)
Surplus before depreciation, in thousand $			292
Depreciation, in thousand $			(254)
Total profit of operations, in thousand $			**37**

*Negative number indicated by ( ).

profit-motivated wholesalers and retailers; and the institutional market in which private voluntary institutions and government agencies can target product use by regulated distribution, pricing, and other stipulations. These agencies buy the weaning food and then distribute it for free or at a reduced price, under more or less controlled conditions. Thus, it is possible for a weaning-food project to sell to the private sector or institutions.

Distribution

Distribution agents The distributor determines how visible to the potential consumer a product will be and controls the availability and visibility of alternative commercial feeding options. Because the distributor can be critical to sales success, it can be advantageous to establish distinct tangible rewards to the distributor system for getting the product out to the people.

A new commercial project must analyze the existing distribution structure to determine which wholesalers and retailers are best suited to distribute its products. Both the number of potential customers and the cost added on by each distribution agent must be assessed. Pricing should be structured to build in incentives for distributors and retailers. For example, if the distributor knows he makes more money selling a product, he is likely to deliver it more regularly and promote it with retailers. With appropriate incentives, advertising costs can sometimes be shared with the retailers.

Distribution agents generally focus on selling products for which there is already a steady demand and on which their commissions are high. Thus, working with large wholesalers may not assure that new products will flow through distribution channels. Individual salesman using an advantageous incentive system can play an important role convincing distributors to accept new products.

Sales organization

Field salesman Unless the product is to be handled by an existing sales organization, a project will probably have to employ a number of field salesmen to contact retailers and institutional buyers directly and, as is often appropriate, to provide them with trial deliveries. These activities will be part of other promotional activities undertaken on a local level.

Branch offices A project often develops a sales organization with a number of branch offices in different parts of the country, where products can be stored. The extent to which branch offices must be created depends on the receptiveness of the distribution system to project products. Usually field salesman are needed to promote products.

Reporting system The sales organization must include personnel whose responsibility is to report developments in field sales. This reporting system should provide accurate, up-to-date data concerning how many items have been sold and how often retailers run out of items. The reporting system personnel

will develop plans to keep items in stock with retailers and will make periodic sales forecasts to guide production planning.

Advertising and Sales Promotion

Each country has its own advertising media, which may include television, radio, cinema, newspapers, magazines, billboards, loudspeaker vans, direct mailings, and displays in retail stores. In addition to such media, a project may also consider promotional activities such as price discounts, competitions, match-boxes, calendars, and T-shirts. These activities are usually very effective means of promoting a project. All advertising for nutritional products should be informative, for example, promoting the use of cup and spoon for feeding. Promotional gifts should have a relationship to nutrition, e.g., napkins and feeding bowls. When possible, a project should plan advertising and promotional activities with professional communication experts and responsible advertising agencies.

Both advertising materials and the designs used for packages and labels should promote breast-feeding and stress the idea that weaning foods should be fed *after* breast-feeding.[17] The foods should be portrayed as complements to breast milk, not substitutes for it. Sanitary feeding practices should be especially emphasized. The World Health Organization has issued guidelines for marketing infant foods.[18]

Marketing Evaluation

Monitoring to determine whether a project's stated market development goals have been attained is essential to determine whether a project can effect changes in the nutritional status of disadvantaged groups. Sales figures are usually not adequate indices of whether foods are reaching the poor; regular consumption and buying-habits surveys are also required. A market analyst should work with nutrition researchers to pretest new products and study consumer beliefs and attitudes concerning nutritional questions.

[17] See Chapter IV.

[18] WHO. *International Code of Marketing Breast-Milk Substitutes.* Geneva: WHO, 1981.

Chapter VIII*

Complementary[1] Feeding Programs

Introduction

The purpose of this chapter is to answer the following questions:

1) How can the design and implementation of complementary feeding programs aimed at weaning-age children be made most effective?

2) What are the roles of local and imported donated foods in improving the nutritional status of weaning-age children?

The Role of Complementary Feeding Programs

In any developing country at any given time part of the population will not be able to afford adequate food for their children because of a lack of income and/or high prices. In addition, people in developing countries may periodically suffer food shortages because of poor harvests, droughts, and seasonal problems in food availability. The number of people affected by these kinds of economic and agricultural problems will be reduced if effective development policies and programs are created and if improvements are made in income distribution, agricultural production, and food distribution systems. In order to meet the short-term needs of the poorest and most disadvantaged groups, many countries and international donors have committed food resources and distributed them, usually free of charge or at nominal prices, through noncommercial channels such as health clinics, mothers' clubs, and churches. Complementary feeding programs use such food resources to prevent and reduce malnutrition

* The primary contributors to this chapter were Hope Sukin and Charles Sykes.

[1] Programs that distribute either subsidized or donated weaning foods free of charge or at a nominal price to indigent families are often called supplementary feeding programs. However, in this chapter such programs will be referred to as *complementary* feeding programs to emphasize that the foods should be used *in addition to* breast milk, not as replacements for it.

in preschool children, particularly those of weaning age, who live in households where poverty and a lack of education contribute to a high risk of malnutrition.

Complementary feeding programs that use donated imported food have been vigorously criticized in recent years, both as dole programs that create dependency and also as ineffective nutrition interventions.[2] In many countries, however, complementary feeding programs may be the only functioning nutrition intervention, particularly in rural areas, and have the potential to promote increased use of health services and greater awareness of the importance of nutrition in the community. The question that must be asked is how can complementary feeding programs be made more effective in promoting the well-being of the weaning-age child? In reply, this chapter proposes that complementary feeding programs can be used for two purposes: (1) to meet the short-term nutritional needs of weaning-age children and simultaneously (2) to initiate and support other strategies aimed at achieving more permanent solutions.

To meet short-term nutritional needs, food can be targeted to malnourished children and children at risk of becoming malnourished, including children who are ill or who have just recovered.[3] To initiate and support other strategies, complementary feeding programs should energetically carry out the following measures:

1. Demonstrate to mothers the link between nutritious foods and the well-being of their children;

2. Promote the use of locally prepared or affordable indigenously processed weaning foods;

3. Provide an educational forum for stimulating such family food habits and practices as timely introduction, preparation, and use of appropriate weaning foods, utilization of indigenous foods, use of foods during illness, sanitary measures for food preparation, water supply and use, and waste disposal; and

4. Provide an incentive for mothers to come to a center and utilize other health and nutrition services, such as immunizations, deworming, prenatal care, and weighing children to monitor growth.

The following guidelines for complementary feeding programs are presented as suggestions for improving their designs and enhancing both their short-term and long-term effectiveness. These guidelines should be used to design new programs as well as to make improvements in already established programs.

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[2] See Chapter X for a detailed comparison of alternative weaning-food interventions, including budgetary and manpower requirements.

[3] See Chapter I for a discussion of the synergistic relationship between malnutrition and disease.

Selection of Participants

Because of inevitable limitations in project resources the target population should be identified as specifically as possible. Selection of participants should be based on program objectives. If complementary feeding programs are to address the needs of the weaning-age child, then priority should be given to children from six to 36 months of age. Immediate attention should be given to malnourished and sick children within this age group. Programs should be located in geographical areas where serious nutritional problems have been identified.

At-Risk Children from Six to 36 Months of Age

Children from six months to 36 months are most at risk of becoming malnourished. In developing countries children in this age range often do not receive foods that are sufficiently high in good quality protein and dense in energy. Inadequate amounts of food, infrequent feedings, and contamination of weaning foods are often associated with malnutrition of the weaning-age child. Children of weaning age are, in addition, more likely to suffer severe consequences from recurrent episodes of infection and malnutrition. In areas where rates of malnutrition are high, it may be cost-effective to permit all needy children from six months to 36 months of age to participate in a program. Such targeting provides an excellent opportunity to educate mothers concerning weaning and health practices.

Sick Children during and after Recovery

Identifying sick children in the population under three years of age and targeting food to them during episodes of illness and through their recovery can help prevent a downhill spiral into severe nutritional disorders or even death. Children tend to lose weight during illness because they lack appetite and/or because cultural taboos restrict foods for sick children. Illnesses also increase certain nutrient requirements. During episodes of diarrhea children need increased amounts of protein and calories, and despite their illness, studies have shown that they can still absorb useful quantities of nutrients from such food as is ingested. If increased quantities of food are available for children after recovery when appetite is improved, they should be able to regain rapidly the weight lost during illness.[4]

Malnourished Children

Where growth monitoring is in use to identify malnourished children, priority attention can be given to those who are faltering in growth. If not identified promptly and properly treated, young children can quickly become seriously malnourished resulting in increased morbidity and mortality. If

[4] See Chapter IV for recommendations concerning feeding during and after illness.

malnutrition becomes chronic, impaired growth and cognitive deficits may become permanent.

Selection of Program Mode

Complementary feeding programs usually take one of two forms: children can be fed at a project center in an *on-site feeding program* or food may be distributed to mothers to give to their children at home in a *take-home feeding program*.

Weaning-age children are particularly difficult to reach in either kind of program. Some studies of take-home feeding programs suggest that, although a weaning-age child may be enrolled as a food recipient, siblings or other family members may consume a substantial portion of the food. Some studies of on-site feeding programs indicate that weaning-age children often do not accompany mothers or older siblings to the center. This chapter will discuss strategies for improving each kind of program's potential for meeting the nutritional needs of weaning-age children.

The relative advantages and disadvantages of take-home programs and on-site programs are discussed below.

Advantages and Disadvantages of Take-Home Compared to On-Site Feeding Projects

Take-home feeding projects are more common than on-site programs. The advantages of take-home programs include:

1. The potential for larger coverage because families from greater distances have to travel to program site less frequently;
2. Less administration and supervision may be required for food preparation and distribution;
3. Greater convenience for mothers, who can use and prepare the complementary foods in their own homes. These foods can be incorporated with foods ordinarily consumed in the family diet. Complementary foods may thus be extended if they are combined with appropriate foods at home. Their food value may also be enhanced if they are combined with sufficiently energy-dense ingredients at home;
4. Giving the responsibility of feeding the child to the family;
5. The possibility of more frequent feedings.

On-site feeding programs usually require greater commitments of money and personnel than take-home programs. Moreover, because of the lack of transportation, money to pay for it, and/or time required to take a child to the center, many mothers cannot reach feeding centers on the daily basis required for their children to receive complementary food continuously from on-site programs. In take-home programs, food can be picked up at intervals, for example, every week or every month. Because of these factors, many countries with large numbers of children requiring increased nutrition cannot implement on-site

feeding programs. On-site programs, however, do have some decided advantages over take-home programs, including the assurance that the weaning-age child receives the food and control of the ration size and sanitary conditions. On-site programs are discussed in detail later and Table 1 provides a detailed comparison of the advantages and disadvantages of take-home and on-site programs.

Strategies for Overcoming Problems in Take-Home Projects

The chances of success for take-home projects can be improved by using packaging and promotional activities to target foods to weaning-age children; by educating mothers concerning nutrition and hygiene; by involving mothers and other individuals in outreach and follow-up activities; and by making receipt of food dependent upon growth monitoring. Mothers' clubs, described in Chapter VI, can be very valuable for education and follow-up.

Packaging and promoting foods as weaning preparations Foods distributed in complementary feeding programs in Sri Lanka (Thriposha), India (Balahar), Ethiopia (Fava), and Chile (Fortesan) have been vigorously publicized as weaning foods. Pictures of children and directions for feeding have appeared on the packages. To promote the use of the foods as weaning preparations, radio and newspaper advertising campaigns have been used. Evaluations of the success of these measures have found that, even with strategies combining education and advertising, food may still be shared with family members other than the weaning-age child; however, the target child receives a larger percentage of the food. Frequently, other family members besides the weaning-age children also are undernourished and, therefore, benefit from the availability of more food.

Education Education should be a major focus of the efforts to overcome the disadvantages of take-home projects. It is vital for all projects to have education components. As much as possible, education should be in the form of one-to-one visits with a mother and discussions with groups of mothers. The aims of education should be to promote the understanding that food is necessary for a baby's growth and health; that the food supplied by the project should be used only for the weaning-age child; that hygienic techniques are necessary in preparing and storing food; and that babies need frequent feedings in small portions.[5] Monitoring of weight-for-age has also been used to help mothers understand the link between food and a baby's growth.[6]

Field visits and follow-up Community and home visits are necessary to ensure that children who are malnourished or at greatest risk of being malnourished are identified and enrolled in a program. These visits may include door-to-door visitation; discussion with village leaders or opinion leaders among women and men concerning which families should be enrolled in the program;

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[5] Chapter IV contains discussions of hygiene and feeding techniques.

[6] See Chapter V. Chapter VI also contains a discussion of the obstacles to change in behavior, including the occurrence of disease, which obscures the link between food and growth.

Table 1

Comparative Advantages and Disadvantages of Take-Home and On-Site Feeding Programs

TAKE-HOME PROGRAMS (THP)

	Advantages	Disadvantages
Financial and Personnel Requirements	Less money and fewer personnel than for OSP.	
Coverage	Greater potential coverage than OSP. Families who live at a distance from center can pick food up at intervals of once a week or month.	Difficult to target households who need food most because these are often without time, money, or members available for travel. Outreach in most programs has been limited.
Food Sharing		Far less control over food sharing than OSP. Food sharing is common in THP.
Frequency of Feeding	It is possible that the child will be fed more frequently than in OSP. However, this is less likely without education or contact with mother.	
Hygiene		Unlike OSP, there is no control over hygiene.
Community Responsibility		Unlike OSP, does not promote community responsibility.
Family Responsibility	Unlike OSP, does promote family responsibility for implementing healthy feeding practices.	
Education		May be more important than with OSP since it is necessary to assure hygienic preparation and proper use and targeting of the food in each home.
Selling or Bartering of Food		More likely to be controlled in OSPs than THPs.

Table 1 (Continued)

Comparative Advantages and Disadvantages of Take-Home and On-Site Feeding Programs

	ON-SITE PROGRAMS (OSP)	
	Advantages	**Disadvantages**
Financial and Personnel Requirements		Greater than for THP: some OSP require higher capital investment for facility and equipment for food preparation[1]; higher cost for organization, administration, and supervision.
Organization and Administration	Many OSP require more community involvement than THP for staffing and donating facilities and equipment.	
Coverage	Better targeting of those most in need because center is located near recipients.	Usually less coverage than with THP. In many cultures children less than 24 months old are not brought to feeding center.
Food Sharing	Assures that the child who comes to center receives a specific amount of ration.	Children receiving ration may be fed less from family food supply.
Frequency of Feeding		Potential for more frequent feeding exists with THP. However, usually education is necessary for this to occur.
Hygiene	Much greater control over hygiene.	
Community Responsibility	Villages can have responsibility for carrying out program; this increases potential for community organization and education.	
Household Responsibility		Unlike THP, takes away individual family responsibility.
Education	Better opportunity to conduct educational activities than in THP. Can have reinforcing effect for healthy feeding practices because more people (mothers and others, such as village leaders) may be involved.	
Selling or Bartering of Food	Unlike THP, does not happen at the individual or household level.	

[1]In many OSP, communities or mothers allow a home to be used and will lend cooking facilities.

monthly weighing within villages to monitor nutrition status; and collecting health and/or employment data to locate families that should be participating.

To promote proper feeding and hygiene practices within households, families participating in the program should be visited, preferably by other mothers or community-level workers.

Linking receipt of food with nutritional growth A contract with families can obligate them to maintain the growth of their child as a condition for receiving food. The distributed foods need not go directly to the weaning-age child. The family may, instead, feed the child other foods purchased with income saved because of the donated food's contribution to the household food supply.

Ordinarily, food is donated to families on a monthly basis. If a child is not growing adequately, the mother must come on a weekly or a daily basis to have her child weighed and to receive food. Receipt of food is, therefore, directly linked to the growth of the child, even if the target child does not actually receive the food.

Timing Timing considerations for distributing complementary foods are discussed later in the section, "Strategies for Overcoming Problems of On-Site Programs."

Advantages and Disadvantages of On-Site Programs

On-site projects have the following advantages compared to take-home projects (see also Table 1):

1. Because on-site projects are usually located inside the community, and, therefore, nearer target recipients, they may have a greater chance of attracting the desired program participants.

2. More control is assured over who is fed and over the ration size a child consumes.

3. Food is more likely to be correctly and hygienically prepared and stored.

4. Villages can have the responsibility for carrying out the feeding program, thereby sensitizing the entire community to nutrition problems and to the linkage between food and healthy children. This approach may also promote and support community organization efforts.

5. Programs may provide a good example for skeptical mothers when they see other mothers feeding complementary food to young children.

6. Programs provide an opportunity to conduct educational activities while children eat.

The disadvantages of on-site feeding programs compared to take-home programs may include higher costs for organization, administration, and supervision. In addition, a facility and equipment for food preparation are required. In rural areas coverage of on-site programs is usually limited to a smaller

population than for take-home programs. Evidence suggests that in some cultures children younger than 24 months of age are not brought to sites, and that families may give children less food at home because they are receiving food on-site.

Strategies for Overcoming Problems of On-Site Programs

Several strategies have been found useful in strengthening on-site programs. They include actively involving the community in organizing and administering the program; reinforcing the concept that the donated foods are complements to, not replacements for, foods given at home; scheduling the time of feeding appropriately; and using a growth monitoring system.

Community responsibility Community responsibility for organization and administration of a program is particularly important. Community responsibility for, and participation in, a program can be best assured if village leaders, mothers' clubs, and other community organizations are involved in discussions to sensitize them to the importance of good weaning and health practices and child care. An excellent educational technique is to involve villagers in a demonstration diagnosing weaning-age nutrition problems by having them take their children's anthropometric measurements. The ultimate goal of these efforts is to gain the commitment of the community to: (1) ensure that children who are six months to 36 months old participate in the program and (2) to secure the attendance of children from the poorest families.

Gaining the participation of village leaders and mothers who feed their youngest children solid foods will help to reinforce the central idea that complementing breast milk with solid food for children after six months of age is both safe and desirable. In addition, mothers should be enlisted to work in the feeding centers so that they can learn how to prepare and store food hygienically.[7]

Food as a complement, not a replacement for foods at home The community and program participants need to be taught the importance of using the donated food as a complement to, not a replacement for, foods given at home. To reinforce this idea, the feeding schedule at the center may be organized to give the complements between normal meal times and, where possible, to encourage concurrent breast-feeding.

Appropriate timing So as not to interfere with home feeding, scheduling complementary feeding should coincide with the free time of mothers or other household members who bring children to the feeding site. Seasonal work schedules should also be taken into account. If the food distribution center is close to or integrated with a health service center, food distribution should be coordinated with the clinic schedule so that participants will need to make as few trips as possible.

Growth monitoring The growth of all program participants should be

[7] Chapter IV.

monitored, and the weight chart used as an educational tool for mothers.[8] The feeding program site is a good place for weighing participant children. Some programs use a child's weight chart as the basic registration and admission document.

It is extremely important to weigh children under one year of age once a month to identify children who are not gaining weight normally. Children may be losing weight for a variety of reasons; care must be taken to insure that mothers are not substituting the complementary food for breast-feeding and/or home feeding. Guidance and additional food can be given to mothers whose children are not growing steadily. When possible, the village should choose one day a month to weigh all children, or at least those children from the time of birth to 36 months of age, to identify those who should be participating in the program.

Choosing between On-Site and Take-Home Programs or Using Both

To determine whether an on-site or a take-home program or a combination of the two is the most appropriate for achieving a given set of objectives, the principal questions to answer are: (1) What are the incidence and prevalence of malnutrition in the under-36-month age group? (2) Where geographically is the major malnutrition concentrated? (3) What existing facilities are available to deal with the problem? (4) Which population groups may benefit most and which least with either approach? If wide-scale coverage is necessary, a take-home feeding program may be called for because this system has greater potential for wide-scale coverage than an on-site program. Moreover, on-site feeding programs cost at least one and a half times as much as take-home programs.

An additional consideration in choosing between programs is: what are the strengths and weaknesses of existing infrastructures? For example, health clinics that are centrally located between villages may provide good geographic coverage and excellent linkages for health screening and referrals. Health clinics so located may be useful in either kind of program, but are a very great asset to on-site programs because coverage could be extended. Other potential assets for on-site programs are mothers' clubs, which may provide excellent forums for food distribution. Responsibility for food distribution may stimulate these clubs to promote good nutritional practices within their community.

A survey of a community's seasonal work patterns and of the seasonal morbidity patterns among neonatal and weaning-age children may suggest that a combination of on-site and take-home distribution would be most effective. Take-home programs provide greater coverage and are more convenient for families to use when seasonal work loads are high.

Table 1 provides a comparison of these and other factors that should be evaluated in choosing a program mode.

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[8] See Chapter V.

Kind and Size of Food Ration

Most food aid programs base a choice of the kind and size of food rations on (1) the nutrient requirements of the average weaning-age child and on (2) the kind and amount of nutrient deficit in a given country or region.[9]

In addition to the general considerations mentioned above, the following guidelines are useful in selecting complementary foods:

1. Indigenous foods or commodities similar to them should be chosen. It is useful if the rations can be added to preparations containing typical local foods. A possible drawback of this approach is that the donated foods, if based on externally supplied ingredients, may act as disincentives to local agriculture, as has happened in Egypt.[10] To decrease the chances of damaging agricultural production and reducing the demand for local foods, externally supplied commodities should be targeted to assure that only the neediest, who would not in any case be able to purchase local commodities, should receive them. Alternatively, the imported commodities can be offered in a form acceptable only for children and not likely to find their way into the general marketplace.

2. Usually the same blended foods, such as Corn Soy Milk, instant Corn Soy Milk, Wheat Soy Blend and Soy Fortified Cornmeal found suitable as foods for for older children, can also be given by spoon to babies aged six to 12 months. When weaning foods are given to this age group, every effort should be made to promote continued lactation by providing the food as a true complement and not as a replacement for breast-feeding. Weaning foods that are less liquid may have to be mashed or ground before they can be fed to babies. Because the formulas mentioned above are high protein foods, sugar and/or oil should be added to increase their energy content. These high protein foods can be blended with traditional porridges and mixtures to increase their nutritional value and calorie density.

3. If resources permit, food distributed in take-home programs should be precooked to save household fuel and preparation time. An advantage of the blended foods mentioned in guideline no. 2 in this list is that they are partially precooked.

4. Acceptability testing with mothers and children who will be participating in the program should be performed on all foods before they are introduced, using criteria described in Chapter VI. In take-home programs, acceptability tests should be carried out on food samples as they have been prepared by mothers.

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[9] Chapter IV contains information on nutrient requirements.

[10] Advisory Committee on Voluntary Foreign Aid, US Agency for International Development, *Quarterly Meeting Report – December 15-16, 1983*, Washington, DC: The Newman & Hermanson Company, 1984, pp. 115-117.

5. The shelf-life of ingredients and of the weaning preparations must be evaluated.

6. Take-home programs are more cost-effective if households are given a ration that includes commodities that are ordinarily purchased by the family and are relatively high in monetary value so that, with the money saved, families could buy and prepare less costly local weaning foods. Families may also sell commodities and use the income from the sale to buy local weaning foods, although it is prohibited for US-donated food commodities. The approach of distributing commodities other than weaning foods demands monthly growth monitoring to assure that weaning-age children are benefiting; also critical are analyses of whether low-cost protein sources are available in the market and education of mothers concerning preparation of local weaning foods to ensure that they are nutritious and free of contamination.

Packaging and Storage of Food

Food commodities must be packaged and stored so that they remain usable and free from contamination.[11] To protect food against rodents, insects, and dampness, safe storage must be provided at distribution centers and education given to recipients concerning protection of the food in the home.

Suitable food containers made from local materials have been found effective and have more than justified their relatively low initial cost. In addition, indigenous storage containers and techniques should be investigated and adapted when feasible.

Education

It is critically important that all complementary feeding programs provide education. Education in take-home programs is vital to assure that proper food preparation decreases the risk of infectious disease and malnutrition[12] in weaning-age children. On-site programs should also provide education. The principal aims of instruction for both kinds of programs are:

1. To develop a mother's understanding of the vulnerability of the weaning-age child;

2. To promote sanitary practices in preparing, storing, and handling of foods;

3. To link nutritious food with a child's growth and health;[13]

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[11] See Chapter VII for guidelines on packaging.

[12] See Chapter IV.

[13] Chapter VI mentions obstacles to establishing this link, especially infectious diseases, which are very common in poverty-stricken countries. Mothers often do not have enough tangible evidence that nutritious food contributes to their children's growth and health.

4. To identify and promote the use of local foods and processing techniques for preparing appropriate weaning foods;

5. To teach mothers when solid foods should be introduced and how often to feed their babies;

6. To foster the continuation of breast-feeding even after solid foods have been introduced.[14]

Common traditional food beliefs and weaning practices should be investigated. Ignoring such beliefs, contradicting them directly, or attempting to discredit them is unproductive and can be interpreted as condescending. Traditional beliefs and practices that are nutritionally sound should be reinforced and incorporated into teaching materials. Above all, program staff should keep in mind the factors that prevent people from accepting new beliefs about the benefits of nutritious weaning foods, including diseases that interfere with the benefits of improved nutrition and delay between improved nutrition and growth. The staff should proceed with respect for a community's traditional beliefs and practices and with a sound scientific basis in its educational efforts.

Growth Monitoring

Growth monitoring[15] is an excellent management and educational tool and should be built into all programs. Growth monitoring systems provide both the program staff and mothers of weaning-age children with important feedback concerning the progress of their children. The staff can use this information to adjust such features of the program as ration size and frequency of feeding, and mothers can use the information to make changes in the family's food practices in response to the child's needs.

The following are guidelines for specific actions that can be taken when growth patterns are abnormal.

1. If a child is newborn to 36 months old and the weight-for-age indicates first degree malnutrition, and/or if the child shows no weight gain for two consecutive months, the program staff should:

   a. inquire as to reasons for the child's poor growth,

   b. offer appropriate nutrition education, and

   c. begin or continue a food ration.

2. If a child is second degree malnourished, the staff should:

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[14] Chapter IV contains information on when to introduce solid foods, and on techniques for food preparation, storage, and feeding.

[15] See Chapter V.

a. follow procedures a. and b. above, and

b. try to increase the food ration.

3. If a child in this age group is third-degree malnourished, the staff should refer the child for medical attention.

Training and Supervision

To achieve program objectives it is critical to train personnel who organize programs, distribute food, and have direct contact with beneficiaries, for example, in educational or growth monitoring activities. A basic training course should include techniques for identifying target groups and for assessing nutrition problems and causes at the community level; techniques for gathering information concerning food habits, beliefs, and practices that affect the weaning-age child;[16] techniques in communication and education; techniques for formulating weaning preparations from low-cost ingredients available locally; and growth-monitoring techniques.[17]

Well-planned coordination and monitoring are essential to the success and flexibility of a program. Chapter IX discusses the importance of program monitoring and of involving the staff actively in this process.

Community Involvement

It is extremely important that communities be integrally involved in the planning, design, and implementation of complementary feeding programs. Sensitization of a community to its nutritional problems and the particular problems of the weaning-age child should be a first step in planning a complementary feeding program or in modifying one already in operation. A complementary feeding program is an excellent mechanism for beginning discussions with community leaders, mothers' clubs, and community development or health committees concerning nutritional needs and the role of the complementary feeding program as a short-term solution to some of these needs. These discussions can provide a basis for the community and private voluntary organizations or other government organizations to develop longer-term strategies for addressing community nutrition problems.

Criteria for targeting should be discussed and program participants identified. The community or a community committee should help identify those families and children who should participate in the program. It is also important that mothers (particularly those with at-risk or malnourished children) participate in cooking or distributing the food and in all educational activities.

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[16] See Chapter III.

[17] See Chapter V.

Individuals from the community should also take responsibility for the program, whenever possible, providing program managers, food handlers, storage facilities, and outreach services.

Regular Attendance and/or Participation

Studies and evaluations of complementary feeding programs suggest that regular attendance in programs is a critical factor for the successful prevention and reduction of malnutrition. These studies indicate that on the average the majority of participants come less than 60% of the time to pick up food packages and that attendance in on-site programs is only slightly better. In peak work seasons in rural areas (harvests and planting) participation decreases greatly. Suggestions for ensuring and increasing regular participation include:

1. Timing the distribution of food so that it is convenient for the mothers or whoever else (grandmother, older sibling) will collect the food or bring the enrolled child. Because of seasonal variations in work schedules, distribution schedules should be sensitive and flexible enough to change to accommodate the participants.

2. When food distribution is integrated with or physically near the health services, food distribution should be coordinated with clinic hours and doctor visits to save participants from making multiple trips.

3. Food distribution should be well organized to minimize the time away from other obligations of the mothers.

Seasonal Food Shortages and Hunger

In many countries, particularly in Africa, there is at least one season during which food availability is greatly diminished. Low crop productivity, lack of irrigation, limited storage techniques and/or facilities, and poor food distribution networks all contribute to this problem. It has been very difficult for traditional Maternal and Child Health Feeding Programs to deal with this phenomenon, and yet seasonal food shortage is one of the most serious problems that confront many countries. Childhood disease and malnutrition rise dramatically during periods of food deficit.

Guidelines for dealing with seasonal hunger include:

1. During a period of food shortage, use food-for-work activities in the most severely affected areas. Educational and/or outreach activities should be integrated into these activities to help ensure that the weaning-age child will receive the proper quantity and kind of food.

2. When possible, increase food rations through maternal and child health programs in areas most affected.

3. If increased rations are not possible, encourage participants to store, process, and preserve foods for the food shortage season.

Self-Sustaining Programs

Governments' capacity to support complementary feeding programs as well as other social sector programs is often limited. Therefore, it is highly desirable that communities attempt to provide as much local support as possible for social and health services so that they are not wholly dependent on government or donor support.

Examples of community and participant self-financing to support food distribution programs include:

1. Community provision of part or all of the food used in the program;
2. Provision by individual participants of grain which is added to a nutrient-dense food provided by the program, such as nonfat dry milk; and
3. Payment of a small fee by participants; provision of personnel, facilities, and equipment by the community.

Coordination with Health Services

In many countries food distribution programs are considered to be separate from basic maternal and child health services, although in many cases it is the health workers who are actually distributing the food. Complementary feeding programs and maternal and child health services often are directed at the same program objectives and target populations; however, educational messages, growth monitoring standards, and administrative procedures are often different. To increase the effectiveness of complementary feeding programs and maternal and child health services, we recommend that these services be *coordinated* to complement and not to compete with or duplicate each other's efforts. The following measures should be undertaken:

1. At the minimum, a referral system should be set up so that severely malnourished and sick children are identified and referred by the complementary feeding program to the closest appropriate health facility. In addition, children who are identified as at risk of becoming malnourished or who are already malnourished should be referred by the health facility to the complementary feeding program.
2. Educational efforts, messages, and materials should be mutually reinforcing and never contradictory. Frequent meetings and work sessions between program managers, fieldworkers, and health personnel should take place on a community-wide geographic basis.
3. Weighing procedures, use of growth charts, and recording and analysis of data should be standardized throughout a country whenever practicable. Two separate systems tend to confuse program participants and create duplication of effort for personnel. Moreover, lack of standardization is an obstacle to higher level decision makers and planners.
4. Guidelines and/or procedures for integrating and/or coordinating complementary feeding programs and health services should be established and added to the written operating procedures of each program.

The Role of Food Aid

Traditionally, food aid has been used either to meet crisis needs during an acute food shortage or to increase food available to a country's poorest population groups. In many developing countries, complementary feeding programs use foods donated by other countries through multilateral donor organizations, such as the World Food Program and private voluntary organizations, such as CARE and Catholic Relief Services.

In view of the magnitude of world food needs, food aid cannot meet the calculated food gaps. Three important steps developing countries must take to meet their own food needs are to increase domestic production, to improve storage and distribution, and to increase the financial capacity to import food when needed. However, as has been stressed in this manual, food availability alone is not sufficient to improve the nutritional status of the weaning-age child. Unsanitary water supplies, unhygienic living conditions, detrimental weaning practices, and poverty are among the other factors[18] that affect the well-being of the child.

In the context of the need for strategies that encompass the many factors contributing to weaning-period malnutrition, food aid should be viewed:

1. as a temporary resource, available on a short-term basis for a clearly defined number of years to meet identified nutritional needs; and

2. as a transitional measure that serves the purpose of giving a country opportunity and time to test long-term strategies for solving its food problems without draining its resources. If food aid is used in this manner, a country can begin to alleviate malnutrition more quickly than if its own resources have to be developed first before it can address the problem.

Examples of food aid used innovatively to promote long-term weaning strategies include providing a temporary source for an ingredient used in a centrally processed weaning food. When production of the indigenous food crop becomes sufficient to fill the demand, the food aid is discontinued. The following centrally processed food projects have used this strategy: Thriposha in Sri Lanka, Balahar in India, Fava in Ethiopia, and Leche Avena in Ecuador.

Food aid can also be used in household and village-level strategies. For example, Project Poshak, an experimental program in India, promoted community awareness of nutrition problems and stimulated community organization with food aid.

Another possible use of food aid is to test, as did the Thriposha program in Sri Lanka, whether a community will accept the concept of a weaning food before a project makes investments in costly equipment.

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[18] See Chapter III, especially Figure 1.

FOOD AID HAS BEEN USED TO MEET CRISIS NEEDS. At a refugee camp in Somalia, CARE workers distribute wheat, Corn Soy Milk, and tarpaulins to cover makeshift grass houses during the coming rainy season.

(Photo by CARE Intern Beth Bartter)

CHILDREN OF THE REFUGEE CAMP. Two of these children were born in the camp and another came as a young baby.

(Photo by CARE Intern Beth Barter)

SITTING ON THE NEW ROOF. Two small children sit with their 12 year old sister on a tarpaulin issued by CARE to cover their grass and stick house during the coming rains.

Case Studies

Sri Lanka's Thriposha Program

To address the nutritional problems of the young child and to develop an appropriate weaning food in Sri Lanka, CARE and the Sri Lankan government with UN and AID support began in 1972 to develop the Thriposha Program. This program was designed to produce and distribute a centrally processed weaning food, named Thriposha. Thriposha was to be available to at-risk, low-income households through commercial channels and was to be distributed free-of-charge through public health clinics for children six months to 12 months old, and for second and third degree malnourished children 12 months to 72 months old.

According to CARE, the program was not intended for food aid distribution, but for development: it was designed to create and respond to the interest, know-how, and capacity within Sri Lanka to produce, process, and distribute a low-cost, nutritious children's food to gradually replace donated food commodities from the United States. Food aid was to be used only in the first phase to test the acceptability of the concept of a weaning food before costly investments were made in technology and until the supply of indigenous food could meet local demand. Thus, the initial phase of the project distributed Wheat Soya Blend, which had been repackaged and named Thriposha to nutritionally vulnerable groups through public health clinics.

With the introduction of low-cost extrusion technology into Sri Lanka and an increase in soy production and the use of indigenous cereals, the proportion of the donated food (Instant Corn Soy Milk) was reduced to 60% of the mixture. In 1981, 10,000 metric tons of Thriposha were produced, and 90% of this was targeted to approximately 550,000 weaning-age and preschool-age children and mothers. The majority of the children participating in the program at that time were malnourished or at risk of becoming malnourished. A more recent evaluation, conducted in 1982 for the US Agency for International Development, concluded that the package of health services (deworming, immunizations, and health education) that were available with the Thriposha ration significantly improved the nutritional status of program participants; however, the relative contributions of complementary feeding and health services to improving nutritional status was unknown.

The program was originally conceived to meet both preventive and curative objectives of reducing total malnutrition in Sri Lanka. Concurrently in 1981, 415,000 pounds of Thriposha were sold on the open market in four districts of Sri Lanka in order to test the commercial viability of the product and its potential to reach lower income households if sold at low prices through commercial channels. For a one-year period in the early 1980s, Sri Lanka imported foods worth approximately $90 million. It is expected that Thriposha, if it becomes a viable commercial product, will reduce the amount of imports. Table 2 presents some of the major steps taken in program implementation.

Nepal's Home-Based Strategy[19]

In response to chronic food shortages and widespread nutrition problems, the World Food Program has been providing food to Nepal since 1972. Corn-Soy-Milk and nonfat dried milk have been channeled through maternal and child health clinics to pregnant and lactating women and preschool children. Nutrition surveys in Nepal have identified children from six to 36 months old as those most vulnerable to deteriorating nutritional status.

However, Nepal's mountainous terrain places severe burdens on both food production and distribution and greatly affects high logistic costs and sporadic timing of distribution. Other problems associated with food distribution include: (1) lack of adequate storage facilities, (2) difficulty in targeting only malnourished children because mothers of children who are not malnourished also want food for their children, (3) overloading of the health workers with food distribution, which takes time away from other services, including nutrition education, (4) the development of community dependency on the food. In response to these problems the Shanta Bhavan Hospital Community Health Program in Lalilpur district developed the approach, described in Chapter VI, for phasing over donated food to locally grown and home-processed weaning food.

Food aid is believed to have served the following purposes in Nepal:

1. It was used to link food with the health and growth of the child.

2. It served as an incentive for women to come to the clinic and receive other services, such as growth monitoring and immunizations.

3. It acted as an incentive to health workers to remind them that food, not just medicines, was important for keeping children healthy.

There is obviously a need for more comprehensive studies of food aid.

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[19] See also Chapter VI.

(Photo by Ruth Angove)

Table 2

Initial Steps Taken in Implementing the Thriposha Program

Step	Comments
1. Acceptability testing of weaning-food concept.	Donated wheat-soy blend was repackaged and labelled Thriposha and distributed in 750 g plastic packets with a picture of a healthy baby.
2. Integration of program into national clinic system.	a. Participants in clinics were screened to detect malnourished or at-risk children and pregnant and lactating women. b. Thriposha was distributed free through the health system. c. Health workers were trained in the use of weight charts, clinical assessment of malnutrition, and the use of Thriposha.
3. Development of several formulas for Thriposha by the Medical Research Institute.	Criteria for development of alternatives were nutritional deficit information, agricultural production projections, long shelf-life, digestibility, suitable protein and energy content, and precooking.
4. Testing for taste, texture, and acceptibility.	Sorghum and soy were identified as the potential primary ingredients, but corn and other pulses were also used.
5. Increase in soybean production in Sri Lanka after 1973.	The Government of Sri Lanka made a commitment to produce necessary foodstuffs and the FAO with technical assistance from International Soy helped boost soy bean production tenfold over a period of eight years.
6. Commitment by the government of Sri Lanka to purchase all local raw ingredients.	
7. CARE was contracted to process and distribute cereals and soy beans provided by the Government of Sri Lanka.	

Table 2 (Continued)

Initial Steps Taken in Implementing the Thriposha Program

Step	Comments
8. Packaging research conducted.	Three types of bags were tested: for bulk shipment to health centers, for daily purchases, and for biweekly/monthly purchases.
9. Distribution of Thriposha consisting of 20% sorghum and 80% wheat-soy blend in 1974.	One year after concept acceptability testing was begun, this formula was distributed. The limitation of the production process was that baking and grinding were laborious.
10. Production of Thriposha with a low-cost extrusion cooker.	This technology helped to consolidate production steps in one location. Investment costs were funded by the Government of Sri Lanka, the United States Agency for International Development, and CARE. Technical assistance was provided by the United States Department of Agriculture's Nutrition Agribusiness Group and Colorado State University.
11. During the following years formulas were changed to reflect crop availability. Donated Instant Corn Soy Milk eventually replaced Wheat Soy Blend because indigenous corn and soy were identified as the local products that would replace donated foods.	

Chapter IX*

Guidelines for Project Evaluation

Introduction

This chapter is a guide for evaluating weaning-food interventions and is designed to alert decision makers to important methodological concerns and to introduce them to the basic principles of evaluation. The chapter discusses how the purposes of an evaluation affect its design and presents a method for building evaluation mechanisms into a project's design so that a project can monitor its effectiveness both while it is in operation and afterwards. Such a built-in monitoring and evaluation system is the simplest and most cost-effective method of evaluation. However, because of this method's limitations, the appendix to this chapter (Appendix 4) indicates the more extensive and thoroughgoing procedures that an outside expert (someone not involved in planning or implementation of a project) should follow when evaluating a program. The chapter also contains guidelines on evaluating program impact.

The Purposes of Evaluation

The aims of a project evaluation will greatly influence the choice of an evaluator, the procedures to be used, and the cost. The following questions, therefore, should be clearly answered before an evaluation is begun:

- Is the project being reviewed to determine expansion or cutback; to improve program design and service delivery; to decide whether it can be replicated; or for some other purpose?

* The primary contributors to this chapter were David E. Sahn, who provided the first draft and the basic concepts, Karen Mitzner, who extensively rewrote and revised it, and Heidi Van Arsdell and Jim Pines, who made valuable suggestions.

- Will the evaluation be used by granting agencies, national policymakers, program managers, fieldworkers, or others?

The following examples illustrate how the purpose of an evaluation affects its design.

If a group of researchers and planners wanted to introduce an intervention into several locales, they would like to know whether it would work in a selected community and, if so, why. They would, therefore, undertake a research evaluation, which would include a pilot project. The evaluation would place a premium on measuring change accurately and determining whether it was attributable to program activities. To avoid ambiguous findings, the design would need to be rigorous.

On the other hand, if a program's managers wanted to improve local project effectiveness, their evaluation design would not be so exacting. The procedures would be simpler and data would have to be easy for fieldworkers to collect. The evaluation would focus on monitoring service delivery and simple indicators of whether the project had achieved its goals. The best design for this purpose is the built-in monitoring and evaluation system. This design is recommended to projects restricted to the simplest and least costly method of evaluation. The following section discusses both its strengths and limitations.

Building In an Evaluation System

In the literature on nutrition projects, planning, implementation, and evaluation are viewed as separate although supportive components of an integrated process. In practice, however, an evaluation, if undertaken at all, is often added onto the project after it is already operating. If an evaluation is merely an afterthought, its scope, quality, and potential are severely limited. This section advocates building the evaluation system into the project. The tasks of project monitoring and impact evaluation are then merged into a continuous and dynamic information system.

A built-in evaluation system provides program planners, managers, and fieldworkers continuing information on their performance. This feedback can help the local project team recognize breakdowns in implementation and make rational changes in project design and implementation. In addition, field-level data from individual project sites can be aggregated to assess the performance of the project as a whole or even the nutritional status of a region. Outlined briefly below are (A) guidelines for using a built-in evaluation system, (B) the reasons for such a system, and (C) its limitations.[1]

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[1] See "Built-in Evaluation System for Supplementary Feeding Programs—Why and How?" by R. Miller and D. Sahn in D. Sahn, R. Lockwood, and N. Scrimshaw (eds.) *Methods for the Evaluation of the Impact of Food and Nutrition Programs* (Tokyo: United Nations University Press, 1984) pp. 265-287, for more information.

Guidelines for Using a Built-In Evaluation System

Data should be collected on a routine basis at the project level. Fieldworkers should routinely generate data concerning their activities and the population they are serving. In addition, a survey team should be hired to go from village to village to collect information.

Quantities of data should be kept at a minimum. Too much data can prove as detrimental to an evaluation as none at all. Therefore, a built-in system should initially include only key indicators of both a project's activities and its impact. For example, basic activities indicators may include the additional weaning-food provided; the number of children who received them; the number of children immunized; and the attendance levels at education classes. Data related to whether a project has achieved its goals, *impact data*, should usually be limited to weight-for-age statistics, ideally collected from several follow-ups of individual children. When possible it is important to record data on morbidity from infectious disease since illness confounds the effect of diet on weight gain and is itself clearly related to nutritional status.

When mothers come to a center with their weight charts, the health worker should keep track of how many children displayed weight gain and how many did not, or alternatively, use a classification system like the Gomez scheme[2] to provide information on population trends. This information can then be compiled on a village-wide basis to extract trends. Single forms should be used to record and collate computations.

The system should be dynamic. As needs arise to answer different types of questions or as the intervention changes, the system can be altered accordingly. The system must be dynamic so that changes in data collection and analytic procedures can be easily made.

Data should be aggregated and used for management at all project levels. Data from growth-monitoring and other variables (Figure 1) should be aggregated for a defined project area. This information can then be used by the village-level project manager to alter project design and implementation when appropriate. The process of aggregation should be continued at the regional level, and ultimately, at the central or highest level of the program hierarchy.

Analytic procedures should be simple. Data analysis should consist of two principal tasks. The first is carrying out computations, and the second is interpreting the summary statistics. The former can be accomplished with simple analytic methodologies, and basic arithmetic, for example, counting how many children gained weight during the past month and how many did not. With this information and an estimate of the number of infants and preschool children in a village, the evaluator can draw important inferences concerning program effectiveness and impact. For example, calculating how many children were weighed and received a food supplement, divided by the number of

[2] See Chapter V.

Figure 1

Sample Logical Framework[1]

Program Plan	Objectively Verifiable Indicators	Means of Verification	Important Assumptions[2]
Program Goal: -Improved nutrition -Reduced morbidity and mortality	**Indicators:** -Weight-for-age -Weight-for-length -Length-for-age -Morbidity and infant mortality	-Special evaluation survey data -Weight-for-age charts kept for monitoring -Vital statistics	-No widespread epidemics -No drastic drop in standard of living -Feasible to measure impact
Project purposes: -Continued breast-feeding -Complementation at 4 to 6 months -Use of oral rehydration salts -Use of preventive health services -Reduce diarrhea	**Intermediate indicators:** -Dietary surveys -Number of oral rehydration packets used -Duration of breast-feeding	-Dietary surveys -Household consumption and expenditure surveys -Survey to assess changes in knowledge, attitudes	-Late introduction of weaning foods -Endemic diarrhea -Mothers complement diets -Weaning foods will not be shared with siblings[3]
Project outputs: -Health center to provide: -weaning foods to mothers -education classes -educational materials, e.g., health charts -training courses	-Number of food rations provided -Number of workers trained Number of classes held -Curricula and training aids developed -Extruder	-Process indicators kept by voluntary agency -Attendance records -Records on number of classes -Stock and flow reports of food commodities	-No prolonged delays in implementation -Low health worker attrition[4] -Extruder cooker remains functional -MCH clinics exist already -Records are accurate
Project inputs: -Personnel -Training -Equipment -Commodities -Other	-Salaries -Dollars obligated -Commodities clearing customs -Equipment available and assembled	-Grant documents committing funds -Auditor reports -Annual budgets -Staffing lists	-Inputs provided as planned -Government supplies complementary inputs -Records are accurate

[1] The uses of this logical framework in evaluating and program planning are discussed in Appendix 4.

[2] Because the information in the "Important Assumptions" column may not be clear without explanation, the following two examples of project assumptions will be examined in footnotes 3 and 4 below: weaning foods will not be shared with siblings[3] and low healthworker attrition[4].

[3] The assumption that weaning foods will not be shared with siblings assures that outputs reach the appropriate recipients and is a necessary precondition for achieving project purposes.

[4] The assumption of low health worker attrition links input to output: the success of service delivery depends upon trained personnel staying throughout the course of the project.

children in a village, gives a good indication of coverage and outreach. Also, dividing the number of children who gained weight by the total number who were weighed will yield an effectiveness ratio. Figures 2 and 3 are illustrations of the kinds of tables and graphs that may form the basis for a monitoring-evaluation system.

Statistical findings must be reviewed by managers at all levels of the project. This review process will help to identify competing explanations for project results. Such data aggregation and review will help clarify the weakest link in the program hierarchy (for example, the community, district, or regional level) or a breakdown in the delivery of services or achievement of impact. In addition, projects distinguished by their outstanding performance can provide lessons that can be used in other areas.

Reasons for a Built-in Evaluation System

Improves program design and implementation Some of the advantages of a built-in system for improving program design and implementation have been discussed above. Perhaps the greatest advantage of this system compared to other methods of project monitoring is that fieldworkers are much more likely to be involved in, and receptive to, decisions aimed at improving project performance.

Improves data quality Incorporating data collection into normal operating procedures at all project sites results in fieldworkers' sharing responsibility for data accuracy. The project team is involved in using and analysing data and thus has an incentive to produce accurate statistics.

Increases data quantity Data can be collected in longitudinal sequences over time.

Provides contextual information In a built-in system, primary responsibility for interpreting trends lies with those involved in the project. They will have a heightened awareness of confounding variables, such as economic trends and changes in enrollment criteria. Confounding variables are discussed later in this chapter.

The Limitations of a Built-in Evaluation System

This system serves the basic function of monitoring a project and providing management information. Its secondary purpose is to provide insights into program impact. The data it generates come only from the project itself and not from a control or a comparison group as well. The built-in system can provide information that will be very useful to the program team in evaluating intervention effects. However, with these data it is necessary for the evaluator and the program team to be alert to the possible effects of confounding variables. Questions will still remain concerning the extent to which such changes are brought about by the program rather than other influences.

Another limitation of a built-in system is that impact indicators must be limited to simple measurements that can be collected continuously by the project team. Collecting data other than weight-for-age measurements, which

Figure 2

Weighing Group Monthly Report

Month: _____

Date of weighing activities this month: _____

I. GENERAL

a. Name of weighing group : _____

b. Village : _____

c. F.P. fieldworker/supervisor of the group : _____

d. Total number of population : _____

e. Total number of cadres active this month : _____

II. WEIGHING ACTIVITIES

01. Total number of balitas* in the area this month (S**) : _____
02. Total number of balitas covered by program (balitas who have weighing card) (K**) : _____
03. Total number of balitas who gain weight (N**) : _____
04. Total number of balitas who don't gain weight this month _____
05. Total number of balitas weighed this month but were not weighed last month : _____
06. Total number of balitas who come for first visit : _____
07. Total number of balitas weighed this month (D**) : _____
08. Total number of balitas who reach the age of 36 months ( ) : _____
09. Total number of balitas at the age of 36 months who weigh 11.5 kg or more : _____
10. Total number of balitas absent this month (02-07) : _____
11. Total number of balitas under red line this month ( ) : _____
12. Total number of balitas who received Vitamin A this month : _____

III. MATERIAL STOCK

No.	Material	Stock at the end of last month	Received this month	Dispensed this month	Stock at the end of this month
1.	Weighing card				
2.	Vit. A				
3.	Oral rehydration packets				
4.	Iron Tablet				

The chairman of weighing group : _____

Signature : _____

Date of Report : _____

Note:

*balita=children under five years

**The significance of these letters is explained in Figure 3.

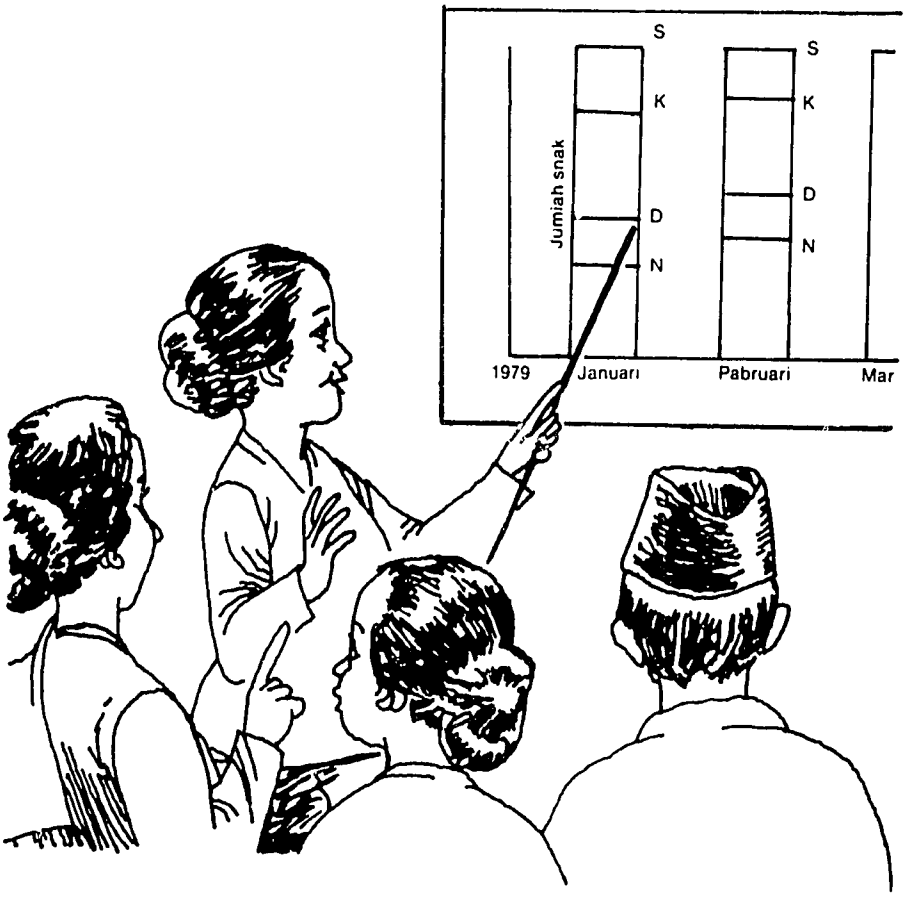

Figure 3
Community Nutrition Profile
Compiled at the Village Level in Indonesia

Symbols on the bar graphs indicating the number of children:

Level S = the number of all children under three years of age in a community

Level K = the number of children with growth charts

Level D = the number of children attending the health center in a given month

Level N = the number of children who gained weight between weighings

Source: *Buku Pedoman Petugas Lapangan UPGK*, Division of Nutrition, Ministry of Health, Jakarta, Indonesia

are usually sufficient for program management, would probably prove too burdensome for fieldworkers.

As a compromise, more comprehensive data could be collected at widely spaced intervals or at the beginning and end of a project. For example, collecting height measurements every six months and weight measurements every two months would provide data on serial growth, as well as data for constructing a Waterlow matrix. This matrix of weight-for-height and height-for-age data gives a reasonably sensitive indication of protein-energy malnutrition. (See Glossary.)

Certain disorders, such as iron deficiency anemia, require blood samples for diagnosis. A decision to collect blood samples, however, must be made with caution, since invasive data collection can lead to irreversible loss of subject cooperation.

Evaluating Program Impact

This section focuses on finding solutions to two major difficulties encountered in evaluating whether health and nutritional goals (impacts) have been achieved. The first is finding simple yet meaningful indicators of nutritional status. The second is identifying whether a program has brought about observed changes and whether they can be attributed to the program. An evaluation cannot have validity, that is, measure what it is intended to measure, unless it answers the following questions: What changes in nutritional status would have occurred in the absence of the program and are there competing explanations of such changes in the population?

Weaning projects most frequently use anthropometric, biochemical, clinical, and dietary measurements as impact indicators.[3] Because these projects emphasize improving children's growth, anthropometric measurements are almost universally used. Therefore, the following discussion will focus on anthropometric measurements, but will include some comments on dietary intake, morbidity and mortality as indicators.

Indicator Sensitivity

An evaluation of nutritional changes should be based on indicators that will reflect them as sensitively as possible. In choosing indicators, however, the evaluator must take into account financial and field-level constraints.

Anthropometric indicators[4] The most thoroughgoing assessment of nutritional status can be made using several anthropometric indicators because no single measurement can assess all types and degrees of protein-energy malnutrition. For the age group under three years of age, weight-for-age is a fairly

[3] An in-depth discussion of morbidity, mortality, microeconomic household consumption and expenditure data, work performance, cognitive performance, and other impact indicators may be found in *Methods for the Evaluation of the Impact of Food and Nutrition Programs* (Tokyo: United Nations University Press, 1984, pp. 265-287) by D. Sahn, R. Lockwood, and N. Scrimshaw.

[4] See Chapter V.

reliable indicator of acute nutritional status. Beyond this time, however, retarded weight-for-age is increasingly likely to reflect earlier malnutrition of individuals whose weight-for-height and even growth rate have become normal. It is for this reason that a combination of indicators is necessary to cover the age span from zero to five years. *The best combination of indicators is measurements of skeletal growth (height-for-age), body tissue mass (weight-for-age), and fatness or thinness (weight-for-length and weight-for-height), collected over time by fieldworkers.* Serial measurements of weight, reflecting failure to grow or actual wasting of body tissues, are the best indicators of individual children at immediate risk of serious undernutrition.

Using indicators without understanding what they can and cannot measure will lead to inaccurate evaluations. In choosing indicators, the evaluator must consider the severity and duration of the undernutrition and how much improvement is expected from the intervention. To illustrate, consider the following limitations of several anthropometric indicators:

1. *Weight-for-age* may be low for any of the following reasons: wasting of tissue mass without deficient skeletal growth; stunted skeletal growth without tissue wasting; a combination of stunting and wasting. With this measurement, children may be classified as malnourished even if their weight-for-height is normal.[5]
2. *Weight-for-height* measurements may not be sensitive to improved nutritional status of moderately malnourished children because they maintain almost normal skeletal growth.
3. *Arm circumference* responds only to extreme changes in nutritional status, and, therefore, is not likely to reflect improvements resulting from an intervention except in children who are severely malnourished to begin with.

The sensitivity of mortality and morbidity as indicators The evaluator must be cautious when using mortality and morbidity data as indicators of nutritional impact. The most serious limitation of the precision of mortality as an indicator is that death has many possible causes other than malnutrition. Nevertheless, postneonatal-preschool mortality is due largely to malnutrition as a direct or contributory cause. Morbidity from diarrheal and respiratory disease in infants and preschool children is also strongly influenced by nutritional status. The presence of disease in an *individual* at a given point in time is so influenced by seasonal and chance factors that it cannot be used to indicate a given child's nutritional status. However, a high prevalence of infectious diseases in a *child population* is highly suggestive of a combination of poor nutritional status of the group and of poor environmental and personal hygiene.

Longitudinal measurements of the prevalence of morbidity in a population

[5] See Chapter V for a more extensive discussion of weight-for-age, weight-for-height, and arm-circumference measurements.

may be used to reflect changes in nutritional status over time, including beneficial effects of complementary feeding programs. In making such an interpretation, however, allowance must be made for changes in programs of immunization, environmental sanitation, and personal hygiene.

Measurement Accuracy

Anthropometric measurements Accurate data collection in the field and their translation into a form suitable for analysis requires motivation and care. Fieldworkers are likely to make errors when they are overburdened or unconvinced of the usefulness of accurate measurements and records. Inaccuracy in field measurements is not a trivial problem that can be taken for granted and ignored. *Measurement errors can have serious effects on program findings.*[6] Such errors do not cancel one another out because, as a group, they exhibit patterns of consistent bias. For example, if the weights registered on a scale are incorrect, they are ordinarily consistently erroneous, that is, either too high or too low by about the same amount.

Even slight measurement errors can profoundly affect the way in which a child's nutritional status is classified. For example, in a rice fortification study in Thailand, to account for daily weight fluctuations in a child's weight, a bias of 0.3 kg was assumed in each child's weight-for-height measurement. Building in this assumption caused a drop from 36% to 25.2% in the percentage of children classified as malnourished. Not only do consistently biased errors affect classification of nutritional status; random errors will obscure the difference between experimental and control groups so that the difference will tend to lose statistical significance.

Dietary intake Measurements of dietary intake that seek quantification such as asking a mother how much food her infant has consumed in the past 24 hours or measuring the food consumed in a household for several days, are often imprecise. The mother may not remember or may not be able to describe accurately the food or its quantity, although this is less of a problem in the early complementary feeding period when variety is very limited. Moreover, a baby may be fed by people other than its mother. Serial dietary intake data are useful for indicating trends; however, the quantitative value of such data as indicators of impact may be very limited.

Mortality The greatest obstacle to drawing accurate inferences from mortality rates is sample size because death is a relatively rare event. A sample for determining mortality rates should, therefore, be based on a total population of at least three thousand or more, depending on the rates of birth and child mortality and the level of precision required. (In determining sample size, the advice of a statistician should be sought.) The use of mortality rates as indica-

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[6] Readers may be interested in a study by Drake and co-workers who demonstrate the effect of measurement errors on the rate of malnutrition reported: *Nutrition Programs in Sri Lanka U.S. Food Aid* (draft) (Ann Arbor, MI: Community Systems Foundation, 1982). Independent of the kind of error made, the study found that the rate of malnutrition reported was too low.

tors is complicated by more than the large sample size required. The census and age data needed for calculating mortality rates (in a given population, the number of weaning-age children who died/the total number of weaning-age children in the population) are unavailable in many parts of the world.

Collecting mortality data per se presents additional obstacles. Vital events registries are generally not well maintained and often ignore fetal deaths, stillbirths, and unattended births. Moreover, there may be social or political disincentives to reporting early deaths. Sex preferences and class-related biases often produce inaccuracies in vital statistics. The other primary source of mortality data is mothers in a community. A survey of mothers can be designed, for example, to collect data limited to a specific reference period, such as the last harvest, or to record complete pregnancy and birth histories. Unfortunately, surveying is not only costly, it is also subject to error because death is a sensitive topic. Mothers sometimes overlook or misreport information.

Data Analysis: Problems and Recommendations

Standards and presentation of data The choice of standards of comparison for the evaluation indicators (Figure 1) will greatly influence the results of impact assessment. For example, selecting a cutoff point for first-degree malnutrition of 90% rather than 85% of the median weight-for-age will result in significantly different calculations of the number of malnourished children in a population.

Often, the choice of which reference values to use for comparison is made difficult both because of differences in definitions of the concept "normal" and also because of the belief that standards are ideals. Whatever reference values are chosen, they should be viewed as potentials and not as ideals or targets. They should serve as means to categorize or compare data. For this nonclinical purpose the World Health Organization International Standards, which are equivalent to the U.S. National Center for Health Statistics (NCHS) Standards, are the reference values of choice.

Waterlow and others have recommended that for relatively undernourished populations, children's weight-for-height and height-for-age should be expressed as multiples of the standard deviation of the reference population (Z scores) rather than as percentages of the median. In addition, it is recommended that the deficits in height and weight be evaluated together by cross-tabulating height-for-age against weight-for-height. For undernourished populations, the latter are both expressed as standard deviation scores. This method allows the evaluator to distinguish between wasting and stunting and solves some of the problems of indicator limitations described in this chapter.

Choice and interpretation of data Impact evaluations should adhere as closely as possible to the basic principles of social science research. An evaluator should begin an evaluation by formulating standard operating procedures that include information on what hypotheses will be tested. In addition, the types of data and the sample sizes required to reach unambiguous conclusions should also be determined.

The choice of sample sizes is one of the least understood and most neglected areas in impact evaluation. The size of a statistically adequate sample is contingent upon several factors, including:

1. the variables to be estimated
2. the normal variation expected in these variables
3. the accuracy desired
4. the number of categories, such as age or occupation, in which one is interested
5. the design of the study, for example, cross-sectional or longitudinal.

In practice, logistical difficulties and the cost of obtaining a sample often influence the choice of how many individuals to include.[7]

Quasi-experimental and Nonexperimental Designs

How to design longitudinal research studies using epidemiological techniques to determine multifactorial causation is beyond the scope of this manual. Guidelines for such studies have recently been published.[8]

The following designs listed in order of complexity are widely used for program evaluation when personnel and financial resources are limited or when more thorough studies are necessary.

Preintervention and postintervention testing of one group The nutritional status of a target group is measured before or at the outset of an intervention. The measurements are repeated after the intervention to determine what changes have occurred. Although this design is very simple and has the advantage over the other designs listed here of involving measurements of only a single group, it may have the disadvantage of a substantial time lag between initial and final measurements. In its simplest form this design does not control for many threats to evaluation validity, some of which are discussed in the next section.

Comparison of long-term participants with recently enrolled individuals The nutritional status of children who have been participating in the project for a meaningful period of time is compared with that of recently enrolled individuals. This design may control better than the single-group design for some threats to validity.

Comparison of a group that receives services with a control group that does not After a project is underway, the status of the group receiving services and that of a similar population not receiving services are compared. A sophisticated variation of this technique involves matching two groups (a control and a treated group), using statistical techniques. If treatment and control groups are

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[7] For a fuller discussion of sample size, see *Statistical Methods*, 7th edition, by G. Snedecor and W. Cochran (Ames, Iowa: Iowa State University Press, 1980) and *Statistical Power Analysis for the Behavioral Sciences*, by J. Cohen (New York: Academic Press, 1969).

[8] See D. Sahn, R. Lockwood, and N. Scrimshaw, in *Methods for the Evaluation of the Impact of Food and Nutrition Programs* (Tokyo: United Nations University Press, 1984).

drawn from two villages that are geographically well separated, this design can control for the spillover effects of a project, which may hamper evaluation in a single village. However, this design may be limited by logistic difficulties and other threats to validity.

The evaluator should be familiar with the full range of strengths and weaknesses of these and other design options.[9]

Validity

Validity refers to whether the indicators used in an evaluation measure what they are intended to. For example, growth monitoring data may be valid indicators of project success or they may show improvement for reasons unrelated to the project. With designs such as those described above, statistical techniques, such as regression analysis, can be used to assess the influence of several factors that may be important determinants of nutritional status. Nevertheless, controlling for the effects of confounding variables that influence nutritional status in addition to intervention variables is problematic: evaluators often fail to investigate factors that may add to or negate a project's effects. The following simple procedures are extremely useful in controlling for confounding variables:

- First, evaluations should only compare children within narrowly defined age spans (from birth to 6 months; from 6 months to 12 months; from 1 year to 2 years; and from 2 years to 5 years), because nutritional risk in preschoolers is related to age. For example, at the onset of weaning, exposure to pathogenic material, and hence risk of infection and disease, is drastically increased in children in nearly all impoverished settings. Moreover, early in infancy immune competency is not fully mature. Very young, newly weaned infants are, therefore, more likely to have poorer nutritional status than older infants.
- Second, evaluations should account for changes in treatment or control group composition, resulting from new enrollees or dropouts. To illustrate, if the most malnourished children die, and, therefore, are dropped from aggregate statistics, a program may appear to be highly successful when, in reality, it is a dismal failure. On the other hand, a program may expand to accept new enrollees, such as children from distant communities with very poor nutritional status. Their inclusion in aggregate statistics may make an intervention appear ineffective, when in fact it was so successful that it was able to reach out to those in greatest need.
- Third, evaluators must account for the statistical phenomenon that causes the nutritional status of a sample to spontaneously regress toward the mean[10],

[9] For detailed information, see *Health Program Evaluation* by S. Shortell and W. Richardson (St. Louis: CV Mosby, 1978).

[10] D. Campbell and J. Stanley provide an extensive discussion of this common statistical phenomenon in *Experimental and Quasi-Experimental Designs for Research* (Chicago: Rand McNally, 1966).

that is, to show improvement. For example, if children are classified according to three grades of malnutrition and each category is considered separately, individuals at the extremes of the category tend to migrate toward the mean, even though there is no intervention. The individuals who worsen beyond the limits of definition of a given category of malnutrition would then be classified in another category. To illustrate this effect, consider the example of children who are, according to the Gomez system, classified as Grade III malnourished.[11] The most severely debilitated children in such a sample are likely to die if untreated. The nutritional status of the group as a whole would, therefore, appear to improve: those children who had the poorest health status would no longer be included in the sample and the status of the remaining children would either stay the same or improve. Thus, if the proportion of Grade III children is not the same in the treatment and control groups, the evaluation should estimate how much they are expected to improve.

In addition, care must be taken in evaluating the impact of an intervention on the most severely malnourished, especially when indicators such as weight-for-height are used. At issue in assessing impact on the most severely malnourished is the phenomenon that individuals tend to cluster around certain points in a measurement scale such as weight-for-height. Using cut-off points is, therefore, imprecise. A more precise method is evaluating the pattern of distribution of the points, such as a Z-score pattern.

As important as statistical techniques are in eliminating confounding variables, these methods cannot account in and of themselves for the dynamic, and often volatile conditions in communities. The evaluator should, therefore, involve the field team in the interpretation of data because they will have invaluable insight and knowledge concerning the effects of local conditions on the project's efforts, such as an outbreak of measles, fluctuations in the price of crops, or government instability. An evaluator who collects data and then retires for data analysis to a computer terminal in a far-off city or country is likely to reach spurious conclusions. Analysis and interpretation of data by people who have not participated in the original project or the data collection process and who have, perhaps, never even visited the site is even more likely to produce inaccurate results.[12]

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[11] See Chapter V.

[12] For extensive discussions of threats to evaluation validity, see D. Campbell and J. Stanley *Experimental and Quasi-Experimental Designs for Research* and "A Review of Issues in Nutrition Program Evaluation," *AID Program Discussion Paper No. 10* by D. Sahn and R. Pestronk (Washington, D.C.: U.S. Agency for International Development, 1981). Sahn and Pestronk also indicate the controls in various evaluation designs for specific threats to validity; their publication is available from: Editor of ARDA, S&T/DIU/P/, Bureau of Science and Technology, Agency for International Development, Washington, D.C. 20523.

Chapter X*

The Appropriate Mix of Weaning-Food Strategies

The Principal Weaning-Food Strategies

The principal strategies for directly improving the nutrition of the young child in the lower socioeconomic populations of developing countries during the weaning period are:

1. developing and promoting home- and village-prepared weaning foods;
2. increasing the availability and consumption of indigenous centrally processed weaning foods marketed through commercial channels;
3. distributing donated and locally produced weaning foods.

The success of any of these strategies depends upon solving the problem not only of making a weaning food available and of educating people to use it properly, but also of communicating the nutrition information necessary to promote and facilitate good weaning practices in general.

Two kinds of government programs can contribute importantly to the success of these strategies, alone or in combination. One is a primary health-care program incorporating care of both mothers and children and the other is a program of entitlements for nutrition and health-education activities, including promotion of appropriate weaning foods. The effectiveness of weaning strategies can also be increased by subsidized weaning foods, weaning-food stamps, or some other means of ensuring that the very poorest people have sufficient food for their young children.

Selecting Weaning-Food Strategies

Social Costs and Benefits

Each of the three principal strategies discussed above suits different populations and is influenced by a number of factors and resources. Tables 1 and 2

* The primary contributors to this chapter were Nevin Scrimshaw and Richard Lockwood.

indicate some important general factors and resources that must be examined by decision makers to determine what is necessary to implement each strategy and the best way to combine them in a given country.

The primary determinant for a planner to consider in selecting a particular strategy is the relative priority that a nation gives to the well-being of infants and preschool children. First, a planner must analyze the relevant constraints, conditions, and other factors that determine the feasibility of the various weaning-food strategies. Then, an analysis of the monetary and other costs of selecting or not selecting a particular strategy must be made. These costs can next be evaluated in the context of available government resources and other government priorities.

The choice of strategies by government decision makers usually involves at least qualitative estimates of the relative political, economic, and social advantages of each strategy and of its costs. The definition of social benefits and costs will vary with the nature of a society and the policies of its government.

A government planner must be concerned with the nutritional effectiveness of a weaning-food strategy, especially in alleviating nutritional problems in low income groups, because these groups do not have the money to purchase nutritious foods even if they are available for sale. The following questions, relevant to low income groups, can be useful in this evaluation. Such questions must be asked systematically for each strategy and for each population in a country.

- Will promotion of a given program with government funds diminish the incidence of malnutrition among the children of weaning age most in need?
- Will the processed foods being considered for government promotion be too costly for the low income groups they are intended to benefit?

Table 1
Factors to Consider in Selecting Weaning-Food Strategies

Primary Factors	Home- and Village-Prepared Foods (HVPF)	Commercially Produced and Marketed Foods (CPMF)	Donated Foods (DF)
Family agricultural land	Useful, but not essential	Not required	Not required
Women's time	More required than for CPMF and DF	Less required than for HVPF	Less required than for HVPF
Family income	Minimal amount required	More required than for HVPF and DF	Minimal amount required

- Will the food-purchasing and consumption patterns of households be adversely or favorably affected by vigorous promotion?

The Selection Process

Each weaning program needs its own set of resources (Table 2). A home- and village-prepared weaning-food program, for example, cannot depend on a health-delivery system that reaches only a small proportion of the population at risk, a nutritional and health education system that is ineffective, or an agricultural extension service too weak even to influence farming practices.

Additional factors that need to be assessed to successfully implement a home- and village-based weaning-food program include: women's time, food cost, and fuel cost. One must weigh the relative merits of a product that is inexpensive but requires significant cooking time and one that requires little fuel or preparation time but has the disadvantage of being more costly. Because

Table 2

Governmental Resources Needed By Each Weaning-Food Strategy

Resources	Home- and Village-Prepared Foods (HVPF)	Commercially Produced and Marketed Foods (CPMF)	Donated Foods (DF)
1. Administrative Resources			
a. bureaucratic manpower	More needed than for CPMF and less than for DF	Less needed than for HVPF and much less than for DF*	Much more needed than for HVPF and DF
b. office to determine eligibility	Unnecessary	Needed*	Essential
2. Operating Resources			
a. storage facilities	Desirable	Needed**	Essential
b. transportation	Unnecessary	Needed**	Essential
c. distribution network	Unnecessary	Needed**	Essential
d. monitoring and evaluation	Important	Important but partly provided by sales	Important
3. Health Delivery System	Useful	Useful	Essential
4. Agricultural Extension	Useful	Not involved	Not involved
5. Nutrition Education Capacity	Essential	Useful	Useful

* Administrative resources are needed if CPMF are subsidized for low income groups.

** Privately owned operating resources will be used if CPMF are not subsidized for low income groups.

of their greater purchasing power and access to products, urban women are much more likely than rural women to choose a precooked weaning food. Rural women may desire it, but usually cannot afford it. However, planners must be conscious that even a favorable assessment of the factors of women's time and purchasing power is not an adequate basis for choosing a given weaning-food program. Education and motivation are necessary for most women to select and prepare nutritious weaning foods.

Any weaning program's success depends upon how well project personnel understand the socioeconomic and other factors determining weaning behaviors in a target population, as discussed in Chapter III. Also, the costs and benefits of each program must be weighed separately for each target population. On a national level, because of the several different sets of population characteristics, cost and benefit assessment is very complex, and the resulting political choices are very difficult.

Indirect Solutions to Weaning-Age Malnutrition

Land Reform and Wage Legislation

Because of the constraints imposed by political and economic conditions, planners need to consider indirect approaches that will affect the two principal factors limiting appropriate feeding of the young child — inadequate knowledge of sound nutrition and hygiene practices and lack of purchasing power. For example, where severely unequal land distribution prevents most rural families from growing their own food or the cash crops that would enable them to buy the foods they would choose, land reform may be, in a social sense, the preferred approach. However, because of political conditions, the existing land-tenancy structure is likely to be maintained in many developing countries and instead, money will probably be expended on a delivery system for donated foods, despite their high administrative and social costs. These social costs often include both the loss of an incentive for local farmers to grow weaning-food ingredients and for local manufacturers to produce weaning foods based on them as well as the misuse of weaning foods because people lack adequate nutrition education. In cities, minimum wage legislation and the organization of consumer cooperatives may help the weaning-food problem, but, for political reasons, may be as difficult to achieve in some countries as land reform.

Time-Saving Technologies

In locales where many women do not have the time to prepare their own weaning foods at home, money might best be spent on the introduction of technologies to decrease the burden of time-consuming activities. For example, the time available for child care can be increased by reducing the time spent collecting fuel-wood, or carrying water, or milling and grinding grains by hand.

Examples of technologies that may be appropriate are deep-water wells, mechanical mills, and biogas digesters for producing methane gas for cooking.

Food-Preserving Programs

Excessive losses from rodents, insects, mold, and simple spoilage can be prevented through postharvest food conservation programs, which promote, for example, sun-drying of grains and using closed storage bins.

Government Subsidies

The involvement by the private sectors of a number of countries in the development and marketing of centrally processed weaning foods for low-income groups has been extensive, but not generally successful. A major problem is that most of these efforts have received little or no government support, even in reaching populations with purchasing power too low to benefit from such foods without government subsidy. Government involvement in the marketing of centrally processed weaning foods can be useful and often decisive. Subsidizing the consumer price of a given food commodity, protecting it from unnecessary imports, or promoting its use through the health-delivery and educational systems will frequently determine the success or failure of an indigenous centrally processed weaning-food effort. Lowering the consumer price of a given food commodity for those most in need results in increasing real purchasing power and can lead to a favorable reallocation of food within the household.

General subsidies for marketed foods are inefficient and costly. Therefore, a subsidy should be limited to a particular food or a particular target group. Finally, the form the subsidy takes, whether it be food stamps for consumers, ration shops, or special outlets, such as free food distribution, will affect the cost and coverage of the program. Government planners must decide whether a price subsidy and its associated administrative and managerial costs will be justified by its impact on weaning-age malnutrition.

The Need for Multiple Strategies

National strategies must be multiple because a country's subpopulations live in varying locales and differ in their ability to produce or acquire food, in how much time and fuel they have for preparation, and in their life-styles. For example, in most rural areas home- and village-based weaning foods may be the only effective strategy, although centrally processed foods may be more successful in urban areas where mothers work outside the home and do not have the time to prepare their own weaning mixes. However, this distinction should not be applied in a simplistic manner. Time may be a seriously limiting factor for rural women and, therefore, processed foods would be an acceptable

alternative if they are affordable. Freeing time for a mother may benefit the health and welfare of the family quite apart from nutritional considerations, allowing her, for example, to improve sanitary conditions in the home, do additional agricultural tasks, or participate in income-generating activities.

Within some subpopulations, such as urban women, there can be a place for all three types of weaning-food strategies. For those urban women who work outside the home, processed foods may be the best solution. Urban women not working outside the home may be in a better position to prepare their own weaning mixtures. For urban women for whom extreme poverty is a major factor in child malnutrition, there is a role for donated weaning foods. These can be provided on a take-home basis, consumed in centers, or distributed in some other way, such as a coupon system. Some kind of subsidized distribution or other entitlement program must be part of a government strategy to reach the poorest of the poor.

Home- and Village-Prepared Foods

In general, the cheapest and most accessible weaning foods are those prepared in the home from supplies usually stocked in the household. The appropriate complementation of breast-milk at the age when a child's growth is most likely to falter requires such small quantities of the household diet as to have a minimum economic impact on the family. However, effective communication of nutrition information is necessary for families to combine and prepare household food supplies suitably. Nutrition education, which is technically difficult and frequently ineffective, requires a substantial investment.

Compared to using centrally processed or donated foods, the home-and-village-weaning-food approach has the advantages of allowing for intervention at multiple points in the nutrition system and of being applicable to all segments of society to some degree (Table 3).

Centrally Processed Weaning Foods

Compared with the costs incurred for home- and village-prepared food programs, the costs of centrally processing, packaging, and distributing even the cheapest combination of ingredients are greater. Furthermore, it is impossible for those most in need to purchase food in adequate amounts.

Coverage can be improved and centrally processed weaning foods made available to a broader segment of those in need through government price subsidies.

Donated Foods

Donated foods are primarily useful for emergency relief of acute food-shortages, for example, those caused by floods or droughts. Donated foods are not a desirable substitute for long-range solutions to undernutrition that promote self-sufficiency—weaning foods produced in the home and village or centrally processed foods. If donated foods flood a country or if the incentive to produce

Table 3

Appropriateness of Weaning-Food Strategies For Selected Target Populations

Target Households	Weaning-Food Strategies		
	Home- and Village-Prepared	Marketed	Donated
Rural	++	+	+
Urban	+	++	++
Mothers Working			
Within Household	++	+	**
Outside Household	+	++	**
Low Economic Status	++	*	+
Medium Economic Status	+	++	-

Key: + Indicates appropriate target
++ Indicates most appropriate target
– Indicates inappropriate target
* Inappropriate without a consumer subsidy or other entitlement program
** Whether a mother works inside or outside the home is irrelevant for determining the appropriateness of donated foods.

centrally processed foods is otherwise weakened, they can have a deleterious effect on indigenous food-producing efforts.[1]

The Educational and Legislative Roles of the Government

Clearly, governments can play an important role in improving the nutritional status of weaning-age children by adopting policies and programs supportive of effective weaning-food strategies. Governments should implement the following policies and activities:

Stress the advantages of breast-feeding and breast milk in advertising materials and other kinds of messages for the public and health professionals.[2]

Emphasize the importance of timely complementation of breast milk to avoid growth failure, the ensuing complications of infectious disease, and impaired cognitive performance. This is best done by making infant growth charts the basis for educational and preventive efforts.[3]

Identify the weaning-food mixtures most easily and economically prepared in the home from foods available and acceptable to the household. The government should develop materials for teaching their use to professionals, paraprofessionals, mothers, and future mothers in the schools.

Encourage the development of centrally processed weaning foods, nutri-

[1] Chapter VI discusses food-aid problems encountered in Nepal; Chapter VIII discusses the transitional role food aid can play in a country's strategies to develop sound long-term solutions to weaning-age malnutrition.

[2] See Chapter VII, footnote 18.

[3] See Chapter V.

tionally equivalent to cow's milk. For most developing countries, cow's milk is in short supply and too costly to use. Nutritionally equivalent foods made from vegetable sources cost much less. Such foods will be useful for those who have some discretionary purchasing power, no matter how limited, and for those who choose a time-saving convenience food despite its higher cost.[4]

Establish entitlement programs, such as food stamps, to provide protection against severe malnutrition for the very poor. Their diet is likely to be deficient in quantity and quality for the needs of their children, and they cannot afford processed weaning foods.

Require manufacturers and distributors of centrally processed weaning foods, especially those designed as breast-milk substitutes, to refrain from advertising or promoting them in ways that would discourage either initial or continued breast-feeding. Moreover, cereal mixtures that are nutritionally inadequate, corn starch, cassava starch, and other commercial products of low nutritional value should not be encouraged for infant feeding and as weaning foods.

Formulate policies concerned with the production, importation, or pricing of milk, using the exceptional nutritional value of cow's milk as a guideline.

The Role of Institutions

Just as the approach to strategies must not be limited to a single methodology, so also the initiation of projects should not be the monopoly of any one sector or institution. Depending on political and social circumstances in a country, concern for the young child during the weaning period may be primarily a function of central, state, or local government, or of a semiautonomous government agency. In countries where government services are weak or poorly organized, nongovernmental agencies may play a particularly important role in initiating weaning-food projects.

International agencies A great deal of the stimulus and support for actions on the part of governments to improve the feeding of young children has come from international agencies, particularly the World Health Organization (WHO) and the United Nations International Children's Emergency Foundation (UNICEF). These agencies have recently sponsored the development of a code for the marketing of infant formulas that emphasizes the importance of complementing breast milk once it is no longer adequate as the sole source of food.[5] The Food and Agricultural Organization (FAO) has sometimes been involved in the development of local weaning foods, and the World Bank has supported maternal and child health programs that incorporate both child weighing and weaning-food distribution.

Bilateral agencies Bilateral agencies, those representing donor governments such as the United States Agency for International Development (AID), the

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[4] See Chapter VII, Table 9 for possible forms of governmental interventions.

[5] WHO, *International Code of Marketing Breast-Milk Substitutes*, (Geneva: WHO, 1981).

Canadian International Development Agency (CIDA), the Swedish International Development Agency (SIDA), the Norwegian Agency for Development (NORAD), the Danish International Development Agency (DANIDA), have contributed to developing weaning programs, including centrally processed and home- and village-based foods. Ministry of Overseas Development (MOD), a United Kindgom agency, has furnished technical assistance in child nutrition to several World Bank projects on population and health. Other bilateral agencies have also provided national and international foundation assistance, usually in support of the efforts of a national institute of nutrition or a nutrition department of a university to develop and test appropriate weaning-food products.

University institutes One example of the role of university institutes can be found in Thailand. Since 1972, the Institute for Food Research and Product Development (IFRPD) of Kasetsart University in Thailand has produced a nutritious product based on textured mung bean protein. It has been used as a protein source for infant feeding and child feeding in government and institutional feeding programs in that country. Thailand's food processing industries have the capacity to produce mung bean protein and other protein-rich food products. Marketing channels are also well developed. However, major difficulties remain.

These include inaccessibility of target populations, inadequate nutrition understanding, insufficient purchasing power, and poor acceptability of new products in traditional diets. To help overcome these problems the Thai government has attempted to expand its network of child-care centers and broaden their coverage to include weaning infants. It has been suggested that the government should also consider partial subsidization to keep prices within the reach of low income families.

In the case of IFRPD's weaning food, three different institutions collaborated: a university food research institute, a private business, and the national government.

Government-affiliated research insitutes An example from Guatemala illustrates the involvement of this kind of institute in a weaning-food project. Incaparina was developed in the 1950's by the Institute of Nutrition of Central America and Panama (INCAP) in Guatemala. It was not a specific formula. Instead, Incaparina was a concept for combining any well-processed oil seed meal and a cereal in a ratio of 1:2 and adding vitamins and minerals. This weaning-food model served as a stimulus for other countries to develop their own centrally processed weaning foods, using locally available oilseed meal and cereals. Bal-Ahar in India and Colombiharina in Colombia were based on the Incaparina model, and Superamine in Algeria and Egypt followed similar principles. None of these weaning foods except Bal-Ahar has reached the poorest segments of society to a significant degree because they have not been sufficiently subsidized.

With one exception all of the centrally processed weaning foods mentioned above have required collaboration among a food-research institute, private

enterprise, and government. The exception, Incaparina, never had direct government support.

Coordination of Intervention Efforts

With so many potential interveners, there is bound to be confusion and overlap in efforts and, therefore, a need for coordination and cooperation. While the Ministry of Health generally oversees intervention efforts, this is by no means always the case. School-feeding programs sponsored by Ministries of Education may in fact include older preschool children; Ministries of Social Welfare may see the welfare of the mother and child as part of their responsibility; and ministries concerned with special sectors of a population, such as Rural Development or Labor, may also wish to institute programs for the mother and young child. In one large Asian country some years ago, five different ministries had established feeding programs for the preschool child, none of which was reaching the very young preschool child most in need, and none reaching more than a token number of children.

The most important aspect of a weaning-food program is not the provision of weaning foods themselves since most mothers can meet the critical need for complementation of breast milk by a small redistribution of the family food supply, perhaps only 2% depending upon family size and composition. If an adjustment of even this magnitude is not feasible, complementary food should be made available to the family from some source.

The use of growth charts[6] to educate and guide the mother as to when a weaning food is necessary is the most vital component. Ideally, of course, the health-care delivery system of a country should monitor the weight charts and provide interventions beyond simple advice when necessary. However, if a health-care delivery system does not reach more than a small proportion of the population, other means must be sought for directly involving the community.

The Ministry of Education in some countries and the Ministry of Rural Development in others can very effectively reach village populations. In addition, nongovernmental organizations or even the university systems can provide support. In Indonesia, university students who spend time in individual villages have proved to be effective potential organizers of village weighing programs. In other countries, voluntary agencies have supported weaning-food programs. While the greatest stimulus to weighing projects and weaning-food programs has often come from UNICEF, it must work through governments. Thus, it is limited by the policies and effectiveness of government institutions in a country. In some circumstances nongovernmental organizations may be the only effective means for establishing or monitoring programs.

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[6] See Chapter V.

Conclusions

No single weaning-food strategy is suitable for a country's entire population. Home- and village-prepared food projects, the development of centrally processed weaning foods at the lowest practical price, and the provision without charge or at subsidized cost of either village-prepared or externally donated centrally processed weaning foods to the poorest of the poor are all necessary. The distribution and promotion of weaning foods through these strategies must be carefully coordinated so that they do not interfere with one another.

In general, priority should be given to the promotion of home- and village-prepared weaning foods that are made from usual components of the adult diet or materials that are readily and cheaply available locally. However, enthusiasm for this approach should not prevent recognition of the desirability of having centrally processed weaning foods available at the lowest practical price. They can be critically important for working mothers and others for whom convenience is important, but who are unable to afford regular commercial infant weaning foods.

The free distribution of food aid should not be so generous as to suppress the development and production of local centrally processed foods, as has unfortunately occurred in a number of countries in the past. Sometimes the provision of one or more ingredients of a processed weaning food through food aid can facilitate its production and low-cost distribution. Obviously, a weaning-food production effort struggling to survive without government subsidy will fail when a country becomes flooded with alternative foods. Conversely, sound government policies can lead to the success of such an effort without direct government expenditures.

(Photo by Ane Haaland)

Appendix 1*

Basic Ethnographic Techniques and Interview Guidelines

Basic Ethnographic Techniques

Ethnographic techniques enable a fieldworker to develop a basic *ethnography*, that is, a detailed recording of the sociocultural context in which behavior occurs. The purpose of ethnographic work is to gain an understanding of behavior that is sufficiently detailed to allow accurate interpretation.

Record Keeping

The following kinds of records may be useful to a weaning-food project team:

Field notes Members of the project team may take brief notes of their observations, interviews, and conversations. These notes can later be amplified in detail. Amplification should be done on a daily basis. Time should be set aside specifically for this task. The following are guidelines for note taking:

1. Take *brief notes* during interviews except when note-taking may inhibit the conversation (for example, a woman may take a fieldworker aside and tell her something the woman considers very confidential). Notes should include questions and key words in responses. Occasionally it may be useful to note the exact words of a conversation, using quotation marks, for example, "I gave him even the last drop." The fieldworker should also note what he or she observes, using parentheses, for example: (She's telling me that mothers should be careful to feed their children clean foods. But when she changed her baby's diapers, which were soiled with diarrhea, she did not wash her hands. She handled weaning food shortly afterwards, and then fed her baby.)

2. Expand the brief notes the same day they were taken. The key words in the notes should remind one of many phrases and ideas.

* This appendix was adapted from conference materials by Susan Scrimshaw and Elena Hurtado, and will appear as "Field Guide for the Study of Health-Seeking Behavior at the Household Level" in *Food and Nutrition Bulletin*, 6 (2), in press.

3. While notes are being expanded, add any impressions in parentheses, for example: (She hesitated and twisted her hands a little before replying to my question concerning how often she gave her baby cheese. Her answer may have reflected what she thinks I believe is a desirable practice, not what she usually does.)

4. Review the notes daily and note any questions that may arise. These questions may provide the fieldworker with reminders for the next interview or conversation, for example: (I still need to ask her why she thinks you have to get babies used to eating solid foods from the very first month.)

Tape recorders. Consider the pros and cons of tape recorders very carefully. Remember that everything recorded will have to be interpreted or transcribed. Be sure that tape recordings do not inhibit the conversation and do not prevent one from taking brief notes. It is best to use tape recordings only as aids in expanding notes because recordings cannot capture observations, which play a very important role in creating accurate records.

Files. Folders may be maintained for replies both to the general questions on diet and feeding practices listed in Table 3 in Chapter III and to questions related to the influence on weaning behavior of social, economic, technological, and biological factors (Figure 1, Tables 4 and 6 in Chapter III). It is also a good practice to keep a folder containing notes on observations, conversations, and interviews with each mother contacted by the field team.

Observations

In the context of ethnographic work, *to observe* means *to examine with all your senses* with the objective of accurately and fully describing what is being examined. As indicated above, observations made during interviews will help to confirm, clarify, or raise questions about what a respondent has said. Observations should also be made during visits with families, when an informal interview is not intended.

It is very important to remember that the meanings of behaviors may be culturally relative. For example, the meanings of tone of voice and eye contact vary from culture to culture.

Observations during home visits can be used to:

1. compare what the informant does with what she or he says;
2. see how a mother or caretaker prepares weaning foods, including what ingredients are used, whether preparation is hygienic or unhygienic, how concentrated the foods are, what quantities are made, and how often they are made;[1]
3. see how the caretaker relates to the baby, especially if it is sick, for example, in terms of attention, and signs of affection or rejection;

[1] See Chapter IV.

4. see who feeds the baby, for example, the mother, a sibling, a grandmother, the baby itself;
5. note what the child eats;
6. note exactly what the caretaker does when giving a food or medicine to the baby, including hygiene, quantity of food or medicine, kind of contact with the baby, and persistence with which mother encourages taking of food or medicine;[2]
7. observe the relationships between the caretaker and other members of the family, particularly who influences or makes decisions concerning weaning foods;
8. observe the general conditions of the family's life, including:

   a. spatial relationships between people, that is, how they position themselves in relation to one another.

   Example:

   A child who is physically isolated may also be emotionally isolated and may receive less food or medical attention.

   b. body positions and gestures: Calmness, agitation, impatience, boredom, anger, tension, interest, and pain may be communicated through gestures or positions. Signals of a mother's agitation or impatience may, of course, have little relationship to the normal behavior of a child when its mother is being interviewed. Instead, such signals may be directed at an interviewer who is monopolizing the mother's attention.

   Example:

   A person who is not calm during the interview may sit or stand with arms close to the body, perhaps moving an arm, leg, or hand repeatedly.

   c. tone of voice: Tone of voice can indicate a great deal about a person's emotional state.

   d. touch: Particular attention should be paid to how much and what kind of touching is given to the baby.

   e. eye contact: Eye contact between a caretaker and the baby is very important. The meaning of eye contact varies from culture to culture and from situation to situation. Interpretations of the meaning of eye contact will more likely be accurate if they are based on a knowledge of the meanings of a given culture's eye signals and if they are assessed in the context of other data, such as tone of voice, body positions, and gestures.

   Example:

   A mother may be distracted from the interview because she wants to look at her child, and she does so until the baby returns her gaze. This kind of

[2] See Chapter IV.

eye contact probably indicates attention and love directed to the baby. The absence of, or infrequent eye contact between a mother and her baby during a long conversation may indicate that the mother is not paying much attention to her child in general.

9. note the condition of weaning-age children. In particular, look for signs indicative of malnutrition, including thinness or swelling of the extremities, hair that looks brittle, has variations in color, or looks thin, hair that falls out easily, anorexia (disinterest in eating), apathy, irritability, or other signs of illness. Respect these impressions. If a child appears to have changed from one visit to another, and looks ill, note that, using parentheses to indicate that the note is an observation.
10. note hygiene conditions in the home, for example, whether animals are allowed in the home, whether children defecate on the floor, and whether bottles, food, or feeding implements are on the floor.

Interview Guidelines

1. Respect the confidentiality of an interview. Be very careful not to make comments concerning one person you have interviewed (or their child or other members of their household) to another. Use first names or initials of respondents in notes, but use only pseudonyms in formal reports. Keep names and addresses of people interviewed in a safe place.

2. Do not influence or bias responses. For example, the question, "Why is breast milk good?" biases the response because the question suggests that breast milk is good. Unbiased questions are "Why are you giving breast milk?" or "What do you think about breast milk?"

3. Do not influence responses by making your biases clear through your attitudes or behavior.

4. Try to work in depth as much as possible. Avoid being satisfied with superficial answers or moving too quickly from one topic to another. Work for detailed responses. Use questions such as, "Why?" "How did you feel when that happened?" and "What do you think?"

5. When you want to be sure you clearly heard what the informant was saying or what the informant really intended to say, you can avoid repeating the question with the tactic of reflecting back the response. For example, to the question, "Why do you think your child became ill?" the reply was given, "Well, it's the man next door, he gave her the evil eye." Question: "Oh, the man next door gave her the evil eye?"

6. The technique of reflecting back an informant's question can be used if the answer might influence an informant's response at that point in the interview or later on.

7. Be patient. It is *not* necessary to ask questions or to talk constantly. For

example, if the interviewer pauses to think, the informant may feel more comfortable pausing before replying.

8. Do not interrupt the work of the informant. If the informant stops an interview to look after her children or to work, but indicates that she wants to continue with the interview, take advantage of this time to think, to review your notes, and to make observations.

9. Always note the conditions of the interview, including the hour when the interview began and when it ended, who was present during the interview, and who the informant(s) was (were).

10. Do not make what may turn out to be false promises or give false ideas of the purpose of the project in order to assure cooperation from the informant. Always tell the truth about the purpose of a project and what is known at the time of the interview about what it will accomplish, not what may be desirable or intended.

11. Use a moderate tone of voice for an interview. Be natural. Do not use an imperative tone. Interviews should be conducted in a friendly tone.

How to Develop Recipes for Weaning Foods*

General Considerations

The foods suitable for infants and young children vary from one place to another, depending on availability, cost, culture, food preferences, and so on. A meal is usually made from several foods; each food supplies some energy and different nutrients, all of which combine together in the meal. It is important that the foods are in the right proportion so that there is an adequate balance between the nutrients, and between energy and the nutrients.**

The foods chosen for a weaning recipe should be easily available from gardens or local markets, low in cost, and used frequently in most households. Local methods for food preparation and cooking which use as little time and fuel as possible should be recommended. The most popular and suitable recipes are those which have been developed by local mothers with the help of a health or community worker.

When a few simple recipes have been developed, they should be tested on a few children in one or two meals daily. A great deal can be learned from such trials; for instance, how the children like the recipe; whether the stools change in any way (mothers often notice and may complain about this); how much food can be given at one time; and how long it can be stored before it spoils.

The volume of the meal must not be large because children aged one to three years can only eat about 200 ml to 300 ml (1 to 1½ teacupfuls)*** of solid food at

* © Margaret Cameron and Yngve Hofvander, 1983. Reprinted from *Manual on Feeding Infants and Young Children* by Margaret Cameron and Yngve Hofvander (1983), by permission of Oxford University Press. This excellent manual contains detailed information on many topics related to weaning-age nutrition, including the value of breast milk, the management of diarrheal disease, and nutrition education.

** This appendix, unlike the manual as a whole, distinguishes between energy and nutrients. See the *nutrient* entry in the Glossary.

*** The recipes in this appendix distinguish between a standard measuring cup (240 ml) and a teacup (200 ml).

one time. If a child is eating only three small meals a day, each one must have a high concentration of energy and nutrients in order to meet the child's requirements over the 24 hours.

The proportions of staple and protein supplementary food in the recipe should give the best protein value possible. These proportions have been calculated for many of the common staple and protein foods and are given in Tables 1 and 2.

The simplest recipe for weaning food is one which has only two ingredients. One example is a cereal or root mixed with a legume. This is called a basic mix. However, other foods must be added to make a complete meal. Recipes which are more suitable for the weaning period and for feeding later are called multimixes.

A multimix has four basic ingredients:

1. A staple as the main ingredient—preferably a cereal.
2. A protein supplement from a plant or animal food—beans, groundnuts, milks, meats, chicken, fish, eggs, etc.
3. A vitamin and mineral supplement—a vegetable and/or fruit.
4. An energy supplement—fat, oil or sugar to increase the energy concentration of the mix.

When these four ingredients are used together in suitable proportions they form a complete meal. One way in which this can be illustrated is as a Food

Figure 1

The Food Square. Breast milk is in the middle because it is a complete food in itself. The square has four parts—one for the staple, and one each for protein food supplements, for vitamin and mineral food supplements, and for energy supplements.

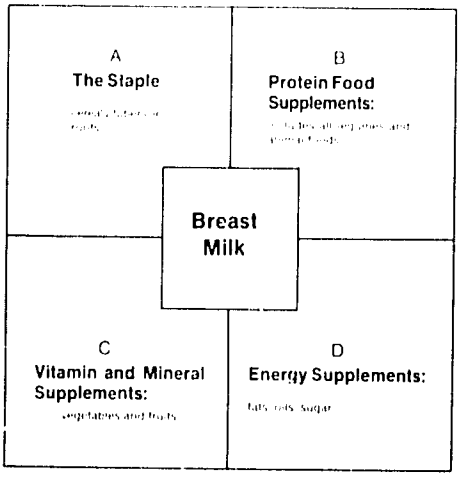


Table 1

Calculated Amounts of Ingredients for Basic Mixes—Using Edible Portions of Raw Foods

Staples (g) / Supplement (g)	Oats	Wheat	Rice	Sorghum, Millet	Maize	Potato	Sweet Potato	Yam	Taro, Cocoyam	Banana	Plantain	Cassava Flour, Gari
Legume (g)	75 / 5	80 / 10	65 / 25	75 / 10	55 / 35	320 / 20	125 / 50	165 / 40	150 / 45	105 / 55	85 / 55	40 / 55
Soybeans (g)	60 / 10	60 / 15	55 / 20	55 / 15	50 / 25	250 / 20	150 / 25	175 / 20	150 / 20	140 / 25	115 / 30	50 / 30
Dried skimmed milk (g)	65 / 5	65 / 10	65 / 15	60 / 15	60 / 15	280 / 15	175 / 20	190 / 15	180 / 15	165 / 20	150 / 20	60 / 20
Dried whole milk (g)	55 / 10	55 / 15	45 / 25	45 / 20	40 / 25	220 / 20	100 / 30	115 / 30	115 / 25	100 / 20	90 / 30	35 / 30
Chick or lean meat (g)	65 / 10	65 / 20	65 / 25	65 / 25	65 / 35	300 / 25	180 / 35	210 / 35	195 / 30	185 / 40	160 / 45	70 / 45
Fresh fish (g)	65 / 15	70 / 30	70 / 30	70 / 25	70 / 20	310 / 25	210 / 35	240 / 35	220 / 40	210 / 40	180 / 45	75 / 50
Egg (g)	65 / 10	65 / 25	65 / 30	60 / 30	65 / 25	300 / 25	180 / 35	220 / 25	190 / 5	190 / 30	170 / 45	60 / 50

1. The basic mixes have been calculated to give the best possible protein value (i.e., amino-acid score). The least amount of protein food is used to supplement the staple to provide the basis of a meal for a child of about two years of age.
2. To each of these basic mixes 10 g of oil *OR* 5 g of oil and 10 g of sugar *OR* 20 g of sugar should be added.
3. Each mix then provides about 350 kcal (approximately one-third of the daily needs of a two-year-old child).
4. Each mix has the same protein value and provides the approximate equivalent of 5 to 6 g of reference protein.
5. The weights given for the staple and the supplement are for raw foods. [This appendix provides variations for the supplements. (ed.)]
6. The volumes of most of the basic mixes are between 200 ml to 300 ml when the water absorbed by the food is taken into account.

Table 2

A Guide to the Proportions by Weight of Staple Foods and Protein Supplements Needed to Make Economical Basic Mixes of Good Protein Value

Protein supplement – Part by raw weight – Edible portion	Staple food	–	parts by weight	–	edible portions	
Legume 1	Rice, maize 2-3	Sweet potato, taro, cocoyam, banana, plantain* 2-3	Yam 4	Wheat, sorghum millet 8	Oats 15	Potato 16
Soybeans 1	Maize, rice 2-3	Plantain 2-4	Wheat, oats, sorghum, millet 4-6	Sweet potato, taro, cocoyam, banana 6-7	Yam 9	Potato 12
Dried skimmed milk 1	Rice, sorghum, millet, maize 4	Wheat 7	Banana, sweet potato, plantain 8-9	Taro, cocoyam, yam 12	Oats 13	Potato 19
Whole milk powder 1	Rice, sorghum, millet, maize 2	Sweet potato, yam, taro, cocoyam, banana, plantain 3-5		Oats, wheat 4-5		Potato 11

Table 2 (Continued)

A Guide to the Proportions by Weight of Staple Foods and Protein Supplements Needed to Make Economical Basic Mixes of Good Protein Value

Protein supplement **–Part by raw weight** **–Edible portion**	**Staple food**	**–**	**parts by weight**	**–**	**edible portions**
Chicken/lean meat	Wheat, rice, sorghum, millet, maize	Banana, plantain sweet potato	Oats	Yam, taro, cocoyam	Potato
1	2-3	4-5	6	6	12
Fresh fish	Wheat, rice, sorghum, maize, millet	Oats	Sweet potato, taro, cocoyam, banana, plantain	Yam	Potato
1	2½-3	4	4-6	7	12
Eggs	Wheat, rice, sorghum, millet, maize	Plantain Oats 6	Sweet potato, banana	Taro, cocoyam, yam	Potato
1	2-3	3	5-6	8-9	12

These proportions will give basic mixes with good protein values. Oil/sugar should be added to a basic mix as indicated in Table 1. The total quantities of the foods used must be adjusted to the child's energy needs and the volume of food he can eat. Amounts suitable for a two-year-old child are given in Table 1.

*The high proportion of legumes in this mix may cause flatulence.

Some additional suggestions for protein supplementary foods for basic or multimixes

Legumes: The average type should be soaked, cooked without the skins, and mashed finely. Whenever available, add some of another supplement to the beans. Groundnut paste or ground sesame seed or any of the animal foods could be used.

Soybean: For protein. Ten g of soybeans are equivalent to about 20 g soybean curd, 25 g home-made Tofu or curd cheese, and 100 g unpressed soybean curd.

Chicken lean meat: Any meat, snail, insect, or similar product used should be well cooked and suitably shredded, minced or chopped.

Fish: Calculations have been based on a fresh white fish. If dried salt cod, stock fish, or small dried fish are used, only one third of the weight before soaking is needed.

Milk:

(a) DSM is best used when beaten into a hot cooked mix. If the powder is reconstituted before being cooked, the maker's instructions suggest using 10 g to make 100 ml (1 dl) or 1 oz to make half a pint (10 oz) of the liquid.

(b) If fresh milk is available instead of the dried milk powder, use eight times more of the liquid milk. For example, 10 g of whole milk powder is equivalent to 80 ml of fresh milk. For yogurts, their value is similar to the milk from which they have been made. A soft curd cheese made from whole milk has about four times as much protein as liquid milk. If made from skimmed milk there would be nearly six times as much protein. Eighty ml of fresh milk is equivalent to 30 ml to 35 ml of evaporated milk, depending on the brand.

Egg: weights of egg are given because eggs vary in size. On average the shell is about 10% of the total weight.

Square shown in Figure 1. The Food Square can be a useful concept when teaching how to choose ingredients for weaning recipes. As breast milk is a complete food it can be put into the middle of the square. It is an important food during the weaning period and, although after some time, the daily amount may not be large, it is a very valuable source of energy and nutrients.

Table 3

Comparative Energy and Nutrient Values of Raw and Processed Foods/100 g[1]

Food/100 g		Energy (kcal)	Protein (g)	Vitamin C (mg)	Iron (mg)	Comments
Potatoes	Raw	87	2.1	8-20	0.5	–
	Boiled	80	1.4	4-14	0.3	Water absorbed
	Roasted	157	2.8	5-16	0.7	
	Crisps	533	6.3	17	2.1	Fat gain; water loss
Wheat	Flour	337	11.3	0	1.5	–
	Bread	233	7.8	0	1.1	Water absorbed
	Chapatti	202	7.3	0	2.1	Water absorbed
	Pasta-Raw	370	13.7	0	1.4	–
	Pasta-Cooked	117	4.3	0	0.5	Water absorbed
Rice	Raw	363	7.0	0	1.7	–
	Boiled/steamed	123	2.2	0	0.2	Water absorbed
Millet[2]	Porridge with:					
	Unmalted flour	25	0.4	–	0.3	–
	Malted flour	83	1.3	–	1.0	Increased amount of flour used
Lentils	Raw	339	24.0	Trace	7.0	–
	Boiled	98	7.6	Trace	2.4	Water absorbed
Soy bean[3]	Raw, dry	355	31.3	0	7.3	–
	Unpressed curd	33	3.1	0	0.8	Water absorbed
	Fermented (Tempeh)	149	18.3	0	10.0	Constituent changes
	Sprouts-Raw	62	7.7	10	1.1	Constituent changes
	-Cooked	34	4.8	2	0.8	Water absorbed; vitamin C lost
Spinach-type leaves[4]	Raw	28	2.0	50	2.5	–
	Boiled	49	3.5	25	4.4	Water loss; vitamin loss

[1] These are representative figures (A.A. Paul and D.A.T. Southgate, eds., *McCance and Widdowson's the Composition of Foods*, 4th ed. MRC Special Report Series No. 297, London: HMSO, 1978). Individual and local cooking methods would show variations.

[2] Adapted from B. Brandtzaeg, Nutrition and technological evaluation of malted flours from ragi (*Eleusine coracana*), sorghum (*Sorghum vulgare*) and green grain (*Phaseolus aureus*) for local processing of supplementary and weaning foods. Central Food Technological Research Institute, UNU Center for Advanced Research and Development, Mysore, 570013, India.

[3] FAO, *Food Composition Tables for Use in East Asia*. Rome: FAO, 1972.

[4] B.S. Platt. *Tables of Representative Values of Foods Commonly Used in Tropical Countries*, MRC Special Report Series No. 302. London: HMSO, 1962.

Guidelines for Planning a Multimix Using the Food Square

Step-by-step guidelines are given to help health workers planning a multimix for the first time. They should make certain that it will have enough energy concentrated into small bulk, as well as having adequate protein, vitamin and mineral value.

Other factors, such as processing effects on nutrient values and the measuring of foods, should also be taken into account.

Step 1: Decide how much energy, protein, and any other important nutrient the meal should provide.

Step 2. Choose the staple, preferably a cereal.

Step 3. Choose one, or more than one protein supplementary food from those that are locally available and inexpensive. Use Table 1 or 2 as a guide to the proportions of staple and protein supplement to use. Sometimes two

Table 4

Effect of Cooking on the Weights and Volumes of Foods Due to the Absorption or Loss of Water*

Food	Weights Raw (g)	Cooked (g)	Volumes Raw (ml)	Cooked (ml)	Approximate changes on cooking
Rice	100	230-250	100	300	volume-increases by 3
Noodles-small	100	200-250	100	250	volume-increases by 2½
Maize flour	100	500-600 (gruel)	100	440-460	volume-increases by 4½
Rolled oats	100	600-700 (gruel)	100	300-350	volume-increases by 3
Potato	100	100-105	-	-	weight-little change
Beans					
whole	100	230-250	100	240-260	volume-increases by 2½
split, no skin	100	250-300	100	250-300	volume-increases by 2½-3
Green leaves			Boiled, drained and chopped		
Spinach type	100	60-70	100g-1 dl		
			10g-1 tbspn		weight reduced by ⅓
Cabbage type	100	80	10g-1 tbspn		weight reduced by ⅕

Miscellaneous
1 average chapatti (flat bread 40g) is equivalent to 25g wheat flour
100g wholemeal or white bread is equivalent to 70g flour
1 average tortilla is made from 60g corn dough

*The amount of water used and the length of cooking time affects the amount of water absorbed or lost from the food. These changes shown in the table are *examples only*. They should be checked locally.

protein foods can be used together (e.g., beans with a little fish or beans with ground sesame seeds). If possible use some animal protein food as even small amounts improve the protein value of mixes based on plant foods only.

Step 4. Decide on the amounts of staple and protein supplement to use. Allowance should be made for the amount of water absorbed by cereals and legumes during cooking (see Tables 3 and 4), and the volume of solid food a child can eat at one meal. Most of the quantities given in Table 1 are suitable for a two-year-old child, but they may need adjusting so that they can be easily measured with a household utensil.

Step 5. Calculate the energy value of this basic mix.

Step 6. Choose the vitamin and mineral supplement to provide the important vitamins and minerals. Dark green leaves or yellow/orange fruits and vegetables are most valuable. Remember that the availability of iron is increased if there is some food containing vitamin C and/or small amounts of meat or fish.

Step 7. Choose the energy supplement to increase the energy value to the required level. This ingredient should not provide more than 25% to 30% of the total kilocalories in the recipe. Children do not like food which is too 'fatty' or 'oily'.

Step 8. Decide which flavorings are needed to make the multimix taste good for children, remembering that small children usually do not like hot, spicy food.

Step 9. Choose methods of preparation and cooking which are simple, preserve the most important nutrients, use as little fuel as possible, and do not give the mother too much extra work.

An Example of Planning a Multimix

This multimix is suitable for a nine-month-old infant who is still having breast milk. The average weight for this age is 9 kg and it is assumed that the infant has three meals a day. It is estimated that there is about 300 ml of breast milk during the 24 hours. At this age infants should be starting to share some of the foods used for family meals.

	Energy (kcal)	Protein (g)	Vit. A (μg)	Vit. C (mg)	Iron (mg)
Daily recommended intake	990	18	300	20	7
Value of breast milk (300 ml)	210	3.2	180	11	0.3
Value to be provided by three multimixes	780	14.8	120	9	6.7
Value for ONE multimix, i.e., TARGET for recipe	260	5.0	40	3	2-3

Step 1. The target for the energy and nutrient value to the multimix was calculated as shown in the table above.

Step 2. Rice was chosen as the staple.

Step 3. Mung bean was chosen as the protein supplementary food. Table 2 shows that one part mung bean should be added to two to three parts rice to give a good protein value.

Step 4. Both rice and mung bean absorb water when cooked. So that the volume of the meal would not be too large, it was decided to use 40 g rice and 15 g mung bean. These amounts can be measured with local utensils.

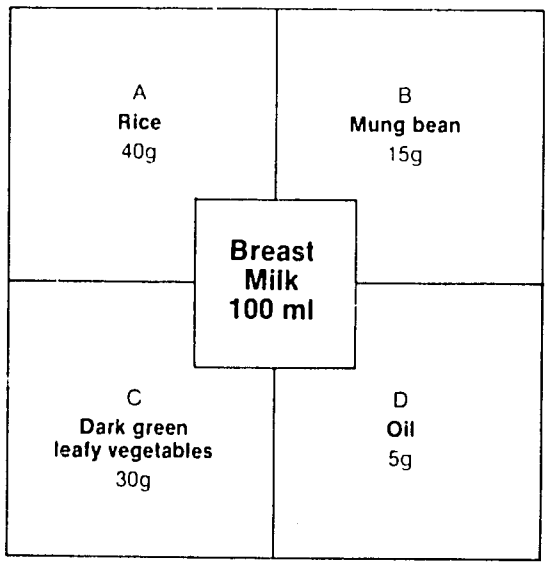
Step 5. The energy and nutrient value of the basic mix was calculated and is shown in Table 5.

Step 6. A local spinach was chosen as the vitamin and mineral supplement. One handful of leaves which weighs 30 to 40 g provides sufficient vitamin A and vitamin C even when allowances have been made for cooking losses.*

Step 7. Local groundnut oil was chosen as the energy supplement. One teaspoon (5 g) increases the energy value to the target for the multimix but does not increase the volume very much.

Figure 2

An example of a multimix using the four parts of a Food Square.



* Since vitamin A-rich foods are not usually given at each meal and since vitamin A can be stored in the body, it is wise to give more than the recommended intake in some of the multimixes.

Table 5

Example of a Weaning Multimix and its Food Value

Food	Raw weight (g)	Approx. raw volume (ml)	Energy (kcal)	Protein (g)	Fat (g)	Retinol equivalents (μg)	Vitamin C (mg)	Iron (mg)	Approx. cooked volume (ml)
Basic mix									
Rice	40	45	145	2.8	–	–	–	0.7	100
Mung dhal	15	10	49	3.3	0.1	0.5	0	1.2	25
Value of basic mix			194	6.1	0.1	0.5	0	1.9	125
Other added ingredients									
Dark green leaves	40	–	19	2.0	–	380	40	1.6	20
Groundnut oil	5	5	44	0	5.0	–	–	–	5
Value of multimix			257	8.1	5.0	380	40	3.5	150
TARGET FOR MULTIMIX			260	5.0	–	40	3	2-3	
Breast milk (⅓ total daily intake)		100	70	1.1	4.2	60	3.8	0.08	100
Value for meal plus ⅓ total daily intake of breast milk			327	9.2	9.2	440	44	3.6	250
TARGET			300	6.0	–	100	6	3.5	250

If 5 g red palm oil was used instead of groundnut oil, the vitamin A value would have increased by about 300 μg. The vitamin C value depends on the cooking method.

Steps 8 and 9. Some of the usual flavorings were added and local cooking methods were used. The multimix recipe was tested with the help of mothers in the community.

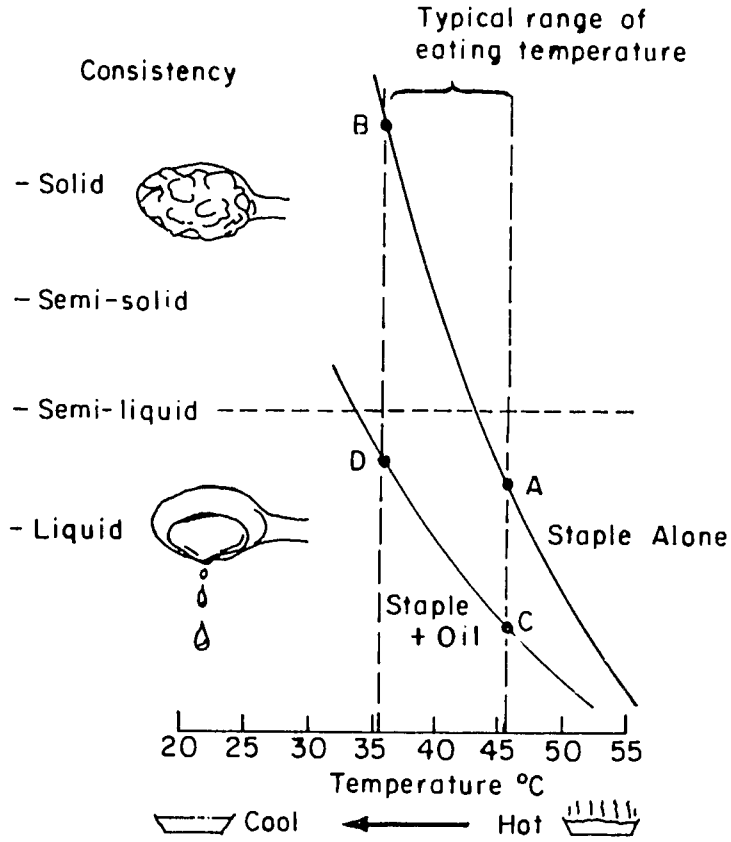
The final energy and nutrient values and how they compare with the target values are shown in Table 5. The volume of the meal is also shown. It is suitable for a nine-month-old infant. Figure 2 shows this multimix recipe in the Food Square together with the breast milk that is likely to be taken at the same time.

There are several points to remember when developing multimixes for the weaning period:

When cooked, cereals absorb different amounts of water. Rice and wheat

Figure 3

The consistency of a gruel changes with temperature.



Gruel made from the staple becomes more solid as it cools (A to B). If oil is added to a gruel it stays soft, even when cool (C to D). See references 1 and 2 in the reference list at the end of this appendix (ed.).

increase about two-and-a-half to three times in volume and maize flour about six times when cooked to a suitable consistency for a gruel. The volume of the cooked legumes is also about three times greater than when raw. This change in volume must be taken into account because a small child is not able to eat more than about 200 ml to 300 ml (1 to 1½ cupfuls). Fresh tubers and roots already contain water and their volume changes little when boiled or steamed.

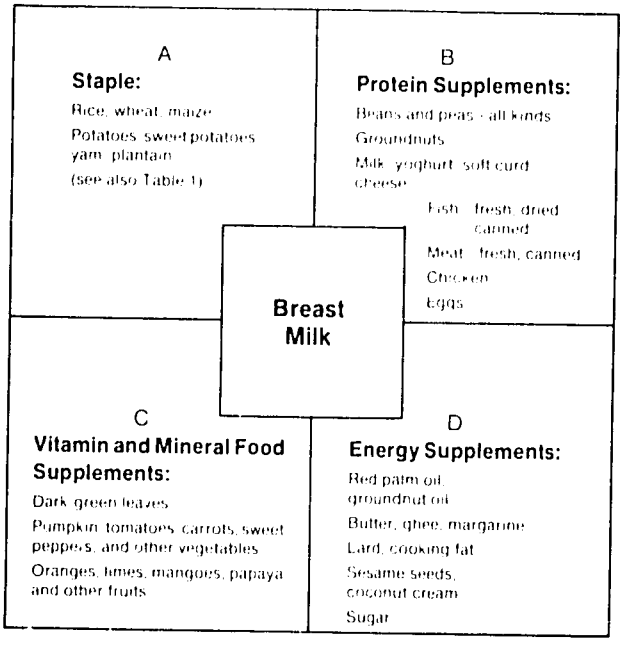
Some cereals, such as oats, have a more balanced amino-acid pattern than others and need only small amounts of a supplement to improve their protein value. Rice has a good amino-acid pattern but has less total protein than other cereals. Maize has a pattern of amino acids that is less well balanced and so more of the protein supplementary food is needed to improve its pattern. This explains why, in Tables 1 and 2, the proportion of cereal and protein supplement in the basic mixes varies so much.

Tubers, starchy fruits, and roots contain less protein and usually they have a poorer pattern of essential amino acids. This makes it difficult to design a basic mix with a good protein value using these staples. An exception is the potato.

The amount of water affects the concentration of protein in a food. Fresh

Figure 4

A variety of local foods for multimixes or family pot recipes fitted into the four parts of the Food Square.



tubers and roots have a relatively high water content. Even when compared with cooked cereals their protein content is usually lower and so with them a greater proportion of protein supplement must be used in the basic mix.

Most legumes are difficult to digest and cause flatulence. This can be avoided if legumes are properly soaked, skinned, and then cooked until they are soft.

When introducing legumes, give only small amounts at one time. For very young children the proportion of legumes in the basic mixes suggested in Table 1 may need to be reduced so that they can be more easily digested.

Protein supplements from animal foods are easily digested and have an excellent amino-acid pattern. However, they are usually expensive and often in short supply. Adding even a small quantity of animal foods to legumes is an economical way of using a high-quality protein supplement. These foods often improve the taste of the meal, and this encourages more of the food to be eaten.

Other important nutrients are often found in the protein supplements. For example, small fish have calcium and B vitamins, meats have iron, and liver has iron as well as vitamins A, B, and D. Groundnuts have a good supply of oil and niacin; whole milk and its products contain B vitamins, calcium, and vitamin A.

Table 6

Examples of Alternative Multimixes for Weaning

Food	Weight (g)	Energy (kcal)	Protein (g)	Retinol equivalents (μg)	Vitamin C (mg)	Iron (mg)	Approx. cooked volume (ml)
Example 1							
Rice	40	145	2.8	–	–	0.7	100
Small dried fish	6	16	2.8	–	–	0.3	5-10
Dark green leaves	40	19	2.0	380	40	1.6	35
Red palm oil	10	88	–	600	–	–	10
Total cooked meal		268	7.6	980	40	2.6	150
Orange	60	27	0.6	28	31	0.4	50
Total		295	8.2	1008	71	3.0	200
Example 2							
Rice	45	163	3.1	–	–	0.8	115
Tempeh*	20	30	3.6	1	–	2.0	15-20
Dark green leaves	40	19	2.0	380	40	1.6	35
Tomato	30	6	0.3	75	7	0.1	25
Fat/oil	10	88	–	–	–	–	10
Total		306	9.0	456	47	4.5	200

* Tempeh is made from soybeans or groundnuts.

Table 7

A Suggested Day's Meal Plan for an Infant of Nine Months Weighing Almost 9 kg

	Weight (g)	Approx. cooked volume (ml)	Energy (kcal)	Protein (g)	Retinol equivalents (μg)	Vitamin C (mg)	Iron (mg)
Breast milk - assumed amount over 24 hours: 500 ml			350	5.4	299	19	0.4*
Morning meal							
Rice raw	30	80	109	2.1	–	–	0.5
Mung dhal - raw	10	25	32	2.2	–	–	0.8
Ghee/butter	5	5	44	–	15	–	–
Total for meal		110	185	4.3	15	–	1.3
Midday or evening meal from family cooking pot							
Rice - boiled		135	176	3.5	–	–	0.5
Small fish from stew		5	16	3.4	–	–	1.0
Sauce from stew with 5 g oil		30	45	--	–	–	–
Dark green leaves - chopped		15	10	1.0	190	10	0.8
Orange to suck (raw)		30	27	0.6	28	31	0.4
Total for meal		205	274	8.5	218	41	2.7
Evening or midday meal							
Rice - raw	30	80	109	2.1	–	–	0.5
Lentils - raw	10	25	34	2.4	1	–	0.7
Ghee/butter	5	5	44	–	15	–	–
Total for meal		110	187	4.5	16	–	1.2
Total value of meals and breast milk			996	22.7	548	60	5.6*

Recommended daily intake	990	17.8	300	20	7.0

*Iron from breast milk is more efficiently absorbed than iron from other food sources (3). [See reference 3 at the end of this appendix (ed.).]

1. The approximate volumes of the meals have been indicated.
2. The contribution of breast milk to the total energy and nutrient intake is important.
3. The nutrient value of meals would change according to the foods chosen as ingredients.
4. Vitamin A would be reduced if a vegetable oil were used instead of ghee or butter.
5. Iron intake could be increased if parboiled rice were to be used and also if any meat were available.
6. Vitamin C values would depend on the cooking methods, though fresh citrus fruit and the breast milk make a good contribution.

Table 8

Examples of a 'Family Cooking Pot' Multimix Meal

					Nutrient analysis of meal				
	Raw weight (g)	Approx. cooked volume (ml)		Handy household measure	Energy (kcal)	Protein (g)	Retinol equivalents (μ)	Vitamin C (mg)	Iron (mg)
Chapatti									
—from wheat flour	25	-		1 piece	86	2.9	-	-	0.9
Dhal									
- from chick peas	25				92	5.0	8	-	1.6
Vegetables, raw, mixed	40	110	or	1/2 cup	14	1.0	133	16	0.6
Oil in cooking	5				44	-	-	-	-
Yogurt	60				54	2.1	6	-	0.06
Sugar	5	105	or	1/2 cup	20	-	-	-	-
Water - to dilute	40				-	-	-	-	-
	Total value of meal				310	11.0	147	16	3.2
Volume of dhal and vegetables		110							
Volume of yogurt drink		105							

Eggs have a good variety of nutrients and legumes often contain some calcium and iron as well as B vitamins.

One of the most useful mineral and vitamin supplement is any variety of dark green leafy vegetable, such as spinach, or sweet potato, or cassava leaves. These are rich in vitamin A and, depending on how they are cooked, contain vitamin C and some iron, the availability of which depends on other ingredients in the mix. Up to 50 g of raw leaves is a reasonable amount to add to a multimix containing 300 kcal. Some fats, like red palm oil, butter, or ghee, supply vitamin A and thus increase the concentration of this vitamin as well as energy.

Fats and oils also improve the taste and consistency of many foods. Figure 3 shows how the consistency of foods varies according to their temperature and whether or not they contain oil [See reference 2 at the end of this appendix. (ed.)]. Normally a gruel or porridge becomes much thicker as it cools. It is more difficult for a young child to eat a gruel that has a thick or solid consistency, which is one reason why mothers add a lot of water when making some gruels. If some oil is added to the gruel it is softer even when it is cool. Thus, the addition of oil increases the energy concentration of gruel in two ways:

by adding kilocalories;

by reducing the amount of water needed to prepare a gruel with the right consistency.

It is not always possible to meet the target for every nutrient at every meal every day. However, it is extremely important that over a period of a week or less, the average daily intakes meet the recommended intakes. This can be done by making use of all the different foods that are available locally. A useful teaching exercise is to list all the possible local foods in the appropriate sections of the Food Square (see Figure 4).

Two alternative multimixes are given in Table 6; they show that the total nutrient value depends on the foods chosen as ingredients. Table 7 suggests how to use multi-mixes in planning meals for the day.

Planning a Multimix from the Family Pot

The multimixes described so far are simple ones which show weights of the raw ingredients to be cooked. These mixes are useful when a meal must be prepared separately for the child.

However, often it is more convenient to use the foods already cooked for the family meal. These foods can be taken from the cooking pot in the amounts needed to make a suitable multimix for the young child.

Example:

An example from India shows how this is done. In this household a typical meal consists of:

— chapattis, a soft flat bread made from wheat flour;

- dhal, a legume dish often made with chick peas after the skins have been removed;
- a side dish of vegetables, likely to contain some dark green leaves or red or yellow vegetables;
- yogurt, taken as a drink, after diluting it with water and sweetening it with a little sugar.

The meal is prepared in the normal way for the family, and afterwards some is put in a separate bowl for the young child.

Table 8 shows the equivalent raw weight of each ingredient needed to make a balanced multimix, the cooked volume of the foods, the nutrient content, and the total volume of the cooked multimix. There is a column in which the volume of cooked foods in local household utensils can be written. No flavorings or spices are shown and no allowance has been made for the cooking liquid, which might be served with the foods. The nutrient value of the meal depends to some extent on which vegetables are used and also on the type of sugar used. The more unrefined type of sugar, called 'jaggery', contains a small amount of iron.

When using the ingredients from the family's cooking pot, it is important to realize that the nutrient content of the cooked foods will be different from those of the foods when raw. This is because some foods absorb water and/or any oil that has been used for cooking. Boiling or stewing for a long time reduces vitamin value, especially those for vitamin C and some of the B vitamins. Therefore, some allowance should be made for changes in nutrient value.

The weights and volumes of the raw foods change when they are cooked. Food composition tables do not usually give the nutrient values for cooked foods because cooking methods are so variable. It is important, therefore, to know the equivalent raw weight of a cooked food. Then it is possible to calculate the nutrient value of the cooked foods used in the multimix. Approximate guides to indicate how the raw amounts of foods change when they are cooked are given in Table 3 and Table 4.

Although different vegetables and fruits add variety, the basic ingredients used in many family diets vary very little from day to day. Therefore, in any one area, there are only a limited number of foods for which the energy and nutrient values have to be calculated. By doing these calculations health workers become familiar with the energy and nutrient values of foods. This makes it easier for them to work out the weights of foods needed when they develop multimix recipes. Recommended weights must be converted into local household measures before being demonstrated to the mothers (see Tables 9 and 10).

When discussing with mothers how to make multimixes from the family cooking pot, it is almost always more practical to talk about volume measures or spoonfuls of cooked foods than to tell them the weights of the raw ingredients to use.

Table 9

The Volumes and Equivalent Weights of Some Raw Foods*

Food**	Volumes 500 ml (5 dl) (g)	200 ml (2 dl) Approximate weight (g)	100 ml (1 dl) (g)	Local utensil Type (ml) Example: Milk can	Weight (g)
Staples					
Rice	450	180	90**	200	180
Wheat noodles (small)	450	180	90		
Rolled oats	200	80	40		
Flours-whole grain	275	110	55		
-refined	300	125	65		
Cassava flour (gari)	350	150	75		
Legumes, oil seeds					
Large, e.g., kidney beans, cow peas		150	75		
Small, e.g., mungbeans, chickpeas		175	90		
Split, no skin, e.g., lentils		175	90		
Flour, e.g., bean		170	85		
Groundnuts, whole		145	75		
Sesame seeds		140	70		
Other foods					
Vegetable oils		200	100		
Sugar		200	100		
Milk, liquid		200	100		
Dried skimmed milk-powder		90	45		
Dried skimmed milk-granules		70	35		

	1 level tablespoon (15 ml) g
Oil	15 (1 tspn = 5g)
Sugar	15 (1 tspn = 5g)
Bean flour	12
Sesame seeds	10
Milk: Evaporated, no sugar	15
skimmed powder	8
skimmed granules	4
full cream powder	9

*All weights and volumes given in this table are for edible portions of food (editor's note).
**Example: for practical use 100 ml rice weighs 90 g.

Table 10

Calculation of Approximate Weights from Known Volumes of Raw Foods*

Foods (raw)	Volume (ml)	× Factor	= Weight (g)
Staples			
Rice		0.9	
Noodles (small)		0.9	
Cassava flour (gari)		0.75	
Refined flours		0.65	
Whole-grain flours		0.55	
Rolled oats		0.4	
Legumes, oilseeds			
Larger, e.g., kidney beans, cow peas		0.75	
Smaller, e.g., mungbeans, chickpeas		0.9	
Split, no skins, e.g., lentils		0.9	
Flour, e.g., bean		0.85	
Groundnuts		0.75	
Sesame seeds		0.65	
Other foods			
Sugar		1.0	
Oil		1.0	
Milk, liquid		1.0	
powder		0.45	
granules		0.35	

The factors are derived from Table 9. The *volume* (ml) × the given factor = weight (g).
Examples: 200 ml rice × 0.9 = 180 g
100 ml cowpeas × 0.75 = 75 g

The *weight* (g) ÷ the given factor = volume (ml).
Example: 75 g cowpeas ÷ 0.75 = 100 ml

*All weights and volumes given in this table are for edible portions of food (editor's note).

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Growth Monitoring Tools

Arm Circumference Tapes

Instructions for making and using tricolored and insertion arm circumference tapes are available, with samples, from:

P.O. Box 49
St. Albans
Herts, AL1 4AX
UK

Cost: samples free

Voluntary Health Association of India
C-14 C. Centre
SDA
New Delhi 110016, India

Cost: US $.20, insertion tapes, and US $.10, tricolored tapes, plus postage. Money must accompany order.

Commercially manufactured

The following tapes can be ordered in bulk:

Cimder Strips Description: two tricolored strips; age specific: 0-3 months, 4-7 months, 8-11 months, 12-23 months, 24-47 months, 48-59 months, and 60-72 months.

Cost: US $20. Write to: CIMDER
Attn: Dr. Jorge Saravia
Apdo. 3708
Cali, Colombia

* ©Griffiths, M. *Growth Monitoring of Preschool Children: Practical Considerations for Primary Health Care Projects.* Washington, DC: World Federation of Public Health Associations. Revised 1984.

Sinaps Strip Description: one insertion tape with dual colored bands. Bands are for specific age groups: 0-30 days, 1-5 months, 6-30 months, and 31-60 months, and are for pregnant women; made of durable sun and rain resistant material; tested in Mexico, Guatemala and Brazil.

Cost: approximately US $50. Price decrease for bulk orders.

Write to:

Aaron Lechtig
UNICEF/Brasilia
Setor Bancario Sul
Edificio Seguradoras 13 andar
70072 Brasilia DF, Brazil

Echeverri Tape and Chart Description: a plasticized paper arm strip marked in centimeters, and a growth chart with a dimly shaded malnourished zone and an unshaded normal zone. Chart can be used through child's sixth year.

Cost: 2.00 Pounds Sterling.

Write to:

TALC
P.O. Box 49
St. Albans
Herts AL1 4AX
UK

Scales

Locally Manufactured

The designs and procedure for making scales are available from:

P.O. Box 49
St. Albans
Herts, AL1 4AX
UK

Hesperian Foundation
P.O. Box 1692
Palo Alto, California 94302 USA

Commercially Manufactured

Scales for Clinics Description: A wide variety of clinic scales are manufactured, each slightly different. Therefore, it is suggested that one write directly to the distributor for details.

Cost: The table top model for weighing small children usually costs between US $150-300.

Write to:
CMS Weighing Equipment, Ltd.
18 Camden High Street
London, NW1 0JH, UK

or

Salter Industrial Measurement, Ltd. (table top, pan model only)
George Street
West Bromwich, B70 6AD
UK

Single Beam or Bar Scales

The Philippine Bar Scale Description: This is a hanging bar available in 10, 25, and 50 kg capacity. It is manufactured in the Philippines and is a type of scale with which health workers there are already familiar. The scale is made of iron, but is zinc plated, and is heavier than many (scale alone weighs slightly more than 3 kg). Counterweights are lead, covered with colored rubber. The bar has machine-etched 100 g gradations. The scale can be tared.*

Cost: US $14.50 (10 kg); US $18.20 (25 kg); US $22.50 (50 kg).

Write to:

Dr. Rodolfo Florentino
Deputy Executive Director
Nutrition Center of the Philippines
MCC PO Box 653
Makati, Metro Manila, Philippines

Kumudini Bar Scale Adaptation of the 25 kg Philippine scale to a Bangladesh project. Description: The same as the Philippine scale except that units of measure are local—*seer* and *chattak*. Calibrations cut into iron rod and painted. Harness for children available. Scale can be tared.

Cost: US $20-25.

Write to:

Mrs. Pati
Kumudini Welfare Trust
P.O. Box 62
Naryanganj, Bangladesh

* Tare: the deduction of weight made in allowance for a weight hung on the scale. For example, if a basket is used to hold the child, the basket can be placed on the scale and the scale *tared* to read zero.

Chinese Wood Scale Description: The capacity of this scale is 30 kg in 100 g graduations. It is manufactured in Thailand from wood and is lighter than many (scale weighs 2 kg). Since numbers are etched on wood they may be difficult to read over time.

Cost: US $25.00 (comes with two harnesses for suspending the child).

Write to:

Nutrition Division
Department of Health
Samsen Road
Bangkok 10200 Thailand

Tansi Bar Scale Description: Light weight metal scale (scale, basket, and weights weigh 2.4 kg). The bar is short; thus, it is not a direct reading scale. The bar only has a capacity to weigh 10 kg. If the child weighs more than 10 kg, a 10 kg weight must be added on the bar. The health worker, then, must remember to add 10 to the number indicated on the bar. The scale is made in India. It can be tared. Enumeration is clear. Capacity is 20 kg. (This may not be sufficient if 6- and 7-year olds are in the program.)

Cost: 200 Indian Rupees (US $25.00). Allow three months from date of order for delivery.

Write to:

P. Sivaraj
General Superintendent
Tansi Tool Room
Tamil Nadu Small Industries Corp. Ltd.
Industrial Estate, Guindy
Madras 600-032, Tamil Nadu, India

Dial Spring Scales

ITAC Model 800 Description: Light weight (1 kg) in durable metal case with unbreakable plastic face. Case painted with enamel, which may chip and expose metal. Easy to read; large numbers mark five kilogram increments and small numbers mark every kilogram with lines at every 100 grams (not available in pounds). Capacity 25 kg in one rotation. Scale can be tared although taring screw in tongue of scale is not as easy to adjust as that of the Salter Scale. Accuracy is 1/2 of 1% of full capacity.

Cost: US $60. Price includes two waterproof weighing pants and carrying bar, FOB*, sturdy export packing extra at cost. A discount is available for large orders.

* FOB: Freight on board.

Write to:

ITAC Corporation
PO Box 1742
Silver Spring, MD 20902 USA

CMS Model MP25 Description: Light weight in unbreakable plastic case, with ventilated plastic dial cover. Easy to read, although ITAC scale is clearer. Capacity 25 kg in one rotation with 100 g divisions, or available in pounds—capacity 56 lb in 1/4 lb divisions. (Not recommended to get both kg and lb on the same scale face.) Scale can be tared; has proven to be extremely durable under rough treatment.

Price: 24 Pounds Sterling, FOB. Orders can be filled immediately from London stock. The cost is for weighing pack that includes the scale, a shoulder bag, and 3 baby-weighing trousers. A discount is available for large orders. A hang bar for older children and a folding door bracket are available separately.

CMS Model DM 20 Description: This is the same scale as CMS Model MP25 but with a dial on each side of the scale. The dial on one side will register 20 kg in one rotation with 100 g divisions, while on the reverse side of the scale another dial has drawings of stages of a child's development and basic feeding routine. The drawings are to aid mothers but may be misleading for malnourished children.

Price: Same as above.

Write to:

CMS Weighing Equipment, Ltd.
18 Camden High Street
London NW1 0JH
UK

Salter Model 235 Description: Light weight in durable non-rust aluminum case with an unbreakable plastic face. Easy to read although ITAC scale is clearer. Capacity 25 kg in one rotation with 500 g or 100 g divisions. Scale can be tared without difficulty. Scale has been well tested and modified to improve performance.

Price: 18.50 Pounds Sterling, FOB for scale only, or 27.50 Pounds Sterling, FOB with five pair of weighing trousers. Allow 12 weeks for delivery. A discount is available for large orders.

Write to:

Salter Industrial Measurement, Ltd.
George Street, West Bromwich
West Midlands, B70 6AD
UK

Marsden Model 165 Description: Light weight, stainless body with vented plastic dial cover, single or dual faced. Capacity 25 kg in single rotation with 100 g divisions or 56 lb with 4 oz divisions. (It is not recommended to purchase a dial with both kilogram and pound divisions.) Scale can be tared. Two-year guarantee.

Price: 25.75 Pounds Sterling, FOB. Weighing trousers cost an additional 3.00 Pounds Sterling each.

Write to:

Marsden Weigning Machine Group Ltd.
388 Harrow Road
London W92HU
UK

Tubular Spring Scales

Chatillon IN-50 Description: Small, extremely light weight, made of non-corrosive brass. Capacity in 25 kg or 50 lbs. Difficult to read; the marker is hard to distinguish and the scale is marked in both kilograms (250 g intervals) and pounds (8 oz intervals). Scale can be tared.

Cost: US $37, FOB. Discounts of 25 to 30 percent are available for large orders.

Write to:

John Chatillon and Sons
83-30 Kew Gardens Road
Kew Gardens, New York 11415 USA

Super Samson Description: Extremely light weight, made of durable plastic. Overload protection. Difficult to read because of small space between numbers. Capacity 20 kg with 200 g divisions, or 44 lb with 8 oz divisions. Scale can be tared.

Note: This scale is best for weighing newborns or children under 2, not for weighing children from the ages of two to five.

Price: 5.95 Pounds Sterling (US $10.00) for 20 kg scale alone. If ordered in a package with a nylon sling, tape measure, and carrying case, the total price is 9.75 Pounds Sterling (US $24.00), FOB. Less expensive scales with a capacity of 10 kg are also available.

Write to:

Salter Industrial Measurement, Ltd.
George Street
West Bromwich, B70 6AD
UK

CMS Plastic Tubular Weigher Description: Similar to the Salter Super Samson. Capacity 10, 15, or 20 kg.

Cost: 5.00 Pounds Sterling, FOB.

Write to:

CMS Weighing Equipment, Ltd.
18 Camden High Street
London, NW1 0JH
UK

Digital Scales

Pathweight Electronic Description: Small (fits into a pocket), light, digital reading, runs on a 9 volt transistor battery. Electronically dampened to improve readibility. Capacity 20 kg. Scale can be tared.

Note: This scale is still being developed. Field trials to be done in September 1984.

Price: Expected to be inexpensive.

Write to:

PATH
Canal Place
130 Nickerson Street
Seattle, Washington 98109 USA

Length/Height Boards

Many models exist. Those mentioned below are available commercially.

Instructions for making a measuring board (board only for measuring length, not standing height) are available.

Price: free

Write to:

AHRTAG
85 Marylebone High Street
London W1M 3DE
UK

Shorr Measuring Board Construction Kit Description: Board is suitable for length and height. Kit includes everything but the wood: hardware, shoulder strap, measuring tape, glue and instructions on how to construct the board and how to weigh and measure.

Price: US $25.00. The construction booklet can be purchased separately for US $3.00. The manual "How to Weigh and Measure Children" is also available separately for US $3.00.

Write to:

Shorr Productions
807 Triphammer Road
Ithaca, NY 14850 USA

Commercially Manufactured Length/Height Boards or Measurers

Shorr Portable Measuring Board Description: Durable portable board (comes with carrying strap) for measuring height and length; 130 cm x 35 cm x 28 cm; weighs 13 lb and is water resistant.

Price: US $175.00, includes illustrated manual "How to Weigh and Measure Children".

Write to: Shorr Productions, see above.

Microtoise Height Measure Description: Light and portable. Measures 0 to 2 meters in 1 mm graduations. Can be suspended from a wall or door frame or run along a table.

Cost: 7.00 Pounds Sterling.

Write to:

CMS Weighing Equipment, Ltd.
Camden High Street
London NW1 0JH, UK

Weight-for-Height Wall Chart – "Thinness Measure"

Price: 1.30 Pounds Sterling in black and white; teaching aids 5.00 Pounds Sterling.

Write to:
P.O. Box 49
St. Albans
Herts, AL1 4AX
UK

Appendix 4

Process Evaluation

Unlike impact evaluation, which assesses how well a project has met its stated goals, process evaluation is an attempt to qualify and quantify the actual implementation of project activities. Even when an evaluator is primarily concerned with whether a project has had a positive effect, ideally all of a project's activities should be evaluated first for the following reasons:

- A project's failure to achieve its goals is often caused by weaknesses in the initial stages, such as inadequate preliminary reconnaissance or poor planning.
- Process evaluation may reveal which indicators would most accurately reflect the success of a project. For example, defining the nature and extent of project services will help an evaluator to determine whether weight-for-age measurements or infant mortality statistics are better indices of a project's impact.
- Process evaluation is necessary for replicating a project because it can answer the question of *how* a project has brought about change, and it can suggest its most effective components.

The following is a series of steps that should be followed in their logical sequence *if an outside expert* is called upon to undertake a process evaluation.

Establishing a Diagnosis of the Nutrition Problems

An outside evaluator should begin by examining a project's data concerning the severity and extent of malnutrition among weaning-age children in an area. This step should be undertaken for two reasons:

First, agencies sometimes commit project resources without establishing the need to do so. Food-aid projects, for example, are especially likely to omit an

* The primary contributors to this appendix were David Sahn and Karen Mitzner.

assessment of need. Rather than measuring success in terms of nutritional and health improvements, food-aid projects all too often limit an evaluation to assessing how much food has been delivered and whether the efficiency of the voluntary agency has increased.

Second, clear definition of the status of a target population before an intervention serves as a bench mark against which to measure program effectiveness. A central tenet of impact evaluation is to measure achievements against predetermined objectives. Before starting impact evaluation, therefore, it is necessary to define these objectives in measurable units and to determine an acceptable level of change in these units.

The last step in the diagnostic procedure, defining the possible causes of the nutritional problem, provides the information necessary for the next stage in the evaluation process: assessing the appropriateness of program plans.

Evaluating the Program Plan

The evaluator should examine the sequence of events by which the plan proposes to bring about its objectives. If one does not already exist, a logical framework or schematic outline should be developed. This outline should provide a clear statement of the program's expectations and make explicit the model with which the project expected to reduce malnutrition. The framework should depict the inputs anticipated in the plan (for example, personnel and equipment), the outputs to be delivered (services, such as nutrition education classes), the purposes (intermediate objectives), and the goals (ultimate objectives).

The uses of the outline. Although it will vary widely from project to project, an outline (Figure 1 in Chapter IX) will have the following general uses:

- Focusing evaluation activities on the collection and interpretation of key indicators, such as weight-for-age data.
- Showing the sources and types of data needed to substantiate program results, for example, weight-for-age charts used in growth monitoring.
- Providing the means to evaluate the project in its broad context, not merely service delivery.

  Many assumptions underlie each stage of a program, as outlined in the logical framework. Identifying them is necessary for successful program planning and evaluation. For example, if a weaning food was routinely shared with siblings, and an evaluation measured only the amounts of weaning food distributed, the results might not be an accurate indication of program success in reaching the targeted child.
- Evaluating the program plan's relevance, adequacy, and efficiency.

Relevance A program is relevant if it is directed at a real problem and its causes. To illustrate, a project has been based on the idea that the amount of

protein in the diets of weaning-age children in an area is insufficient. An evaluation of relevance would measure dietary intakes or food consumption to verify whether inadequate protein in the diet is, indeed, the major cause of malnutrition in the area. If the evaluator establishes that the children do show evidence of not receiving sufficient protein instead of calories or some other nutrients, the evaluator should then question why. Is the problem caused by an inadequate protein intake or by other factors? For example, is infection affecting food intake and utilization? If so, the program may need to include immunizations, improved environmental sanitation, and personal hygiene to be relevant.

Adequacy A program is adequate if sufficient in and of itself to alleviate the diagnosed problem. The evaluator should consider the various factors that may prevent nutritional improvement. For example, a project has developed formulated foods to be sold through regular commercial outlets. However, the prevalence of malnutrition is highest in rural areas. Distributing these foods to remote rural areas may be too expensive, and the people too poor to purchase them. This project is inadequate because it cannot benefit those in greatest need. A strategy for marketing the product and for subsidizing its cost would be necessary to meet the criterion of adequacy.

Efficiency A program is efficient if it is an effective and economical means of meeting objectives. For example, an evaluator has found that protein complementation at a feeding center is both a relevant and an adequate plan for reducing malnutrition. He can judge whether the plan is also efficient by answering these questions: Is the complement being provided in an inexpensive and acceptable form, and are the methods of preparation and delivery the most time-effective and cost-effective ones possible?

In this context, the evaluator might consider alternative methods of preparing the food and question whether preparation on site or at a central commissary is more cost-effective.

Evaluating the Implementation Process

The next major step after evaluating the program plan is project monitoring, which indicates whether services were provided, managed, and used according to plan.

Input accounting The first tasks in evaluating implementation or project monitoring are: accounting for supplies, personnel, and other inputs (Figure 1 in Chapter IX) and calculating the fixed and variable costs of operating the project. Ideally, the evaluator will also calculate the opportunity costs of inputs, for example, the cost to a mother of the lost opportunity to make money because she is breastfeeding. Methodical cost accounting will provide a basis for determining whether the project's impact was worth its cost.

Accurate accounting of inputs may appear to be one of the easiest evaluation tasks, but in practice this is not the case. Problems in assigning costs to inputs

and poor maintenance of implementing agency records are among the reasons for imprecise accounting of inputs.

Resource use Once accounting for inputs is complete, the next task is to examine how these resources were used, i.e., transformed into outputs (Figure 1 in Chapter IX). In this step, the evaluator precisely defines the services provided and their recipients. For example, if a project were distributing food rations, the evaluator might ask:

- How many food rations were distributed?
- How many calories were in each ration?
- Who were the recipients?
- Did the people designated to receive a food supplement actually consume it?

If services were not delivered as planned, in most cases the evaluator should not proceed to evaluate impact but should concentrate on either redesigning the project or improving the implementation of exisiting plans.

Examining Intermediate Indicators

Before determining whether a project has met its ultimate goals, the evaluator should assess the achievement of *project purposes* by examining selected *intermediate indicators* (Figure 1 in Chapter IX). For example, if a project's purpose (intermediate objective) was introducing nutritious complementary foods to four-to-six-month-old children, an appropriate intermediate indicator would be a survey of dietary intake. Furthermore, the evaluator should not assume that because a project has attained its intermediate objectives, it has also achieved its ultimate goals. The documentation that a large number of food rations were distributed, for example, does not necessarily mean infant nutrition has improved. If a project has accomplished its planned purposes, it is likely that it has at least partially realized its nutritional and health objectives. However, one must ask to what extent these objectives have actually been achieved, because the conditions existing at the beginning of the project may have changed or some of the assumptions may have been erroneous. For example, a widespread epidemic may have occurred during a project. (See the "Important Assumptions" column in Figure 1 in Chapter IX.)

In large-scale interventions, data on intermediate indicators should be collected at all project sites. Impact data can then be collected on a selective basis. If reaching intermediate objectives in sample communities is indicative of realizing project goals, this pattern will probably hold throughout.

Glossary

Amino acids: The subunits that make up proteins. The name refers to the chemical composition—each amino acid has an amino group and a carboxyl group. Amino acids are classified from a functional viewpoint as nonessential and essential. Nonessential amino acids are those synthesized in the body in adequate amounts. Others are termed essential amino acids because the body cannot make them in adequate amounts and they must be supplied by the diet. See also the definition of **essential amino acid.**

Amino-acid score:

$$\frac{\text{mg amino acid in 1g test protein}}{\text{mg amino acid in requirement pattern}}$$

In practice, the amino-acid score is equivalent to "chemical score" and "protein score," although "chemical score" as originally defined was relative to the amino-acid composition of egg protein. Expressed either as a ratio to unity (recommended) or on a percentage scale. May sometimes be used for other than the **limiting amino acid.** [*Energy and Protein Requirements. FAO Nutrition Meetings Report Series*, no. 52 (Rome: FAO, 1973)].

Anemia: Any condition in which the amount of hemoglobin in the blood is less than normal for any reason, such as fewer than the normal number of red blood cells or a packed red blood cell volume smaller than normal. Anemia is frequently manifested by pallor of the skin and mucous membranes, shortness of breath, palpitations of the heart, soft systolic murmurs, lack of the usual energy, and fatiguability. Anemia is among the most common of the nutritional disorders.

Anorexia: Loss of appetite.

Anthropometry: The science of measuring the dimensions of the human body to determine differences in individuals and groups.

Antinutritional substance: Any substance in the diet that reduces the availability, absorption, or biological activity of a nutrient.

At-risk indicators: Factors indicating that a child is likely to be undernourished, including low birth-weight, failure to gain weight in early infancy, difficulty breast-feeding or bottle-feeding in early infancy, poverty, a sibling with malnutrition, death of more than four siblings, birth order greater than three, and illiteracy. There may be some seasonal and regional variability in indicators, such as high seasonal unemployment and contaminated water supplies. (See also Table 5 in Chapter II and Table 2 in Chapter V.)

Beriberi: A disease resulting mainly from a deficiency of thiamine, a factor of the vitamin B complex, in the diet. Sensory nerves are likely to be affected more than motor nerves with symptoms beginning in the feet and working upward.

Biological value: The percent of nitrogen retained by the body after absorption from the gastrointestinal tract.

Bitot's spots: Lusterless, grayish white, foamy, often triangular deposits on the bulbar **conjunctiva**, near the cornea. These deposits are related to vitamin A deficiency.

Calculated protein efficiency ratio (C-PER): An *in vitro* assay for the prediction of the protein efficiency ratio (PER) of food proteins. [L. D. Satterlee, H. F. Marshall, and J. M. Tennyson, *J. Am. Oil. Chem. Soc.*, 56(1979):103-109.]

Calorie: A unit of heat quantity used in determinations of the heat-producing or energy-producing value of foods and defined as the quantity of heat needed to raise the temperature of 1 kg (one litre) of water from 14.5°C to 15.5°C under normal atmospheric pressure.

Carbohydrates: The compounds most typical of this class of foods contain carbon, hydrogen, and oxygen only, and the most important for food value are sugars and starches.

Centile: Also percentile. The *n*th centile or percentile of a set of numbers, arranged in ascending order of magnitude, is that number below which *n* percent of the numbers fall. At the 50th centile, half the population will be above and half below this value.

Cereal grains: A class of seeds that includes corn, rice, wheat, and sorghum.

Colombiharina: A vegetable mixture for both **complementary** and exclusive feeding to young children developed by the Institute of Nutrition of Colombia.

Colostrum: Yellowish early milk, rich in antibodies and vitamins.

Complementary food: Any solid, semisolid, or liquid nutrient fed to a nursling in addition to human milk. The manual uses the term "complementary food" instead of "supplementary food" because the former emphasizes the importance of continued breast feeding, conveying the idea that the food is a complement to, rather than a partial replacement for, breast milk. Introduction of complementary food marks the initiation of the weaning process. Comple-

mentary foods are **weaning foods.** Weaning foods may be made in the home from local foods or manufactured foods. They do not include tea, herbal drinks, or other medicinals. Weaning foods are of two types: those acceptable only for child feeding (transitional foods) and those consumed by adults as part of the regular household diet. A child may also be weaned from breast milk to animal-milk and vegetable-milk formulas.

Complementation: (1) The creation of high quality dietary protein, ideally in the amino-acid pattern required for human growth and metabolism, by combining two or more protein sources to compensate for the **limiting amino acids** in any one of them. For example, cereal grains are often complemented with legumes. (2) The use of **complementary food** in addition to breast milk.

Confounding variables: In the context of this manual, factors that have not been accounted for in an evaluation of a weaning-food program and that may be responsible for a program's success or failure.

Conjunctiva: The membrane lining the eyelids and covering the exposed surface of the sclera, the white part of the eye.

Cretinism: A form of idiocy and dwarfism, appearing in the first years of life, which is related to iodine deficiency in the mother during pregnancy or in the young child.

Cross-sectional nutrition survey: Survey in which all the observations are made over a relatively short period of time (compare **longitudinal survey**).

Delayed cutaneous hypersensitivity: An antibody response to an antigen that is manifested in 48 to 72 hours as erythema and inflammation at the site of the antigen's cutaneous administration.

Dermatitis: An infectious lesion of the skin.

Dermatosis: Any noninfectious lesion of the skin. Such changes are associated with a number of nutrient deficiencies.

Digestibility: The percent of ingested nitrogen absorbed from the gastrointestinal tract.

Duryea: A weaning mixture containing high-lysine corn and soy flours, milk powder, vitamins, and minerals and having a protein composition of 28%.

Edema: Swelling caused by water retention. Edema is a characteristic sign of **kwashiorkor.**

Energy: Used in the context of a protein-energy deficit, the term refers to calories.

Essential amino acid (EAA): An amino acid that cannot be synthesized from materials normally present in the diet at a rate commensurate with normal bodily needs. Also called indispensible amino acid by some investigators. The essential amino acids for human adults are isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine. Infants also require dietary histidine, and newborns can require cystine until they can produce the enzyme required for its synthesis. [W. C. Rose, *Physiol. Rev.*, 18(1938):109.]

Folic acid: A substance found in green leaves and other sources, which exhibits vitamin B activity and is used to treat certain anemias.

Failure to thrive: Persistent unsatisfactory growth of a young child for any reason.

Faffa: A vegetable and dried-skim-milk mixture developed by the Institute of Nutrition of Ethiopia for both complementary and exclusive feeding to young children.

Fortification: Addition of nutrients to a food, e.g., soybean protein to corn for tortillas.

Goiter: A swelling of the thyroid gland, whose principle lobes are located on either side of the trachea. In malnourished populations, goiter is commonly caused by iodine deficiency.

Gomez classification: A system for classifying malnourished children that identifies three degrees (or grades) of malnutrition. According to this system, a well-nourished child is one whose weight is equal to or greater than 90% of the 50th centile weight, that is, the median weight, of the reference population for the age in question. First degree (Grade I) malnutrition is indicated by a weight in the 89% to 75% range, second degree (Grade II) malnutrition by a weight in the 74% to 60% range, and third degree (Grade III) malnutrition by a weight less than 60% of the standard weight-for-age.

Grades I, II, and III malnutrition: See **Gomez classification.**

Groundnuts: Peanuts. See **Legumes.**

Gruel: A thin porridge.

Hypodevelopment: Underdevelopment or retarded development of a child.

Imbalance of nutrients: A long-lasting disproportion among essential nutrients in the diet with pathological consequences, whether or not there is an absolute deficiency of any essential nutrient, as determined by the requirements of an adequate diet.

Immunological tests: Tests of the competence of any of the many components of the immune system.

Incaparina: A processed weaning food, containing 26% protein, developed for use in Guatemala, composed of a mixture of processed corn and cottonseed flour, vitamins, and minerals.

Incidence: The number of instances of illness commencing, or of persons falling ill, during a given period in a specified population. Unlike **prevalence**, incidence is a measure of new cases. Incidence is usually expressed as a rate, the denominator being the average number of persons in the specified population during the defined period or the estimated number of persons at the midpoint of that period [*Bull. Wld. Hlth. Org.* 35 (1966): 783.]

Indicators of nutritional status: Physical, functional, and biochemical measurements that contribute to precise characterizations of the nutritional status of a group and to quantitative descriptions of changes in nutritional status. Examples of indicators are weight-for-age and arm-circumference measurements.

Infant: A child younger than one year of age.

Infantile tetany: A disorder in infants marked by intermittent muscular contractions and tremors, abnormal sensations, and muscular pains, which may occur in the healing stage of rickets when blood calcium is reduced.

Kwashiorkor: A syndrome resulting from an acute deficiency of protein relative to energy, usually exacerbated by infectious diseases and diarrhea and characterized by **edema, anorexia**, apathy, and a variety of biochemical and pathological changes. The classic example of kwashiorkor is a "sugar baby," that is, a child fed only a pablum of starch; such a child shows only a little weight loss because his energy stores are preserved. Kwashiorkor and concomitant infections usually result in the death of a child, unless treated. Kwashiorkor almost always occurs in conjunction with some degree of marasmus; children suffering from a combination of these disorders do not simply manifest all the signs of both kwashiorkor and marasmus.

Legumes: The British usually use the terms "pulses" and "groundnuts" instead of legumes and peanuts, respectively. Both peanuts and soybeans are legumes, but when processed to remove the oil, have the same protein content as the meal from **oilseeds**, such as sesame and sunflower seeds.

Limiting amino acid: The amino acid in a given protein showing the greatest percentage deficit in comparison with the amino-acid pattern judged optimal for human growth and metabolism.

Longitudinal survey: Survey in which the observations are made over a relatively long period of time (compare **cross-sectional survey**).

Marasmus: Severe undernutrition due to chronically inadequate intake of all nutrients, including protein, characterized by loss of subcutaneous fat and tissue **wasting**. The child with advanced marasmus is both greatly underweight and protein depleted. Advanced marasmus is the result of long-term food deprivation, and, therefore, much of the physiological and biological response is adaptive unlike the **kwashiorkor** response, which is acute and degenerative. Between the extremes of severe kwashiorkor and marked marasmus there is a continuum of disorders in which kwashiorkor is superimposed on marasmus.

Morbidity: The rate of disease occurrence or the proportion of diseased persons in a given population. Morbidity may be used as an indirect indicator of nutritional status in a population and of the efficacy of a nutrition intervention.

Mortality: The rate of death or proportion of persons who have died in a given population. Mortality may be used as an indirect indicator of nutritional status in a population and of the efficacy of a nutrition intervention.

Neonatal tetanus: Acute and often fatal infections in newborn infants usually contracted by contamination of the open end of the severed umbilical cord.

Neonate: A child ranging in age from newborn to 28 days old.

Net protein utilization (NPU): The percent of ingested nitrogen retained by the body, that is, the product of **biological value** and **digestibility**.

Nutrient: Any of the organic and inorganic compounds and elements contained in foods and utilized in the normal metabolism of the body. Nutrients are generally classified as carbohydrates, fats, proteins, vitamins, minerals, and other metabolizable organic compounds, such as organic acids.

Unlike the rest of this manual, Appendix 2, "How to Develop Recipes for Weaning Foods," makes a distinction between energy and nutrients.

[Y. Hofvander and M. Cameron, Chapter 15 in *Manual for Feeding Infants and Young Children* (New York: Oxford University Press, 1983), pp. 117-127.]

Nutritional Status: The condition of the body resulting from the intake, absorption, and utilization of food and from pathological factors affecting these processes.

Oilseed: A seed whose amino-acid pattern is similar to that found in legumes; the class includes cotton, sesame, and sunflower seeds.

Oilseed meal (presscakes): The product remaining after oil has been removed from such plant sources of protein as soybeans, peanuts, sesame seeds, and cotton seeds, by pressing, extraction, or a combination of both methods. If the meal is purified it can be used for human food. Otherwise it is used for animal feed.

Organoleptic characteristics: In the context of food, its taste, smell or appearance.

Preschool-age child: A child between 1.0 and 3.9 years of age.

Prevalence: The number of instances of malnutrition or of malnourished persons, or of any other phenomenon of interest such as **mortality** or **morbidity**, without distinction between new and old cases.

Pronutro: A mixture containing 22% protein, developed by the Hinds Company of South Africa for both **complementary** and exclusive feeding to young children. The mixture is composed of soy, corn, and peanut flours, nonfat milk solids, and wheat germ.

Protein: (1) A major class of nutrients. (2) An organic compound consisting of amino acids linked by peptide bonds. Proteins are responsible for a wide variety of structural and functional roles in the body, including all enzymatic activity.

Protein efficiency ratio (PER): A biological method of estimating protein quality. It is defined as weight gain per weight of protein eaten. Values are usually measured using rats. Originally measured at different levels of protein and the maximum value quoted; later rats were conventionally fed diets containing 10% protein; currently, standardized procedure uses diets containing 9.09% protein. [T. B. Osborne and L. B Mendel, *J. Biol. Chem.*, 32(1917):369. AOAC, *Official Methods of Analysis of the Association of Official Analytical Chemists*, 11th ed. (Washington, D.C., 1970).]

Protein score: Measures the extent to which a food or food combination supplies the **limiting amino acid** as compared to the provisional pattern. See **amino-acid score.** [*Protein Requirements*, FAO Nutrition Meetings Report Series, no. 37 (Rome: FAO, 1965).]

Pulses: See **Legumes.**

Rachitic rosary: A row of beading at the junctions of the ribs and their cartilages, often seen in children with **rickets.**

Reference pattern: The pattern of amino acids in a reference protein. Also used in a less rigorous manner to mean a pattern of amino acids used for reference.

Rickets: A vitamin-D deficiency disorder. In rickets, mineralization is defective in both bone and cartilage. In children with rickets, growth is retarded, the skeleton becomes fragile, and fractures may occur repeatedly with minimal trauma. Defects in dentition with delay in eruption and extensive caries may also occur.

Salter scale: A spring scale for weighing babies with a weight limit of 25 kg, which can be hung from a tree branch or house beam.

Staple foods: Any food that supplies a substantial part of the energy requirement and is regularly consumed by a community or country, for example, **cereal grains** are staple foods in most developing countries.

Stunting: Impairment of skeletal growth due to malnutrition, detected by measurements of height-for-age.

Supplementary food: See **complementary food.**

Superamine: A vegetable mixture, containing 26% protein, developed by the Ministries of Health of Algeria and Egypt for both **complementary** and exclusive feeding to young children. The mixture contains wheat flour, chickpea flour, lentil flour, skim milk powder, sugar, vitamins, minerals, and flavoring.

Synergism: The combined effect of different factors, such as malnutrition and disease, which have a total effect greater than the sum of their individual effects.

Validity: In the context of program evaluations, a criterion referring to whether the indicators used in the evaluation measure what they are intended to.

Wasting: The depletion of essential cellular constituents, especially reflected in loss of body fat and muscle tissue, resulting from prolonged food deprivation and often associated with infections and other diseases. Measured by weight-for-age.

Waterlow classification system: A method for classifying protein-energy malnutrition: the so-called Wellcome classification [*Lancet*, 2(1970):302]. The point at which malnutrition begins is defined as a reduction in body weight below 80% of the Harvard fiftieth percentile or standard weight-for-age. This point corresponds approximately to the Harvard third percentile. [For standard and fiftieth percentile Harvard values, see H.C. Stuart and S.S. Stevenson, in: W.E. Nelson (ed.) *Textbook of Pediatrics*, seventh edition (Philadelphia: Saunders, 1959)]. Malnourished children are classified according to two criteria: the presence or absence of edema and a minimum body weight above or below 60% of the fiftieth percentile or standard Harvard weight-for-age. The criteria are cross-tabulated to produce the designation of nutritional status as follows:

Weight-for-age (% of Harvard standard)	Edema	
	Yes	No
80 - 60	Kwashiorkor	Undernourished
< 60	Marasmic Kwashiorkor	Marasmus

[See also J.C. Waterlow. "Classification and Definition of Protein-Energy Malnutrition," Annex 5. In G.H. Beaton and J.M. Bengoa (eds.) *Nutrition in Preventive Medicine* (Geneva: WHO, 1976), pp. 530-555.]

Weaned: A child who has been weaned is one no longer receiving any breast milk.

Weaning: The process during which breast milk is progressively replaced by other nutrients—solid, semisolid, or liquid. Intake of beverages of little nutritional value, such as tea, herbal drinks, and other medicinals does not constitute weaning by this definition. Weaning is a transitional period terminated when breast milk is no longer part of a child's diet.

Weaning food: In this manual, weaning food and complementary food are used interchangeably. See **complementary food.**

Weanling: A child in the process of being weaned.

Weanling Diarrhea: Diarrhea occuring during the weaning period, which may be a sign of or contribute to the development of protein-calorie malnutrition. The term was coined by Gordon et al. to emphasize the relationship between

intestinal infection and deterioration in the diet and nutritional status that usually follow diminution in the supply of breast milk or its complete withdrawal. The diarrhea is sometimes caused by infection, but may also be due to indigestible food and to atrophy of the intestinal mucosa, or enzyme deficiency, particularly in long-standing cases of protein-calorie malnutrition. [J.E. Gordon et al., *Amer. J. Med. Sci.* 245(1963):345.]

Xerophthalmia: Pathological changes in the eye resulting in dryness of the conjunctiva and cornea (called xerosis) usually associated with systemic vitamin A deficiency. The disorder may progress from dryness of the membrane covering the exposed surface of the eye and lining of the lids, to softening and necrosis of the cornea, leading to corneal collapse, scarring and blindness.

Z score: A score describing the difference of a measurement from the mean in standard deviation units.

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