ANTHROPOMETRIC MEASUREMENTS IN A RELIEF
PROGRAMME IN NIGER: A TOOL FOR DECISION MAKING AT
THE COMMUNITY LEVEL

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INTRODUCTION

During emergencies, life and death decisions may have to be made quickly and on the basis of inadequate information. In May 1974 towards the end of the drought which affected wide areas of sub-Saharan Africa, the government of Niger (GN) together with the League of Red Cross Societies (LRCS) and the United Nations Development Programme (UNDP) decided to carry out a nutritional relief programme for part of the affected population. In contrast to Upper Volta and Mauritania, little objective data was available upon which to base plans for this programme. A comprehensive sampling survey had been carried out by the United States Centre for Disease Control which provided the only hard data available, but unfortunately, this survey was confined exclusively to the sedentary population of the area, nomads not being included, and opportunities to gather data earlier in the drought had been lost. Moreover, most of the relief personnel in charge of decision-making were apparently unaware of the availability of this data.

This paper describes an attempt to use the anthropometric assessment of human nutritional status as a basis for making administrative decisions on priorities in the distribution of relief and the location of medical relief teams.

BACKGROUND

Niger was one of six Sahelian countries to be hit by drought in the period 1969-1973 (see Fig. 1). Covering an area of 1,204,000 km² and a distance from North to South of some 1,100 km, the country spans a great range of climate and thus of human economy. Agriculture is practised, overwhelmingly in the South, where rainfall is greatest, the major crops being millet and, to a much smaller extent, sorghum. Here also the population is densest, since the overwhelming majority of the country’s approximately 4.5 million inhabitants live south of the 15° parallel. North of this line the population is much sparser and is mainly pastoral in economy, the population...
practising a roughly north-south transhumance, following the advancing and retreating rain and grazing.

Drought in the area had led to both reduced production of the staple food crops and the death of many thousands of livestock. Deprived of their animals, a large part of the nomadic population migrated south into an area populated by subsistence practising a roughly north-south transhumance, following the advancing and retreating rain and grazing.

The objectives of the six month joint programme were to provide basic medical care and to supplement the food distribution in refugee camps and the most affected villages, focusing on the vulnerable groups — children and pregnant or lactating women. The target population was estimated to be approximately 100,000 scattered over the whole country (approximately 1,200,000 km², that is 30 times the size of Switzerland). Initially, priorities of the location of the ten expatriate Red Cross teams running the programme could only be based on what little information was available. However, after several weeks of field operations it became clear that the good rainy season, and the increasingly efficient food distribution by the government had led to a rapid improvement in the nutritional status of the population. Initial estimates from relief workers had led us to believe that some 5% of children would require therapeutic feeding, whereas in fact, only about 2 per thousand were reported from the biggest sites. After two months of operations (by July 1974) therefore, it was necessary to reassess the objectives and priorities that the six month programme envisaged.

A reassessment and evaluation system was set up to provide decision-makers with objective data on the nutritional needs at a community level. Choices between the following alternatives had to be made urgently:

(1) Should the Red Cross pursue the recruitment of volunteers to extend operations to all sites initially planned?
(2) Should existing resources be allocated to new areas by reducing or phasing out activities in selected sites?
(3) Should an immediate but gradual withdrawal of the teams be undertaken according to the nutritional condition of the respective camps?

The present paper discusses the methods and results of this nutritional reassessment and re-evaluation effort, keeping in mind its stated objective, that is, to assist decision-makers to optimize the use of scarce resources.

**METHODS**

A mobile team was employed for the survey, composed of a physician, two technicians (one of them a civil engineer) and a demographic investigator. A sociologist familiar with the local population was also recruited for this purpose for a very limited period of time. Using a four-wheel drive vehicle, the mobile team visited in turn each of the sites where Red Cross teams were either located or expected to be located. One to four days were spent in these areas where numerous small nomadic settlements were scattered over a wide area.

At each site, height, weight and mid-arm circumference were measured of all children under 10 years old in the selected camps and villages. Sex, status (nomad or sedentary) and, for persons living in refugee camps, country of origin were also recorded.

Height was measured to the nearest centimetre with a locally constructed wooden measuring stick (in horizontal position for toddlers and in vertical position for the older children).

Weight was measured to the nearest 0.1 kg on a 25 kg Salter Scale, checked every day with a standard weight.

Arm circumference was measured to the nearest 0.1 cm on the left mid-upper arm with an oil cloth tailor’s tape.

All measurements were made by the same expatriate volunteer. The accuracy of measurement was checked by measuring 25 children, giving mean errors of ± 0.5 cm, 0.05 kg, 1.1 mm for height, weight and arm circumference respectively.

**Sampling**

All or up to 100 children, whichever came first, were selected from each site. Measurements were taken of a total of 3455 children from 8 major areas, and 58 villages and camps. The size of the communities ranged from about 30 to several thousand persons.

As few as 9 children were examined in the smaller nomadic camps. In the case of larger settlements, up to 128 children (instead of 100 as initially planned) were measured by the mobile team.

No reliable census lists were available in the villages. The local health workers (recruited from the Red Cross programme) and the authorities were informed in advance of the team visit in such a way that they could ensure that all children would be present at the site. A bias towards over-representation of malnourished children cannot be ruled out because the objectives of the survey were clearly explained to the local authorities. Visits were scheduled very early in the morning in order to examine the young children before they left with their mothers in search of wild foods.

**Criteria used for the assessment of malnutrition**

Since the objectives of the reassessment and evaluation were to estimate the extent of acute starvation (famine) among the population, the relatively age independent indicators, weight-for-height (W/H) and arm circumference-for-height (AC/H) were used. Chronic undernutrition, prevalent in Niger under normal conditions, may result in a linear growth retardation indicated by a lower height-for-age ("stunting") which may be associated with a W/H within the "normal" range. An acute reduction in food intake for an individual, which was the immediate concern of the relief programme, produces a rapid loss of weight ("wasting") with little if any measurable effect upon height. Age independent indicators (W/H, AC/H) thus permit us to measure the degree of recent starvation to some extent independently of the chronic malnutrition affecting the same population, and both can be taken to be an index of current nutritional status.
Results have been expressed as percentages of the expected value at a given height calculated from the 50th percentile of either the Stuart-Stevenson standard or the standards of Wolansky for the AC/H indicator. Thresholds for acute undernutrition were taken at 80% for W/H and 75% for AC/H. Seventy percent (70%) for W/H was initially retained as an alternative threshold.

The analysis of data in the field was simplified as much as possible because of the lack of staff and time. Simple tabulations indicating the prevalence rates of PCM according to the various thresholds in the visited dwellings were made in the field and were submitted to headquarters. A graphic representation of the results was obtained in the field by plotting each individual measurement on a reference curve roughly drawn by hand (Fig. 2). In addition to a graph for each site, contingency tables were constructed showing the number of children under the thresholds by sex, status and place of origin. This analysis was carried out by the mobile team at night or while travelling. No significance tests were computed during the relief programme. Detailed statistical analysis was carried out after the programme was completed.

RESULTS AND DISCUSSION

The result of anthropometric measurements of 3455 children from different sites were reported to the administrators responsible for the feeding programme. Since the administrators were unfamiliar with this type of nutritional assessment — using anthropometric results — care was taken to present results in a clear and unambiguous way. Initially a graphical presentation was used since it was thought that these would clearly show differences in nutritional status between different places. However, the inaccuracy of the reference curve and the rough plotting of the results, together with the large range in the numbers of children at each point (from 9 to 128 children) made comparison between points difficult. In fact, numerical tabulations turned out to be the only useful presentation in practice. It should be noted that no significance tests were performed on the data at the time of the survey. Several professionals actively involved in the relief programme had some statistical background and great care was exercised in interpreting PCM rates obtained from small dwellings.

The report submitted to the administrators at headquarters was divided into four parts:

1. A description of the locality: population size, types of housing, sources of food and water, whether or not there was a government clinic together with an outline of the major causes for patient attendance.

2. Anthropometric measures: graphic representation of the readings (W/H, AC/H) for each locality (see Fig. 2); number of children measured and of children classified as PCM;

3. Results of clinical examination, especially for xerophthalmic lesions;

4. The conclusions of the mobile team.

The objective of the measurements was the screening of populations and not of individuals. That is, to compare the nutritional conditions in various settlements, and to determine an order of priority for each distribution. Exactly which individuals were classified as malnourished by either technique was of little concern. Individual names were not recorded by the teams and malnourished children were referred to the attention of the health services.

The two anthropometric indices gave comparable results in most cases. Nevertheless interpreting two sets of results was soon regarded as an unnecessary burden and a useless complication in field conditions. The field application of the AC/H measurements was found to be extremely limited and a detailed comparative analysis was later performed in order to determine which technique is most suitable for further similar field assessment.

The most stringent threshold of severe PCM, that is, 70% of the expected W/H, appeared after a few weeks to be of little practical value, since the proportion of children observed under this threshold ranged from nil to 1.4%, making this definition of severe PCM of no use as a screening tool in this population. The cut off point of 70% of W/H had been based upon the assumption that there would be acute famine and widespread...
maramus in the camps, since several weeks before the survey the proportion of maramic children estimated to be in need of therapeutic feeding was 5%.

A wrong choice of cut-off point can lead to incorrect conclusions. For example, at the first sites visited (Aberdissinat and Ingall) the local authorities had requested that a Red Cross centre be set up because of the poor condition of the children. The clinical impression of the survey team physician was that an acceptable nutritional status existed amongst the children, an impression which was confirmed by the low prevalence of measured PCM as defined by the cut off point of 70% W/H. No team was, in fact, assigned to these localities. But after the assessment of all camps and villages was completed, it became apparent that this decision was wrong, since Ingall and Aberdissinat did have one of the highest rates of PCM, according to the 80% W/H threshold (see Table 2).

The reassessment was instrumental in unveiling the "double standard" by which some victims of a disaster attract sufficient attention to become relatively privileged compared to the non-affected population. The preliminary analysis strongly suggested that at the time of the survey, nomads, most of them from foreign origin, were better off than the sedentary, (Nigerian) population, which confirmed several reports from external observers and Red Cross teams. The relief effort – at its peak of efficiency – was mostly directed to the nomads and a good rainy season for several weeks was beneficial to both for the surviving livestock and their milk production. The nutritional status in Hamdallaye camps and Hamdallaye villages differed markedly (Table 2). The camp, located near the capital, contained about 12,000 Malinan nomads who were settled in 1973. The nutritional situation was reported as extremely severe. Measles, diarrhoea and maramus were widespread up to July 1974. Several factors contributed to a dramatic improvement in conditions, amongst which were greater concern from the new government for the well-being of refugees, increased contribution of voluntary agencies resulting from international publicity, and the impact of the joint mediconutritional programme. Since they were not sufficiently coordinated, most of these efforts led to massive assistance being given to the residents of the Hamdallaye camp. In October 1974, the first anthropometric measurements taken concurrently in the camp and in the village, indicated that the children of the local villagers, who did not receive relief food, were suffering from a higher prevalence of malnutrition (11.9% less than 80% W/H) compared to nomadic children from the camp (1.9% less than 80% W/H). The average value of W/H for the two groups were 90.4% and 99.8% in the village and the camp (see Fig. 2). Measures were immediately taken to extend food and medical relief assistance to neighbouring sedentary villages.

One main outcome of the evaluation was to put an end to the uncertainty regarding the return to a "normal" situation, defining normality as a state of chronic seasonal malnutrition rather than to mass starvation calling for emergency international assistance.

As part of the evaluation system, survey teams had been instructed to count periodically tents in a number of settlements. A large number of refugees, previously depending on international assistance, resumed their nomadic activities with the livestock spared by the drought. The dramatic drop of the number of refugees in all but one camp (Fig. 3) confirmed the anthropometric data.

These convergent findings led to the progressive and orderly withdrawal of the teams. The sequence of the interruption of emergency assistance was based in part on the result of the measurements. The sites where Red Cross teams had been assigned were ranked in decreasing order of prevalence of PEM as estimated by the assessment and evaluation team. The ranking order obtained by the W/H technique served as a guideline at the time of decision, relief teams being quickly phased out of the most malnourished villages. Clearly additional factors had to be considered such as the duration of contract of the volunteers,
the local pressures to retain relief teams and the logistical constraint.

In many relief programmes, the hardest decision to reach is how and when to put an end to the emergency assistance. In this regard, the reassessment has proved itself a valuable aid.

Further analysis and discussion

The anthropometric measurements were coded and computer-analysed several months after the relief programme. The objective of the statistical analysis was three fold:

(a) To compare tentatively the results with those from other surveys in Niger;
(b) to review the major decisions and conclusions reached during the actual operations after exclusion of possible bias;
(c) to compare both technique in terms of sensitivity and specificity and estimate the benefit of using measurements of arm circumferences as a single indicator in relief nutritional programmes.

The decisions made during the programme on the basis of the field analysis were not significantly altered by subsequent statistical analysis. In most instances, no significant differences ($x^2$ and rank correlation coefficients) were found between measured groups. Statistical significance is a luxury during a relief programme; in spite of the possible and even probable biases implicit in this type of rapid field survey, the authors feel that it is operationally, if not scientifically, valid to base important decisions on non-significant differences. It is reasonable to consider that the risk of error is much less using a sample survey of this type even with its biases; to disregard the differences on the basis of non-significance of differences between groups would lead programme managers to allocate resources almost at random. Some biases may have been introduced by the methods used for data analysis. Children over 120 cm in height had to be excluded from the statistical analysis to avoid an excess of tall children with a weight less than 25 kg (upper limit of the scale): well-fed tall children with a weight over 25 kg were, de facto, excluded in the field.

Younger children, or more precisely smaller children, were significantly at a higher risk of PCM than taller ones. There was little evidence of a bias by relative excess of small children in the various localities. More significant is a possible correlation between the time of the visit and the observed nutritional status. A survey carried out in November might have possibly yielded a lower rate of PCM than the same survey in September. No definite time trend was observed in our survey.

Other anthropometric surveys

The sample survey carried out by the CDC in Niger, showed a prevalence of 11.4% of acute malnutrition (children under 80% W/H). In our reassessment and evaluation, respectively 7 and 9.9% of the children were found under the thresholds of 80% W/H and 75% AC/H. In order to match somewhat the samples of both surveys, children taller than 130 cm were excluded from the calculations. It is of interest that similar prevalence rates for malnutrition were obtained for the two surveys, although it should be noted in making the comparison that the CDC surveys excluded the nomadic population.

A survey among pre-school children attending the mother and child centres for immunizations indicated a malnutrition rate of 34% (Ministry of Health, unpublished report). The population studied and the norms used (75% of a Nigerian Standard) make any comparison impossible.

Comparison of the two techniques

This part of the study is beyond the scope of this paper and is dealt with at length elsewhere. The findings will be briefly summarized. While both techniques used by the evaluation team can yield similar overall percentages by careful selection of the thresholds, marked differences existed in regard to the individuals actually classified as suffering from PEM. Out of the 216 children under the 80% threshold for W/H, only 116 are under the AC/H threshold of malnutrition while 188 regarded as acutely undernourished by this indicator are above the W/H threshold (Table 2).

Accepting the 80% W/H threshold as the reference indicator the sensitivity and specificity rates of the AC/H technique (threshold 75%) were respectively 0.54 and 0.93. The coefficient of correlation between weight and arm circumference measurements was highly significant ($p < 0.001$) which confirms that both are reflecting the same phenomenon.

Although the differences in the prevalence of malnutrition using the two techniques were small and non significant (Table 1) the prevalences obtained by both techniques are more likely to
reflect an actual difference than not. The prevalence of the sites by decreasing order of observed rates of PCM are comparable for both techniques. The rank correlation is statistically significant, $R = 0.88, p < 0.05$.

Arm circumference for height or field techniques based on mid arm circumference such as the Insertion Tape or the Quipu have proved valuable for individual screening or mass surveys. However, weight-for-height is, from our experience, the most useful indicator. At little extra cost in time and money, the weighing of children will provide universally acceptable information on body wasting. In conducting the survey, most time consuming tasks were travelling and setting up of an acceptable sample, which includes contacting local authorities and the briefing of health workers. The actual measurements took comparatively little time and effort from the team.

**CONCLUSION**

Anthropometric measures are accepted as a reliable indicator of malnutrition. They have been extensively studied as a screening tool of individuals in experimental and emergency conditions. At a higher level of decision involving populations, it is not always recognised by administrators that a continuous evaluation could lead to a substantial improvement in the allocation of scarce resources.

An assessment and evaluation system should be built-in and budgeted in any major nutritional relief programme. The value of an evaluation will, beyond any doubt, offset its cost. The evaluation should ideally be performed by local personnel such as health workers rather than by an expatriate team which could best supervise and improve the quality of data collection.

Although the improvisation of an evaluation team is far from being recommended it proved in Niger to be an acceptable and useful mechanism to provide badly needed information during the drought. Weight-for-height appears to be a reliable and practical nutritional indicator under field conditions. Although arm circumference gave comparable results, there is a marginal benefit in using weight-for-height. In any case, the use of two indicators tended to complicate the interpretation and was a burden rather than an additional aid for the administrators.

International standards from "normal" or "reference" populations should be selected. Local or national norms are unnecessary because the objective is to identify and compare roughly the size of the problems between various communities and not to make a comparison of the nutritional status of an individual or group with the international standard. Plotting individual measurement on a graph, though a useful form of presentation for non-technical staff, was sometimes misleading because of inaccurate scaling or different sample sizes.

The analysis of the data performed after the programme suggested that the mean of the observed weight or arm circumference expressed as the percentage of the expected value for each given height is a more sensitive indicator than the prevalence rate of malnutrition, that is the proportion of children under an arbitrary threshold.

Statistical analysis is essential to interpret properly the information but great care should be exercised not to confuse scientific research and data collection for decision-making. Scientists should overcome their reluctance to make any statement or provide any advice to administrative or political authorities unless supported by a whole battery of significant tests.

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