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Editorial

The state of nutrition in the world

Abraham Horwitz

It is encouraging to report that the field of nutrition is neither dormant nor static in the world. Quite the contrary, there is a great deal of activity relating to nutrition going on within the international community of agencies and a number of the governments they serve. Regarding different actions in food and nutrition, a distinct and dynamic trend can be seen. I would like to highlight some of the major activities.

We certainly have better information about the prevalence of the undernourished population. The "First Report on the World Nutrition Situation" [1] and the recent update on 33 developing countries [2], including some of the least developed, show that even on the basis of a strict indicator—dietary-energy supply (DES) less than 1.1 times the basal metabolic rate (BMR)—the problem is simply enormous. Some believe that it is actually much larger than these reports suggest.

The "Update on the Nutrition Situation" is richer in economic and food indicators and focuses on underweight children since 1980. The update reflects the profound effects of the recession and structural-adjustment policies on human welfare, including malnutrition, especially in heavily indebted countries. The need to promote and implement "development with a human face"—to use the felicitous expression of Dr. Richard Jolly of UNICEF—becomes clear. Indeed, it is urgent, because, as the report states, "Decade by decade, the trend in child nutrition seems to be of gradual improvement, if undisturbed by crisis (political, economic, or drought)." Or by epidemics, we may add.

The process of updating information by groups of countries or regions or by examining data on specific nutritional deficiencies must continue if we want to strengthen advocacy for nutrition at the highest decision-making levels of governments. This is one of the statutory responsibilities of the SCN.

Because better information is available, the Inter-Agency Food and Nutrition Surveillance Programme was launched and is progressing. The focus must be on the decisions needed to implement policies and programmes leading to the information required. The number of developing countries that can either create or extend an effective surveillance system has clearly increased.

The SCN is starting to collect data on the flow of international resources for nutrition. The method employed, once validated, should be applied to all multilateral and bilateral agencies assisting developing countries, and should also include national funds. The moment will arrive, if we persevere, when we will know reasonably well the prevalence of undernutrition and malnutrition in the world, the resources being invested, and whether the nutrition policies and programmes in operation respond to priorities and to the available scientific evidence.

In emphasizing the dynamism of nutrition in the world today, we can affirm that we have better knowledge about the determinants and the consequences of malnutrition. There is stronger evidence that the most pressing problem in periurban and rural communities, particularly poverty-stricken ones in the developing world, continues to be the synergism of malnutrition and infection. This is still true 25 years after the classic monograph by Scrimshaw, Taylor, and Gordon [3]. The child-survival policy does not regularly include among its activities a nutrition programme, which is essential, particularly for an effective oral rehydration therapy. The classic study by Puffer and Serrano, sponsored by the Pan American Health Organization [4], established that in 57% of the children under five years old examined, malnutrition was an underlying or associated cause of death. We are still far from implementing a comprehensive primary health care approach, as distinguished from a targeted one, to control major infections at the community level.

This editorial is based on opening remarks made at the fifteenth session of the Sub-committee on Nutrition of the United Nations Administrative Committee on Co-ordination (ACC/SCN), held at UNICEF headquarters, New York, 27 February–3 March 1989. Dr. Horwitz is chairman of the sub-committee.

Preliminary results of the Collaborative Research Support Programme [5] give us better knowledge of the functional effects of substandard levels of food-energy intake in the range of mild-to-moderate deprivation. The study focuses on three key functional measures—namely, morbidity, cognitive and behavioural performance, and reproductive outcome. Once the wealth of archived data is examined, one can foresee highly significant policy implications. It is in the interest of all governments and the SCN members to have this fundamental study completed and widely disseminated so that its outcomes can be appropriately translated into policies and programmes.

The impacts of the economic adjustment policies during the 1980s on the health and nutritional status of the poor and, in general, on their living standards, incomes, and consumption are better understood. Remedial measures have been designed and are starting to be applied to the highly indebted, middle-income countries and to low-income Africa, both requiring different overtones in their strategies to protect the poor. Furthermore, the control of food insecurity in Africa, reflected in widespread hunger, is the object of a systematic approach focusing on increasing incomes of the poor, reducing fluctuations of food prices and supplies, and improving the effectiveness of food aid.

There is better evidence, determined by effective growth monitoring, on the significance of food supplementation to prevent malnutrition and promote better health in pregnant and lactating mothers and children under five. Food supplementation is no longer "just medicine" for children with severe protein-energy malnutrition. It must be used for all malnourished human beings.

No doubt we have more experience on how to prevent vitamin-A-deficiency blindness, iodine-deficiency diseases, and iron-deficiency anaemia, although they all remain highly prevalent in many areas of the world. We have also advanced our knowledge on the intersectoral linkages that impair food consumption and induce malnutrition. Greater progress has been made in relation to agriculture than education. For instance, it has been documented that extra income for poor rural people is not sufficient, at least in the short-term, to induce substantial improvement in the nutritional status of children of pre-school age.

Among the "missing components" are public health, female education, and reduced energy requirements at work—all of which require further research. We need more information and effective operational approaches to institutionalize the linkages of nutrition with agriculture and with education as well as with other economic and social sectors.

Novel methodologies to change behaviours toward healthful and nutritional practices have been developed and tried with success. Well-tested "rapid assessment procedures" based on anthropological approaches are available. Perhaps more important, we count today a number of large-scale, successful, well-targeted, and well-managed nutrition programmes that can be replicated. On the other hand, there are also countries whose health and nutrition indicators approach those of some of the industrialized societies. The impact of the recession and the adjustment policies was less intense in these countries than in others of the same region.

Although long overdue, there are more studies and programmes focusing on women as essential for increasing the resources of communities and households while protecting the health and nutritional status of their families.

Yet, despite these distinct signs of progress, both conceptual and operational, and several others, the problem of insufficient intake of food, particularly energy intake, and overt malnutrition still shows a high prevalence in the developing world. Depending on the indicators used and the cut-off points, the numbers of undernourished and malnourished vary widely. Experts do not yet seem to have reached agreement. However, using the more strict and limiting indicators, it is accepted that there are at least 340 million human beings undernourished as a result of severely inadequate diets, and that more than 140 million children are stunted, with impaired potential for intellectual and social development and for access to the opportunities that society offers. Small is certainly not beautiful; normal is!

It can be safely asserted that in most developing countries there is not yet a critical mass of mothers and children who benefit from health, food-consumption, and nutrition interventions. Nor do governments and the international community of agencies invest enough to reach such a critical mass, sustain its impact, and institutionalize specific processes. Rates of infant mortality, early childhood mortality, specific morbidity in children under five, malnutrition, low birth weight, food consumption, and other indicators justify this assertion. It is known that policies and programmes for better food consumption and nutrition must take into account the economic, social, and cultural characteristics of each nation. However, experience shows that the basic principles and methods to reach specific goals can be adapted to different characteristics. There is indeed a need for more research to refine knowledge and its application, but, at the same time, there is also an urgent need for greater investments to progressively reduce the numbers of underfed and malnourished. This can be done, and, ethically, it should be done.

It is a matter of great distress to note that the numbers of the poor seem to be increasing in the world. Furthermore, the prevailing political ideologies do not seem to know how to deal effectively with the poor, or how to prevent poverty. Because the pace of economic and social development appears to be too slow, the need becomes essential for specific direct interventions targeted to those at greater risk, aiming at improving their nutritional status.

We submit that available national and international resources, if better co-ordinated, could eliminate most undernourishment and malnutrition. Co-ordination of plans and programmes within and among the sectors still awaits effective implementation. With the distinct trend toward larger targeted investments in food and nutrition that we witness today, better co-ordination will come to be of paramount importance.

The SCN has been observing and participating actively in this dynamic process for better nutrition in the developing world, as we hope this fifteenth session will show.

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In memoriam: Mogens Jul

The death of Mogens Jul of cancer on 4 February 1989, in Hillerød, Denmark, deprived the United Nations University of one of its wisest advisers and one of the most dedicated supporters of its food and nutrition research and training activities. A member of the advisory committee of the World Hunger Programme from the founding of the UNU in 1975, Professor Jul served as chairman of the committee from 1978 to 1981.

Mogens Jul, 1914–1989

After obtaining a diploma in chemistry from the Technical University of Denmark in 1937, he joined the Technological Laboratory, Danish Ministry of Fisheries, where he was director from 1942 to 1948. Concurrently, he was Associate Professor in Fishery Industry at the Technical University, head of the Faculty of Chemistry, and co-manager of the Danish Institute of Refrigeration. In 1948 he was named head of the Department of Technology, FAO Fishery Division, in Washington, D.C., and continued in this position in Rome, Italy, from 1951 to 1953.

He was then asked to return to Denmark to establish what was later known as the Danish Meat Research Institute, in Roskilde. He was director there from 1953 to 1968. During that period, he founded a chair in food preservation at the Royal Danish Veterinary and Agricultural University and became the first associate professor there from 1955 to 1985. He was also head of the Danish Meat Products Laboratory, Ministry of Agriculture, a part-time position which he held from 1955 to 1971, and was then engaged there full-time until his official retirement in 1984.

He was extraordinarily effective as head of the secretariat of the Protein Advisory Group of the United Nations in New York from 1968 to 1971. After returning to Denmark, he founded the Danish Research Institute for Poultry Processing, where he was director from 1971 to 1980.

Professor Jul's creative abilities were called on both nationally and internationally. Simultaneously with his position as head of literally all meat and poultry research in Denmark, he was instrumental in the founding of the Danish Meat Trade School and establishing food-science education at the Veterinary and Agricultural University. He was also a board member of the Danish Agricultural Data Processing Centre, the Planning Group of the Danish Bacon Factories Export Association, the Agricultural Consultative Group for Research, and the Technical Board of the Poultry Export Association.

For some time he was chairman of the Chemical Engineering Group in the Danish Society of Civil Engineers, and he became co-founder and first chairman of the Danish Society for Food Technology and Hygiene. The (Danish) Academy for Technical Sciences also made frequent use of his skills. From 1957 to 1964 he was vice-president and chairman of one of its sections, a board member of the Danish Technical Information Service, of the Protein Chemistry Institute, and of the Industrial Ph.D. Diploma Committee. After his official retirement, he became chairman of the Academy's Catering Committee and was one of the driving forces behind the foundation of the Danish Catering Centre.

Professor Jul was also very active in public committees, nationally and internationally. In Denmark he was chairman of a working party under the Danish International Development Agency (DANIDA) which created an FAO Veterinary Faculty at the Veterinary and Agricultural University. He was a member of the DANIDA Technical Committee on Agriculture, of the Committee on Technology Assessment of Food Industries under the Ministry of Environment, and of a joint FAO/DANIDA evaluation mission on dairy development programmes in less-developed countries. For several years he was also a board member of the Danish Technical Research Council.

From 1979 until his death, he was vice-president of the Intra-European Research Programmes COST 91 and COST 91 bis, entitled the Influence of Processing and Distribution on the Quality and Nutritive Value of Foods. He was head of the evaluation mission for the largest dairy development in the world under the World Food Programme in India in 1975–1976. Two of his reports on this project were published in the *Food and Nutrition Bulletin* (vol. 1, no. 3 [1979], pp. 15–19; and vol. 7, no. 2 [1985], pp. 14–20). He served as a consultant to UNIDO on food technology and nutrition research, and to the secretariat of the Nordic Council on nutrition policy in 1985, to the Danish Ministry of Agriculture on food research in 1986–1987, and to the International Foundation for Science on food technology and village development in 1986.

The Commission of the European Communities (CEC) made frequent use of his skills. He was a member of the CEC Programme Committee for Food Research under the Permanent Committee for Agricultural Research in 1978, and co-ordinator for Poultry Research from 1980 to 1984.

Active in management, he was a member of the planning council for the Management Centre Europe, in Brussels, and a research and development consultant for short periods in several sectors of private food and beverage industries. He was a member of the International Committee of Food Science and Technology from 1964 to 1968, became a Fellow of the Institute of Food Science and Technology, UK, in 1965 and a Fellow of the Institute of Food Technology, USA, in 1981, and was an honorary member of several Danish societies.

Within the UNU, Professor Jul was responsible for a number of significant initiatives, including a joint meeting with the UNU Human and Social Development Programme on "Goals, Processes, and Indicators for Development" in 1979, and a multidisciplinary workshop held at the Rockefeller Foundation Conference Center in Bellagio, Italy, in 1980. The report of this meeting shaped the direction of UNU food and nutrition activities for the next five-year period. He was also a tireless supporter of the fellowship programme, and he interviewed potential fellows in many different countries.

No one who has worked with the United Nations University during this period will ever forget the gentleness, tact, and good judgement with which Professor Jul presided over advisory committees, task forces, and workshops. Both his talents and his gracious personality will be greatly missed.

Observations on the FAO's methodology for estimating the incidence of undernutrition

J. C. Waterlow

The Food and Agriculture Organization's *Fifth World Food Survey* [1] is, in most respects, a valuable and well-set-out report, covering a difficult subject extensively and clearly. The points that I wish to make here are concerned only with the appendix on estimating the number of malnourished people and are directed mainly to some of the biological assumptions and interpretations made therein.

The basis of the methodology is in principle straightforward and involves two stages. First, a cut-off point is determined for energy expenditure, below which a person of any given age and either sex may be regarded as deficient. Second, on the reasonable assumption that over a period of time intake and expenditure must be equal, information is obtained about the distribution of intakes. The third step is to calculate from these two sets of data the number of people whose intake for expenditure is below the cut-off point.

It should be mentioned at the outset that, for practical reasons, the calculations based on individuals' intakes are scanty. To estimate the prevalence of malnutrition it was necessary to assume that the proportion of households with inadequate energy intake represents the proportion of undernourished individuals in the whole population. The FAO was aware of the shortcomings of this procedure in that it ignored the possibility of inequitable distribution within the household.

In this note I am concerned only with certain aspects of the first step. This step itself has two components: determining the basal metabolic rate (BMR) on the basis of body weight, and then arriving at a minimum level of daily energy requirement, expressed as a multiple of the BMR.

Before addressing these two components separately, a general comment is in order about the framework within which the discussion proceeds. It is accepted that a person can be in energy balance, and his requirements met, at different levels of body weight, so that for any individual or group there is a range of requirements. The *Food Survey* seeks to determine the *minimum* requirement, or lowest point of the range. The phrase "minimum energy requirement" was avoided by the 1981 Expert Consultation on Energy and Protein Requirements (see its report [2], hereafter referred to as the Rome report). For protein and other nutrients the term "minimum requirement" has generally been taken to mean that an individual should consume this amount or more, although for certain nutrients an upper limit of intake exists at which there is danger of toxicity. In the case of energy, it has generally been held that this concept does not apply, because a person who eats more than the requirement becomes obese.

Indeed, it does seem legitimate to treat energy in the same way as other nutrients and to allow a range of acceptable intakes corresponding to a range of acceptable body weights. The main difference from other nutrients is that the range is rather small.

Body weight as a basis for estimating requirements

The *Food Survey* points out that if a person's intake is less than the requirement at his existing body weight, the result will be loss of weight and a consequent reduction in energy expenditure until balance is restored at the lower level of intake. This process is referred to as *costless biological adaptation*. The concept involves two value judgements that are not made explicit and are not adequately discussed: the first is a judgement about the lower limit of acceptable weight; the second is the assumption that transition from one body weight to another is costless.

For adults, the *Survey* takes as its lower limit the minimum desirable weight of the Metropolitan Life Insurance Company tables. Technically, this is not a good choice. Those tables are based on mortality

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rates obtained many years ago in a selected American population—those who took out life insurance. Today, it is generally recognized among nutritionists that it is preferable to use a purely objective measure of body weight in relation to height, such as the Quetelet index or body-mass index (BMI = weight/height^2, with weight expressed in kilograms and height in metres). The problem is to evaluate the acceptable range of BMI.

We have discussed this question in more detail elsewhere [3]. Briefly, for adults at all heights and of both sexes the lower limit of the Metropolitan desirable weight corresponds to a BMI of about 20. This appears to be an acceptable figure for industrialized countries. The Fogarty Conference in the United States and the British Royal College of Physicians [4] chose BMIs of 18.6 for men and 20 for women as their lower cut-off points, rounded off to 20 for both sexes. These values, however, based on mortality risk, cannot be extrapolated to the developing nations. It could be argued, however, that for developing countries a cut-off point of BMI at 20 is too high, since in many apparently healthy population groups the average is 18 to 19, so that in half the subjects it will be even lower [5].

Data on the distribution of BMI in several emerging countries collected recently by the FAO suggest that 18.5 would be a reasonable lower limit in both sexes. This is in agreement with our own analysis [3]. The choice of the lower limit clearly would have a large effect on estimation of the number of undernourished people. This is a point to which a great deal of attention must be given when the FAO prepares its next world food survey.

In addition, one may question whether transition to a lower level of body weight is costless even within the acceptable range. Ample evidence suggests that such a transition does not simply represent a loss of fat. Some loss of lean body mass, probably mainly of muscle mass, occurs that may have functional consequences.

It is, of course, a matter of degree. Information on changes in body weight and energy expenditure has been summarized in farmers during the season when food is short and the need for physical work is at its peak [6]. Energy expenditure goes up at the expense of body weight, which may fall by a maximum of 5 kg. This would correspond to about 2 BMI points, so that, if the initial BMI was 20 or 21, in the hungry season it would fall to 18 or 19, or just about the lowest acceptable limit. This degree of change may appear to be costless, but it reduces the body's reserves that may be needed in illness or pregnancy. It has been shown in the Gambia that in the hungry season there is a significant fall in infants' birth weight [7].

The concept of costless adaptation in body weight is unsatisfactory for different reasons when applied to children. It is, indeed, a fact of life that large numbers of children in developing nations are well below the international reference levels of length or height for age [8]. The *Food Survey* regards this height deficit (stunting) as acceptable at least within limits (see below); it then argues that, as for adults, for any given height there is an acceptable range of body weight, and for assessing the child's requirement it chooses a body weight of one SD (standard deviation) below the reference median weight for height.

These proposals produce a substantial savings in energy requirement. If the requirement per kilogram is taken as 100 kcal per day, a two-year-old child at the reference median weight and length would need 1,260 kcal per day. At one SD below the median reference height for age and reference weight for height, the child's requirement would be 1,085 kcal per day, a saving of 13%.

Are these proposals justified? One has to distinguish between the short term and the long term. Weight for height is concerned with the short term. I do not suggest that one SD below the median in itself represents a weight deficit of any importance. Even in a deprived population, however, the weight for height of many children is above that cut-off point. The *Food Survey* concept is that such a child, like an adult, can adapt without cost by reducing his body weight until it reaches the cut-off point. This is a dangerous proposition.

In adults, as mentioned above, during the lean season, when energy expenditure exceeds intake, physical activity is maintained at the expense of body weight [6]. Since what matters is activity rather than body weight itself, this adaptation in adults may be regarded as acceptable, if not actually costless. There is evidence that in children the response is different: in one study of pre-school children, when the energy intake was reduced from 87 to 80 kcal per kg, physical activity was decreased while weight gain continued [9]. The profound influence of food supply on the activity level of young children has been documented [10]. Any so-called adaptation that involves a reduction in activity cannot be regarded as costless.

On the question of height, the *Survey* accepts that young children worldwide have roughly the same potential for growth but argues that there is a growing body of evidence that a growth rate below the genetic potential is not necessarily harmful [11]. This view may be correct within limits, but the evidence quoted to support it is not impressive. It is inappropriate in this context to rely on a study conducted in Bangladesh [12] which was not directed to the point at issue. The Rome report did indeed accept that there is "a wide variation in children's sizes, with no indication that the differences per se are related to health, well-being or physiological function." The question, as always, is one of degree. It is necessary in practice to make value judgements. It would surely be going too far to maintain that deficits of more than two SD below the reference median, such as are found in some 50% of children in many populations [8], are acceptable and costless.

In the short term it may be necessary to accept that stunting is a fact of life in developing countries; it would indeed not make sense to mount a nutritional programme to eliminate stunting, if only because we do not know what its cause is in nutritional terms. However, we are not concerned only with the short term.

The subject of stunting—its natural history, epidemiology, and causal factors—has recently been discussed in depth [13]. Three things are clear: First, stunting is an index of social deprivation, to which many factors contribute. Indeed, in the United Kingdom height has been used as a measure of the health and nutrition of children ever since the pioneering work of Boyd Orr. Second, physical growth retardation is often, although not invariably, accompanied by retardation of mental development [see, e.g., ref. 14]. Third, small body size per se results in reduction of physical working capacity, which is very important in a rural environment [15; 16]. Thus, although to be small may reduce the risk of death when food is short, this adaptation is by no means costless.

To the extent that the efforts of UN agencies are successful in improving the conditions for disadvantaged people, there is likely to be a decrease in the prevalence and extent of stunting and a consequent increase in the food requirements of children. We know that the FAO plans for the future as well as for the present. It is important not to give the impression that the status quo is acceptable and that there is one standard for the rich and another for the poor.

Infection

The *Food Survey* appendix rightly devotes some attention to the effects infection and other undefined environmental factors on requirements, but unfortunately without any clear outcome or recommendations. Although UN committees have defined requirements in terms of the needs of "healthy" people, they have always recognized that this is an abstraction, since very large numbers of people in the world are not healthy. It is naturally impossible to make a general rule that will provide quantitative estimates of the extra requirements, because conditions vary widely. The Rome report took one step forward, giving a concrete example of the extra amounts of energy and protein required to produce catch-up growth in a child exposed to repeated infections.

The basic principle was to determine the degree of growth deficit produced by infection and then to calculate the requirements for catch-up. Quantitative information has to be obtained about the prevalence and duration of infections in any population and the average effect on growth of one day's infection. This information allows calculation of the impact of infection on growth [17]. Two conclusions can be drawn from this kind of exercise: (a) In general, to produce catch-up growth in children, the extra amount of protein needed will be relatively greater than the extra amount of energy. (b) Except in extreme cases, the extra energy needed will not be great compared with the normal energy requirement. This follows from the physiological fact that the energy cost of growth is small compared with the requirement for maintenance.

It is unfortunate that the appendix does nothing more to illuminate the problem. It does not even indicate what kind of information is needed as a basis for calculating, even roughly, an allowance for the effects of infection. It has already been pointed out that, for both adults and children, a so-called costless adaptation that consists in a reduction of body weight will diminish the body's reserves or margin of safety in the face of environmental stress. No such adaptation is truly costless unless it occurs in persons who are initially at or above the upper end of the acceptable range, a situation that is not very common in populations subject to undernutrition.

The maintenance requirement and the cut-off point for undernutrition

Both *The Fourth World Food Survey* [18] and the fifth have taken the line that the minimum energy expenditure needed for any kind of normal existence (i.e., the maintenance requirement) could be taken as a cut-off point; with intakes below this, people would be undernourished.

The appendix to the fifth *Survey* discusses fully and frankly the main problems of this approach. First, by definition, maintenance involves minimal physical activity: it allows for washing, dressing, cooking food, and moving about the home, but not for the physical activity demanded in rural communities for the production of food. Thus the maintenance requirement may be a suitable criterion for urban populations who are largely sedentary. In communities that rely on the physical work of their inhabitants to produce food, however, a person who is living just at the maintenance level is maintaining his nutrition at the expense of others, and is in effect increasing their requirements.

It is a difficult and laborious task to quantify physical activity, with all the variations that occur between individuals and communities. It may be simplified when it is possible to apply more widely the doubly-labelled-water method, by which total energy expenditure can be measured non-invasively over periods of 10 to 14 days.

The second problem, again well recognized by the fifth *Food Survey*, has already been alluded to: that the intake data are based on households, and it cannot be assumed that food is evenly distributed within households. Some studies of intra-household distribution have been done, but it would be hazardous to generalize from them.

For the time being, therefore, the use of the maintenance requirement as a cut-off point, in spite of the sources of error, does seem to be the best available approach.

The Rome report proposed that 1.4 × BMR would be a realistic value for the maintenance requirement. Since that report was drafted, several studies in which energy expenditure was measured in a whole-body calorimeter [e.g., ref. 19] have confirmed that this is a reasonable estimate of the expenditure of people leading a very sedentary life, with minimal physical activity. To apply this criterion, the predicted BMR ($\overline{BMR}$) for any age and sex group is obtained from the equations of Schofield et al. [20], reproduced in the Rome report. The maintenance requirement is then estimated as 1.4 $\overline{BMR}$, with an SD of 0.1 $\overline{BMR}$ (coefficient of variation about 7%). The calorimeter studies have shown that virtually all the variability in the maintenance requirement can be attributed to variability of the BMR, and that the energy cost of a fixed activity pattern expressed as a multiple of BMR is relatively invariant.

The *Food Survey* also proposes the use of an alternative cut-off point of 1.2 $\overline{BMR}$, based on the hypothesis of Sukhatme and Margen [21]. The essence of the hypothesis is that an individual's BMR is not fixed but may alter from week to week, adjusting to short-term imbalances between energy intake and expenditure. Thus all the variability found in a given set of measurements of BMR would represent within-subject variations, because different subjects have been measured at different points within their range of adjustment or adaptation. It is then concluded that all people, if faced with low food intake, could adjust their BMR to the lower end of the range. On this view, the appropriate cut-off point would not be 1.4 $\overline{BMR}$ but 1.4 $\overline{BMR}$ − 2 SD = 1.2 $\overline{BMR}$. The difference is far from negligible when it comes to determining the number of undernourished people. The *Food Survey*, very fairly, gives estimates based on both cut-off points. Thus it is calculated that in 1979–1981 the proportion of people undernourished in all developing-market economies taken together would be 15% if the cut-off point is 1.2 $\overline{BMR}$, and 23% if it is 1.4 $\overline{BMR}$ [1, table 3.1]. In terms of energy, the difference between the cut-off points is of the order of 150–200 kcal per day.

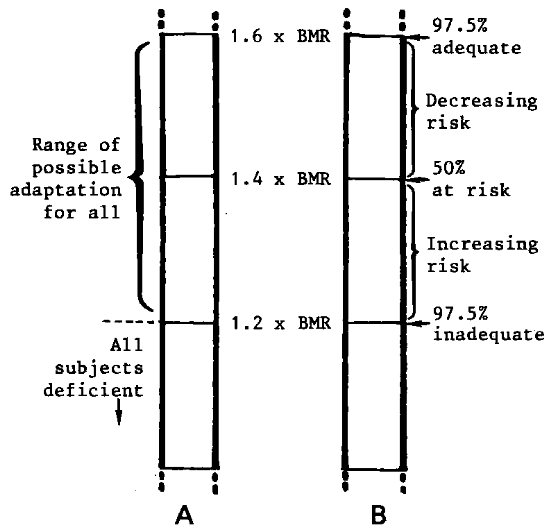

FIG. 1. Alternative approaches to estimating maintenance requirements for dietary energy: (A) Subjects are assumed to be able to adapt the level of their maintenance requirement to an energy intake of 1.2 × BMR. No subject with an intake above this level would be at risk; all subjects with an intake below it would be deficient. (B) Mean maintenance requirement = 1.4 × mean predicted BMR. The zone from 1.6 down to 1.2 × BMR represents an increasing risk. For a subject with an intake above 1.6 × BMR the risk of being deficient is very small. Subjects whose intake is below 1.2 × BMR are almost certainly deficient.

However, I should point out that, as far as I can see, the difference between the two criteria, cut-offs at 1.2 $\overline{BMR}$ (A) and 1.4 $\overline{BMR}$ (B), is not simply a quantitative one, like the difference between 70% and 80% of expected weight for height as a criterion of malnutrition in children: there is also a qualitative difference. By both criteria, anyone with an intake of less than 1.2 $\overline{BMR}$ would be definitely undernourished. According to A, anyone with an intake greater than 1.2 $\overline{BMR}$ is not undernourished; according to B, intakes between 1.4 and 1.2 $\overline{BMR}$ represent a zone of increasing risk of undernutrition, and intakes between 1.4 and 1.6 $\overline{BMR}$ (mean + 2 SD) represent a zone of decreasing risk. This situation is analogous to that for protein requirements. The contrast is shown in figure 1.

This qualitative difference in the nature of the criteria implies that there should be a difference in the procedures for matching intakes against minimum requirements. According to A, a distribution of intakes for a given age-sex group has to be matched against a fixed cut-off point. According to B, there has to be a matching between two distributions. (Strictly, from information provided by the FAO, the procedure is a "matching within the framework of a bivariate (joint) distribution of intakes and requirements.")

Recent work does not support the conclusion that within-subject variation accounts for almost all the variability in BMR. Measurements repeated over days, weeks, or months show that the BMR of an individual is remarkably stable. The within-subject coefficient of variation is about 2%, while the coefficient of variation between subjects is 6%–7% [22; 23].

It could be argued that the within-subject variation is small because the BMRs were measured under similar, if not identical, conditions, and that the variation would be greater if they were measured under the stress of major alterations in intake or activity. This is not the place for a detailed discussion of the hypothesis, however. Summaries and critiques appear elsewhere [24; 25].

It should be noted that the Sukhatme-Margen hypothesis is based mainly on results obtained nearly 20 years ago on army recruits over a period of five weeks. It remains to be seen whether it is relevant to the situation of people who throughout their lives are exposed to marginal food intakes. This is the situation with which *The Fifth World Food Survey* is concerned.

For a long-term adaptation to be acceptable, a sustained decrease in "economic" or "discretionary" activities would not be a viable option. Apart from adjustments in body weight, the only information that we have relates to BMR.

In the world-wide analysis of BMR by Schofield et al. [20], by far the greater part of the data was derived from measurements in industrialized countries. The authors concluded tentatively that in developing countries the BMR might be lower than the overall average by 9%–10%, a conclusion based almost entirely on reports from India. Since then the FAO has itself collected further measurements of BMR in developing countries, and Henry and Rees [26] have made a further analysis of the older literature. The findings show that in developing countries BMR does tend to be lower than the values predicted from the Schofield equations that were used in the Rome report and by the *Food Survey*, the difference being greater in males than in females. Some examples are given in table 1.

TABLE 1. BMRs predicted by different equations

Age (years) and sex	Body weight (kg)	Predicted BMR (kcal)		A – B as % of A
		A[a]	B[b]	
18–30				
male	60	1,600	1,490	+6.9
female	50	1,230	1,200	+2.4
30–60				
male	60	1,560	1,450	+7.1
female	50	1,250	1,180	+5.6

a. From the equations of Schofield et al. [20]. Average standard error of estimate, ±138 kcal.

b. From the equations of Henry and Rees [26]. Average standard error of estimate, ±132 kcal.

Conclusion

It is not the purpose of this article simply to be critical of an important and valuable document, but rather to indicate topics that require further consideration and areas where more information needs to be collected in preparation for the next world food survey.

As mentioned, a working group of the International Dietary Energy Consultative Group was charged with the task of defining criteria for the diagnosis of chronic energy deficiency, with special emphasis on individuals. This group has reached a tentative conclusion that the most practical criterion for adults is one based not on measurements of energy intake or expenditure but on physical state as measured by the BMI [3]. The difficulty is to define a cut-off point for the lower limit of acceptable BMI. It may well be that, as with the anthropometric criteria of nutritional status in children, it will be advisable to have several cut-off points, corresponding to mild, moderate, and severe deficiency or risk of deficiency.

The current *Food Survey* approach similarly involves judgements about the acceptable range of body weight, with conclusions about "costless adaptation" that, as we have argued, have not been fully thought out. In relation to children, they are unacceptable. The methodology also requires the collection of data of food intake or proxies for food intake—a difficult and time-consuming task. It is to be hoped that in the future more use will be made of criteria based on physical nutritional status and more consideration given to the functional costs, if any, and the levels of activity that may be related to differences in physical status. This, of course, is more easily said than done. The FAO cannot move faster than the physiologists. This paper will have achieved its aim if it makes clear the needs for further research, often ignored by funding bodies, and the directions in which that research might go.

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Urban nutrition in developing countries: Some lessons to learn

Rainer Gross and Carlos Augusto Monteiro

There is no doubt that in recent years concern about nutrition and health in urban areas has been increasing. Several important publications have appeared, such as that of Schürch and Favre [1] and the URBIS newsletter. Two workshops have been held in Great Britain [2; 3], and an article on this subject appeared in the *Food and Nutrition Bulletin* [4].

Definition of the urban environment

The nutritional condition of a population and the causes of problems depend on among other things the environmental characteristics of the community. Therefore it is necessary to distinguish precisely between rural, urban, and metropolitan areas. Until now, what constitutes an urban area has been defined structurally by the number of inhabitants living in the conglomeration: communities with more than 20,000 inhabitants have generally been called urban. However, there are many conglomerations with more than 20,000 inhabitants that are just large villages and should be designated rural. Therefore, the urban area needs to be defined from a functional, not a structural, point of view.

A rural society lives mainly from agriculture, whereas urban society depends on a higher level of economic diversification. This can have important consequences with respect to nutrition. Whereas the nutritional status of a rural community often suffers from seasonal climatic fluctuations [5–7], particularly when there is a latent lack of food, that of an urban population is less influenced by such changes [8] because of its economic diversity. In the case of drought, for example, urban populations are affected less because of their differentiated possible sources of income; the income of the rural population, which depends mainly on agricultural production, is affected severely by lack of rainfall.

The appearance of the metropolis in this century makes a further functional definition necessary to distinguish it from urban areas. The metropolis is more complex, not only from the economic but also from the cultural and environmental points of view. This may influence the etiology of health and nutritional problems in different ways.

The importance of family income

Several studies have shown that the nutritional status of a population is determined by its economic situation. In general, the poorer the population, the higher the prevalence of malnutrition. This can be demonstrated by comparing the gross domestic product of countries and the nutritional status of their populations [9], and also the nutritional status of populations classified by their wages within a country or a smaller area of a country [10], or even within a city [11]. For this reason international development agencies, such as the World Bank, use nutritional indicators to assess the level of development achieved.

Within urban communities such as shanty towns, slums, and residential areas, however, the nutritional status of children as stratified by family income may not necessarily show significant differences [12]. This could be due to the smaller economic differences in the communities, but there may be other reasons for it. Figure 1 shows the growth retardation of pre-school children from different socio-geographic areas of São Paulo classified by their families' income level [11]. It can be seen that an increase in family income does not result in a linear decrease in growth retardation. In very poor communities, improvement in family income first leads to increased body growth, but further economic improvement has very little biological effect in pre-school children.

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FIG. 1. The influence of family income on stunting in children up to six years old in (A) slums and shanty towns and (B) residential areas of São Paulo. (Income expressed in multiples of the official minimum wage. Stunting expressed as the percentage of children under 80% of the NCHS reference standard height for age. Source: Ref. 11.)

Furthermore, children in the slums and shanty towns are shorter than those from families of the same income group in the residential areas. These two facts suggest that, besides family income, other factors such as environment (water supply, sewerage facilities, health services, etc.) or even cultural background could limit growth. It has been shown in other studies that socio-cultural factors within a community such as origin and education of parents, or environmental factors such as sanitation facilities, can be of much more importance than the economic conditions of households [12; 13].

The metropolis shows several characteristics of a biological system, such as hierarchical organization of its elements, cybernetic control of subsystems, structural and temporary oscillations and instability, a partially open and partially closed state, and self-organization of the structure and its function [14]. Although the metropolis is subject to a process of breakneck development, it has a high level of inherent stability due to a variety of complex interrelationships. Greater diversity and complexity in a biological system provide a better buffer against environmental disturbances. This is valid also for a complex system such as a metropolis.

To take the analogy further, what the intake of energy and nutrients is to a micro-organism, income is to the community and the family. On the basis of a survey undertaken in Rio de Janeiro, Brazil, between 1980 and 1983 (during an economic recession), it has been hypothesized that *a deterioration in the family wage does not necessarily lead to a decrease in the nutritional status of children [15]. Families try to buffer the decrease in the wages by purchasing cheaper* foodstuffs, reducing waste, and pursuing diversified forms of employment.

These facts lead to the conclusion that an increase in family income alone does not necessarily lead to an automatic improvement in nutritional conditions.

A new pattern of feeding practice

It has been observed worldwide that urbanization reduces the period of breast-feeding and causes earlier weaning. However, studies in São Paulo and Rio de Janeiro show a new trend. More and more mothers tend to breast-feed their children longer [15; 16]. Those who are establishing this new feeding pattern are better-educated mothers from higher-income families.

New patterns of nutritional problems

Malnutrition

The inhabitants of metropolitan areas (and their nutritional problems) are more heterogeneous than those of rural areas. On the one hand we find a society living under poor socio-economic conditions displaying the classic problems of malnutrition. In epidemiological studies carried out between 1983 and 1986 in the three largest metropolitan areas of Brazil, infants and pre-school children mainly showed a high prevalence of stunting (10%–15%), but a low prevalence of wasting (2%–5%) [11; 12; 15]. The reduction in body growth rate and weight was found only in children 10 to 12 months old and older (fig. 2). In contrast to the case in rural areas, this growth retardation started several months after breast-feeding had ceased and dietary supplementation commenced [12]. These data may indicate that malnutrition in this age group is caused less by hunger (or, rather, lack of energy) than by poor sanitation and health facilities.

School-age children show a different picture. The older those from the deprived section of the population become, the higher the prevalence of wasting, without there being a major increase in stunting [17]. Children in some government schools showed a prevalence of wasting of up to 24%. Undernutrition seems to increase in this age group, although all the schools surveyed maintained feeding programmes with food of appropriate quality. There may be different causes (such as low food intake in the family or in the school) that are as yet unknown.

On the other hand, there is a socio-economically better-off group which displays the nutritional problems of populations of the industrialized countries. For instance, children at a private school in the above-

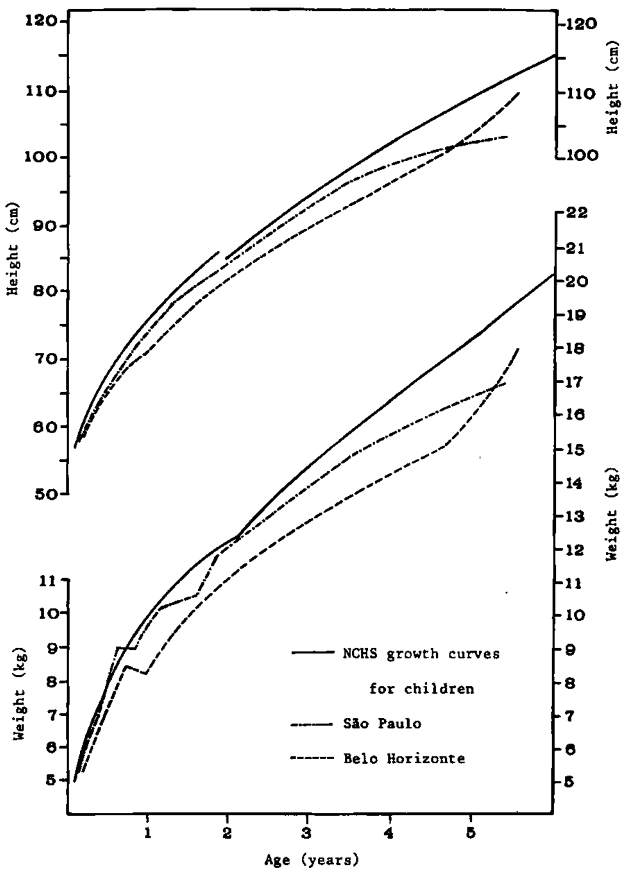

FIG. 2. Mean height and weight of infants and pre-school children in urban communities of São Paulo (N = 1,003) and Belo Horizonte (N = 253) compared to NCHS growth curves

mentioned study area displayed a prevalence of obesity of 18% [17].

Anaemia

In the metropolitan areas of Brazil anaemia seems to be more prevalent than acute malnutrition (tables 1 and 2). Two studies [12; 18] found no association between these nutritional problems. This may indicate that in metropolitan areas there are more groups with different nutritional risks.

Neglected urban risk groups

The paucity of data currently available demonstrates that the comparison of social categories such as urban and rural is too broad and non-specific to help us understand the nutritional problems of the metropolitan population, since urban society and the causes of nutritional problems are too heterogeneous to allow generalizations. It seems rather more useful to identify risk groups and search for the causes of their particular problems.

In most cases, pregnant women, lactating mothers, and infants are the main risk groups in rural communities, and, therefore, nutritional surveillance and interventions are concentrated on them. However, it is not clear whether the pattern of risk is the same in urban areas. In Brazil, there are some indications that deterioration of nutritional status in low-income families due to food restriction during economic crises occurs particularly in older children (table 2) and physically highly active adults [19], and less in infants [15].

The elderly

Until now, international nutritional research has mainly been concerned with mothers and children as the most vulnerable groups. The life expectancy of the population in developing countries is increasing [9]. With the slow decrease in birth rate, the proportion of elderly people in these societies is growing. This is particularly so in urban regions, where life expectancy is higher and the birth rate is lower than in rural areas. We are far from knowing the magnitude and gravity of nutritional problems of the elderly in developing countries. There is not even a simple, widely accepted methodology for measuring their nutritional status, such as exists for infants and children (e.g., anthropometry).

The urban homeless

Despite the fact that homelessness is recognized as a serious and growing urban problem, the magnitude and causes of this problem are not known. Since the part of the population that is homeless has no stable physical base, it is difficult to evolve scientifically acceptable methods for estimating their number and composition. Estimates of the number of homeless in the United States vary from about 250,000 to upwards of 3 million [20]. Practically no data are available from urban areas of developing countries. Unaffiliated persons living in extreme poverty suffer from an extremely high prevalence of physical and mental disability.

Within the homeless population, street children need special consideration. In contrast to the homeless adult, who often lives in social isolation without permanent contact with any other person, street children respond to the challenge of their life problems by interacting with other children, from informal groups to highly structured gangs.

The prevalence of malnutrition in these children varies considerably, depending on the city [21]. In Bogotá, for example, vitamin deficiency and malnutrition seem not to be serious problems because most restaurants allow street children to scrape leftovers from the plates. In contrast, in Karachi and Cal-