EARLY WARNING ALARM SYSTEMS OF NUTRITIONAL DETERIORATION IN EMERGENCY PERIODS*

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SUMMARY

The food and nutritional situation in many countries is worrysome and at the same time little known. A constant surveillance of the food and nutritional situation with the help of proven epidemiological techniques is imperative.

Surveillance, in the context of catastrophes or disasters, involves certain particular aspects, different from surveillance in normal times. The selected indicators must be not only sensitive and related to vulnerable groups, but it is also essential that they be accepted and recognized by government officials. Its prediction value, therefore, must rest not only in the technical field but must also be recognized as such by the corresponding authorities.

On the one hand, meteorological and agricultural indicators are the most popular in regard to their predictive value, but they are not so well recognized by the authorities. Unfortunately, very often indicators which refer to the medical-nutritional status of the population are the only ones that have stimulated and permitted decisions and actions that have been undertaken during past emergencies.

The establishment of an interministerial and intersectoral structure that may have access to data collected in the field has proven to be more indispensable for further data collection and their interpretation. In the absence of such a structure, epidemiological surveillance runs the risk of remaining theoretical without practical repercussions.

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INTRODUCTION

The food situation in many of the developing countries is considered as alarming by international experts. Alarming because many signs truthfully indicate, although they are difficult to quantify, that food production does not follow the corresponding pace with the demographic growth rhythm, but rather at a distance. The appearance of acute food scarcity and of sudden protein-calorie malnutrition epidemic breakouts in the last five years are a confirmation, unfortunately late, of the seriousness of the situation.

If experts are in agreement on this point, the same unanimity occurs in regard to the need of collecting quantitative comparable data, reliable and sensitive in order to measure objectively the food and nutritional situation of the population. Even though there exist numerous food data at country level, and in less scale, also nutritional data, their representative value is mediocre. Average figures of demand or of production can mask important disparities that exist and will continue to exist between the different regions of a given country and, above all, among the different socioeconomic groups. Tables 1, 2 and 3 illustrate the extrapolated tendencies of food production and demographic growth, as well as data on food demand which are bound to appear in the coming years. The fact that in a given country the food production and demand are comparable or equal at national level, does not mean in any way that the malnutrition phenomenon cannot acquire an epidemic dimension in certain less privileged sectors. Table 1 shows the apparent growth evolution of the food production and the demographic projections for the years 1969 to 1985. It is clearly observed that for many developing countries with a market economy, demographic growth is greater than the increase in food production. This is confirmed by the analysis of Table 2 which illustrates the appreciable numer of countries that show a food deficit. The margin of error of this type of statistics is considerable, especially in those countries lacking means to undertake representative and well-structured surveys. Statistics concerning countries where a great part of the agricultural production is directly consumed by the peasant families, must be taken with caution.

In many countries the food and nutritional situation is equally quite vulnerable to the ominous effects of emergency situations or of natural disasters. A moderate change in rainfall or in sunlight hours may have incalculable consequences in the nutritional status of the population. The case of Sahel, in Western Africa, is an example that perfectly illustrates the dramatic repercussions of a capricious rainfall in a poor country. The emergency situations are generally classified in two main categories:

1. Emergency Situations of Short Duration

These are caused, for example, by earthquakes, floods of regular importance or hurricanes. Their effects on food production and nutritional status may be minor. On the contrary, the distribution and commercialization systems are especially

TABLE 1

EXTRAPOLATION OF THE GROWTH RATES OF FOOD PRODUCTION, AND PROJECTION OF DEMOGRAPHIC GROWTH, 1969-1971 to 1985

	Food production	Population
	Annual percentage	
Developed countries:	2.8	0.9
Market economies	2.4	0.9
USSR and Eastern Europe	3.5	0.9
Developing countries	2.6	2.4
Developing countries with a market economy	2.6	2.7
Africa	2.5	2.9
Far East	2.4	2.6
Latin America	2.9	3.1
Near East	3.1	2.9
Asian countries with centrally-planned economies	2.6	1.6
WORLD	2.7	2.0

FAO estimates.

TABLE 2

NUMER OF COUNTRIES WHICH HAVE REGISTERED SURPLUSES AND DEFICITS OF ENERGETIC AVAILABILITIES IN THE DIFFERENT REGIONS

	1961				Average 1969-1971			
	Surplus		Deficit		Surplus		Deficit	
	More than 10%	Less than 10%	More than 10%	Less than 10%	Less than 10%	Less than 10%	More than 10%	Less than 10%
Western Europe	14	5	–	–	17	2	–	–
North America	2	–	–	–	2	–	–	–
Oceania	2	–	–	–	2	–	–	–
Eastern Europe and USSR	4	3	–	1	7	–	–	1
Other developed countries	1	2	–	–	2	1	–	–
Developed regions (total)	23	10	–	1	30	3	–	1
Latin America	5	4	8	8	8	6	4	7
Fas East	–	4	7	5	4	4	3	5
Near East	1	1	10	2	1	3	4	6
Africa	–	5	18	14	3	8	12	14
Asian countries with centrally-planned economies	–	2	2	–	1	1	1	1
Regions in the developing process (total)	6	16	45	29	18	22	24	33
WORLD TOTAL	29	26	45	30	48	25	24	34

FAO estimates.

TABLE 3

ESTIMATED NUMBER, BY REGION, OF PERSONS RECEIVING AN INSUFFICIENT PROTEIN-ENERGY SUPPLY, 1970

Region	Population	Percentage receiving a below-the-limit supply	Number of persons receiving a below-the-limit supply
	Thousands of millions	%	Millions
Developed regions	1.07	3	28
Developing regions, not comprising Asian countries with centrally-planned economies	1.75	25	435
Latin America	0.28	13	36
Far East	1.02	30	301
Near East	0.17	18	30
Africa	0.28	25	67
WORLD (not comprising those Asian countries with centrally-planned economies)	2.83	16	462

According to FAO.

affected. This kind of disasters have as a common peculiarity their oftenly sudden appearance, and in the majority of cases, they affect a rather limited geographic zone. In Latin America, earthquakes, floods and hurricanes are among the most frequent causes.

2. Emergency Situations of Medium or Long Duration

These are caused by a poor crop resulting, for example, from droughts or from uncontrollable climatic factors. The existence of precursive signs is particularly important for the establishment of a surveillance system and an effective forecast of these disasters which affect directly the nutritional status of great population groups. We can affirm, for example, that the drought that caused so much havoc in Nicaragua in 1972 had considerably more important nutritional effects than the earthquake that destroyed the city of Managua. However, the publicity this drought received is not comparable with that given to the earthquake, although it may be that in the long range the former caused more deaths than the latter.

The two types of situation have numerous common points. The food and nutrition situation does not deteriorate in such a marked way as the medical situation in a population. In general, it can be predicted and foreseen at a certain term thanks to the surveillance of precursive signs of progressive deterioration of the situation. This surveillance is indispensable both to integrate this information in the long-range planning and to decide with sufficient time as to the provision of *emergency help* to the populations subjected to an *increasing* risk of malnutrition. This should have been the case for the last famine periods.

Therefore, the primary objective of this paper will be that of critically reviewing the predictive value of the different indicators, parameters and existing or proposed systems for the nutritional surveillance of the population. This does not apply to long-range planning, but rather is directed to the establishment of an early alarm and an adequate adoption of corrective measures at medium range.

INITIAL EVALUATION

Initial evaluation must provide as far as possible, information concerning the following areas:

1. Extensiveness of the nutritional problems.

2. Identification and description of groups, particularly of those at risk (vulnerable groups).

3. Causal factors more susceptible of measurement.

4. Information sources that the surveillance system may use to its advantage.

The goal of a surveillance system is to contribute to a satisfactory nutritional status of all the population. Therefore, it will be necessary to evaluate said nutritional status. The types of malnutrition or of nutritional deficiencies are equally important to know. The nutritional survey carried out by the Institute of Nutrition of Central America and Panama (INCAP) in the Central American Isthmus illustrates this point. For example, it is very important to learn if protein-calorie deficiencies are very widespread, and to establish their severity and type of prevalence. Vitamin deficiencies concern vitamins A, C, D or other trace elements. These evaluations or assessments are important and essential for national planning as well as for eventual actions of food aid in case of acute situations.

Identification and description of the more vulnerable groups is equally essential, a fact that we have already underlined in different occasions. It is impossible to adopt a practical and applicable operational decision based on the global statistics of food production, compared to its demand. In effect, a disastrous food situation may appear to be excellent according to the national statistics. A production excedent and the exportation of very rich-protein products, for example beef or fish meal, does not in any way mean that part of the population does not suffer from severe protein-calorie malnutrition. The point, therefore, is to establish the most important data concerning the population groups who are more susceptible of suffering from malnutrition. This classification must take into account the following factors:

1. *The Biological Situation:* age group, sex, and physiological status (in this respect the vulnerable groups appear to be the same in the majority of the world countries).

2. *The Physical Situation:* rural zone or urban zone, type of ecology, zones of savanna or rain forests. Particularly illustrative of this point is the case of Sahel. Drought has especially devastated the northern part of the Sahelian countries, that is, the southern desertic part between the 250 and 300 isohyetas. The neighboring zones, with a rainfall of approximately 1,000 mm and a completely different agriculture and ecology have suffered little with the drought. Therefore, the geographic situation is very important. Of course, the sanitary environment, the prevalence of different communicable diseases and the type of food sources, will also play an important role. However, these indicators must not be included in the initial evaluation, since they are susceptible of being modified and of indicating a deterioration of the nutritional status. In contrast, said information will define with precision the vulnerable groups.

3. Perhaps more important is the information on the sociocultural situation. For example, in certain regions of the Sahel, the nomads have particularly suffered with the drought because of their way of living, both from the ecological and cultural viewpoints. In the same manner, more deprived socioeconomic groups tend to be the most vulnerable and the more susceptible to suffer from an aggravation or deterioration of the food production. The importance of sociocultural control must never be underestimated.

Identification of the causal factors is also very important. For example, besides the sociocultural context, associated factors such as the socioeconomic and the ecological factors, certain knowledge must be obtained on causal metereological, climatic, demographic or agricultural factors.

In summary, the information sources vary from country to country, but it is evident that (this point will be discussed further on) they must go beyond the purely medical or nutritional domain. Thus, this requires a multisectoral approach both in the forecasting of an acute deterioration domain, which is the one of our interest at the moment, such as in the domain of long-range planning.

LEVEL OF INDICATORS

The World Health Organization has grouped the different types of information in four levels:

1. *Level A* which groups the indicators of an ecologic nature: meteorology, soil, water, vegetation, demography and infrastructure. All of these indicators are mildly susceptible to sudden changes, except for the meteorological factor which is extremely important.

2. *Level B* comprises resources and production. These cover agricultural production, cattle, import and export of foods, and the stores existing in the country.

3. *Level C* is of an economic nature, both of home economics as of community economy. This comprises sales, the way profits are used, data on prices, availabilities at the local market, and data on food consumption at family level and at individual level.

4. *Level D* is the resultant of the action of the three preceding levels, that is, of the physical and nutritional health status of the population, and of each group of individuals. The health status of the population is better appreciated by the health status of the more vulnerable groups.

Figure 1 schematically illustrates the influence of these causal factors and, of course, the importance that indicators derived from them have on the health status of a given population. It is important to emphasize here that quite often nutritional status does not change but tardily after the appearance of the causal factors. It is evident that a drought can in the first place, be predicted, and afterwards confirmed a long time before the nutritional effects are felt and become detectable by anthropometric measurements. The chain of events or of causal factors is illustrated in Figure 2. This graph clearly indicates the chain of events that finally leads to nutritional situation (WHO).

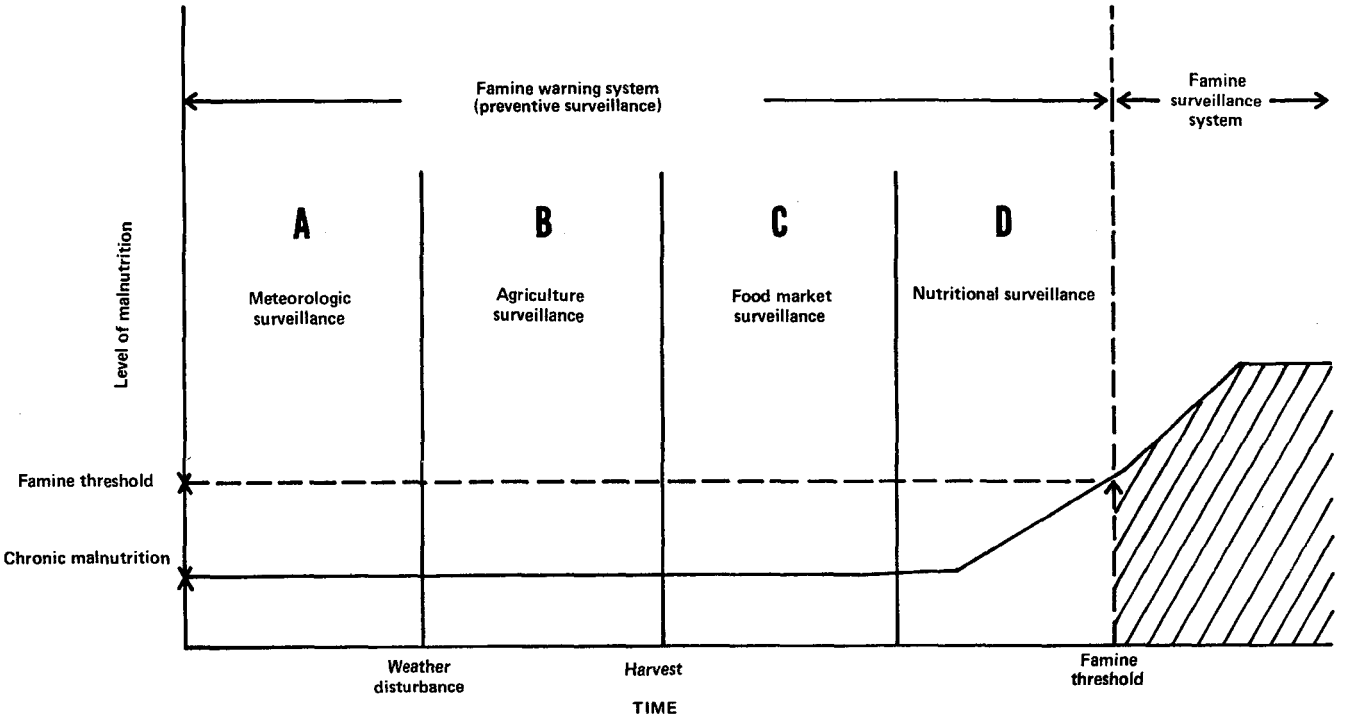

Fig. 1. *Relevance of various surveillance systems according to nutritional situation.*

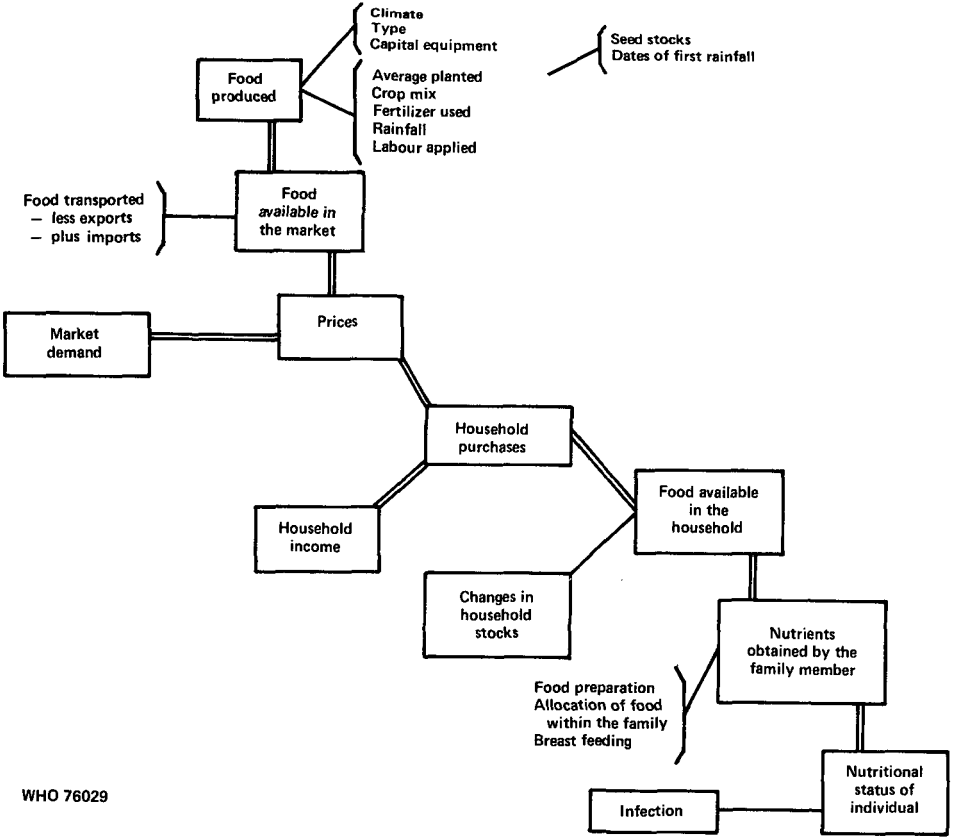

Fig. 2. *Chain of determinants with regard to nutritional status.*

PRECOCITY AND RELIABILITY OF THE INDICATORS

In general, medical nutritionists and other experts in public health are not concerned but with the final result of a long process which culminates either in a satisfactory nutritional status or in the presence of nutritional deficiencies in the population. It cannot be excessively repeated that the analysis or the measurement of the nutritional situation of a population, or even of its evolution in time, has little predictive value. This does nothing but confirm in an irrefutable manner, a status already consummated.

The more one goes back in time or approaches level A, the more the predictive value of the indicator also increases. The prediction or confirmation of a drought status constitutes a very early alarm sign of a dangerous food situation.

If the predictive value of the indicators increases when approaching level A, the reliability of these data also diminishes in the same way. Prediction of a drought is an early indicator, but rather unreliable, since it is very difficult to determine in a valid form, which will be the impact of said drought on the nutritional status of the vulnerable population groups. On the opposite, the anthropometric measures and the increasing prevalence of malnutrition have little predictive value, since they reflect a consummated fact, but undoubtedly constitute an extremely reliable indicator of deterioration. Between the two extremes, the agricultural production indicators (prediction or confirmation of a deficit, economic indicators such as availability in the market, prices not controlled by the central authority) have a lower predictive value but are more reliable from the technical point of view.

ACCCEPTABILITY OF THE INDICATORS AND THEIR IMPACT ON DECISIONS

It is oftenly confirmed that the predictive value and reliability of an indicator are inversely proportional. Now, the reliability is a quality indispensable for the political level, that is, the level where important decisions are taken both at long and at short-term range. The statement of an emergency status and the organization of food distributions in practice are not decided upon deficitary production previsions. It is opportune in this plane, to insist on the acceptability of different indicators and of the conclusions attributed to them. To again cite the example of Sahel, numerous indicators, not quantified but concordant and relatively reliable, attracted the attention of national and international experts long before the international community was mobilized. Although technically unquestionable, conclusions did not receive the political attention they deserved. Therefore, it is indispensable to count with consensus not only on the predictive value and reliability of the indicator, but also on its acceptability by the persons in charge of taking a decision. It is a well-known fact that, particularly in the domain of natural disasters, the admonition or warning of an imminent disaster oftenly results fruitless due to the lack of acceptability and understanding of the message. It is not enough to announce with precision the

imminence of a cyclone: it is necessary that the message be transmitted and accepted by the population. Finally, it is indispensable that a certain number of measures be pre-established and translated into actions the day the message of alarm is received. The cyclone that in 1973 caused more than 1,800 deaths in India is a classical example. The admonition, thanks to the metereological world-wide surveillance of cyclones permitted to foretell national authorities with more than 8 hours of anticipation. However, the lack of transmission and of understanding prevented the arrival of this message to the local authorities and to the affected population.

We can therefore summarize these statements by saying that the earlier the indicator, more will be the time available for an intervention, but that on the other hand, the less reliable this is, the less susceptible will it be of impressing the responsible authorities so that they take immediate action. Now, it cannot be greatly overemphasized that a technical information, a precise sign of alarm, is not valid but in the measure this is understood, accepted and transformed into actions and decisions.

QUALITIES OF THE INDICATOR

Here we can summarize the preceding considerations by citing only the indispensable qualities of an indicator of food deterioration in case of catastrophe:

1. The indicator must be *sensible* to every critical change of the nutritional or food condition. Two criteria can be adopted:

   a) that the indicator reaches a critical value or "cut-off point" considered as an alarm sign;

   b) that the dynamic evolution of the indicator manifest a downward or upward tendency. The existence of a threshold or of a well-defined tendency in a given direction can represent a reliable signal that will generate action.

In the developing countries quite a number of factors which are responsible of malnutrition do not present sufficient sensitivity to determine the future nutritional status. For example, several climatic factors are not sufficiently known with the required precision to permit attributing them a responsibility calculated on the basis of certain food productions and, of course, on the food status.

2. The second quality lies on the *predictive value.* Therefore, more dedication is necessary in regard to the measurement of the causality factors than to discover early signs of changes in the process of being established.

3. Lastly, the indicator must be acceptable and susceptible of generating an action on the part of the responsible authorities. Perception of the relation cause-

effect by the authorities is at least as important as its real existence. The responsible authorities are more susceptible to act on the basis of a true diagnosis of a food scarcity than on the basis of technically valid indices, but whose possible effects on malnutrition cannot be clearly perceived by them.

4. The indicator should cover the especially vulnerable groups and thus permit to identify the population strata that will be affected by the food scarcity.

PREDICTIVE VALUE OF DIFFERENT LEVELS OF INDICATORS

It is important to keep in mind the fact that we are not dealing with a surveillance system for the purpose of establishing a long-term plan, but rather to detect early a serious abnormal situation. Table 4 indicates the value of the main indicators which pin-point alarm signs.

Level A, or the causality factors of ecologic type, have a great precocity, but their acceptability or reliability, that is, the relation of cause to effect is often debatable. With the exception of demography its value insofar as alarm signs, is also generally minimal. The galloping demography in certain countries acquires, nevertheless, a character which at the same time is early, reliable, and acceptable of a dangerous tendency in the coming years. The level B indicators concern resources and production. We must here distinguish among the different types of economy:

In the pastoral-type economies (the Sahel nomads, for example), the key indicator is the inventory of their herds. This is a less precocious sign but a relatively reliable and acceptable one. Its value, as far as alarm sign is concerned, is considerable. The populations whose subsistence is based on the health status of their herds, are in effect directly and rapidly affected as soon as the herds diminish in number due to droughts or epidemics. This has been clearly illustrated in the last droughts that have affected Africa.

In the economies of agricultural type the predictive data concerning the importance of crops are, of course, an earlier sign than what statistics indicate once the harvest has taken place. However, it often happens that what has been gained in earliness is lost in acceptability and reliability. Furthermore, the international estimations (FAO) many a time are incomplete and those originating in the governments are frequently to be taken with certain caution. On this occasion I consider appropriate to mention FAO's publication entitled *Food Crops and Shortages*. This monthly journal, unfortunately of very restricted diffusion, provides global data on the state of the crops, or on the crop predictions of the majority of the world countries. Nevertheless, its value is considerably limited, once again, by the disputable quality of the data received by this Organization, but it definitely is a praise-worthy tentative of an early alarm system of international level.

Data concerning food stores equally constitute a precious information, but a deterioration or a considerable diminution of food stores quite often is very rapidly

TABLE 4

LEVEL OF INDICATORS

	Precocity	Reliability/ acceptability	Value as alarm sign
Level A (ecology)			
Meteorology	+ + +	−	−
Soil capacity (pastures, crops)	+ + +	+	−
Demography	+ + +	+ +	+ (Very early alertness)
Level B (resources and production)			
Livestock (pastoral economy)	+ + +	+ +	+ +
Prediction of crops	+ + +	+	+ +
Estimates of crops	+ +	+ +	+ +
Food stores	+	+ +	+ +
Level C			
Revenues (in a market economy)	+	+ +	+ +
Price of products			
Availability at family level	+	+ + +	+ +
Way of distribution of foods in the family	+ +	+ (Does not change sufficiently)	None
Unemployment, cost of life (market economy)	+	+	+
Level D		Very tardy but undisputable ALARM	
Anthropometric measurements (weight/height)	+	+ + +	+
(moderate malnutrition forms)	−		
Prevalence of PCM and specific deficiencies	−	+ + + +	Tardy
Mortality < 1 year	−	+ + +	Tardy
Specific mortality	−	+ +	Tardy
MCH consultations	−	+ +	Tardy

followed by a nutritional deficiency in the families. In general, indicators concerning level B are among those which present the more favorable compromise of precocity, reliability, and acceptability.

Equally important to consider are indicators of level C. In a market economy the combined study of profits and price of the products is particularly valuable. In the measure acquisition power diminishes considerably, this represents an alarm sign that should not be overlooked. A marked reduction of availabilities at the family level precedes nutritional signs by a small margin. Therefore, it is of a lower predictive value, but the reliability of such informations and their causality relationship are, again, evident.

The value of the way of distributing foods in the family is of negligible value as alarm sign, due to the lack of sensitivity of this variable. Its analysis, however, is essential at the moment of practicing the initial evaluation. The state of unemployment and the cost of life are of minor practical interest.

Level D is constituted by alarm indicators absolutely undisputable but unfortunately tardy, excepting perhaps the anthropometrical measurements which, being far from early, permit nevertheless to discern between a moderate evolution or a progressive deterioration of the nutritional status of the population. This indicator is more precocious than the appearance of a high protein-caloric severe malnutrition or of specific clinical deficiencies prior to the increase of specific mortality. In regard to anthropometric measurements, the difference existing between the comparable weight and height and weight compared with age, could be underlined. In an emergency situation, the height/weight parameter is, in general, preferred to that of weight/age. The reasons are very simple. Growth retardation accumulated in the course of several years represents a form of chronic malnutrition, but it may well be that it does not correspond to an actual acute malnutrition status. A very small child for his age, in effect (weight/age $< 80\%$) can have, however, a present acceptable nutritional status (weight/height $> 90\%$). It is generally considered that the indicator weight/height permits an easier discernment of the recent fusion of muscular and fatty tissues from the permanent growth deficit.

CONCLUSION

It is essential to stimulate an effective and decisive action on the part of the authorities, based on the evolution of indicators of high predictive value (level A). However, we must ascertain that level D is more or less the only criterium which generates a decision and an action. In the majority of the cases these come too tardy. In practice, priority in the domain of early prediction of emergency situations must be given to the causality factors, measured by indicators in level B: food production, rentability and consumption levels. This cannot be done within the framework of a health ministry nor within the framework of an only ministry. Hence, it is essential to establish an interministerial and intersectoral structure that, on the one hand, can

count with data collected in the field or which are available in the different departments and that, on the other hand, has access to the highest decision levels of the country in order to generate effective actions, whether these are of planning at medium range or of adopting palliative relief measures.

RESUMEN

SISTEMAS DE ALARMA PRECOZ DE DETERIORO NUTRICIONAL EN PERIODOS DE EMERGENCIA

La situación alimentaria y nutricional es a la vez preocupante y poco conocida en numerosos países. Una vigilancia regular de la situación alimentaria y nutricional con la ayuda de técnicas epidemiológicas comprobadas es, por lo tanto, imperativa.

La vigilancia en un contexto de catástrofes o de desastres reviste ciertos aspectos particulares que la distingue de la vigilancia en tiempos normales. Los indicadores seleccionados no sólo deben ser sensibles y concernientes a los grupos vulnerables sino que además es esencial que ellos sean aceptados y reconocidos por los responsables nacionales. Su valor de predicción debe, pues, ubicarse no sólo en el plano técnico sino que, de igual manera, debe ser reconocido como tal por las autoridades correspondientes.

Los indicadores de tipo meteorológico y agrícola son los que gozan de mayor valor predictivo, pero éstos no son del todo reconocidos por las autoridades. Desafortunadamente muy a menudo los indicadores referentes al estado médico-nutricional de la población son los únicos que han estimulado y permitido tomar una decisión y una acción durante emergencias pasadas.

El establecimiento de una estructura interministerial e intersectorial, que pueda disponer de datos recogidos en el terreno se hace más y más indispensable para su recolección e interpretación. En ausencia de tal estructura formal, la vigilancia epidemiológica corre el riesgo de permanecer como un hecho teórico sin repercusión práctica.

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