A NATIONAL FOOD AND NUTRITION SURVEY PROJECT

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Ghana, with a land area of 92,000 square miles, and a population of 6.7 million (1960 Census), is entirely tropical. It lies between latitudes 5 and 11° north. It may be divided broadly into three climatic zones—the dry coastal belt, the rain forest belt and the northern grasslands. This climatic division is much more relevant to the question of nutrition than is the political whereby eight regions are formed. The rainfall is seasonal and it varies between 20 and 100 in. per year. Along the coast and in the north most of the rain falls in two periods which total 90 days, while the forest belt enjoys many more rainy days. The temperature range is small, usually 75°-95°F. throughout the country.

Several limited nutrition surveys have been done (Colbourne and Edington, 1950; Fortes and Fortes, 1935; Grant, 1954; Lawson, 1957). Most of these were socio-anthropological; a few results have been obtained from budget surveys; and clinical assessments of nutritional state have been done, and so have height and weight measurements of school children. Far and away the most comprehensive surveys—results unfortunately not published—were done throughout the country by Purcell. From all these surveys and also from hospitals and clinics, there is a mass of evidence about the existence of widespread nutritional difficulties in many groups. None of the evidence is statistically satisfactory.

After the founding of the National Food and Nutrition Board in 1959, subsequent to the Platt-Mayer Report of 1958, it was decided that an adequate nutrition policy could not be evolved without a proper knowledge of the nutritional status of the population. A national food and nutrition survey was, therefore, required. The aims and objectives were clearly defined and these are:

1. To find out, both qualitatively and, to some extent, quantitatively, the kinds of foods people eat and the adequacy or inadequacy of the diet. It was hoped broad patterns could be seen very rapidly and this hope has been justified.

2. To determine the distribution of food within the family and factors which influence this.

3. To find out the broad agricultural patterns and practices which have a bearing on food.

4. A clinical survey was to be undertaken to correlate the findings in the food survey with what is actually happening in the individual.

It is to be reiterated that this was not to be a survey for the sake of survey. It was to provide the basis for an action programme and the baseline for measuring its success or failure. It was with these aims in view that the physician (human nutrition), the physician (nutrition survey) and the scientific nutrition officer had several preliminary meetings planning the project and determining the basic data to be collected. The data were kept to the minimum since a survey of this magnitude can be very wasteful in men, money and material and may yield little of practical value.

Personnel and Equipment

The following personnel were available to take part in or assist with the nutrition survey:

1. One physician, specially appointed to be in charge.

2. One physician (nutrition) of the Ministry of Health available for planning and advice.

3. One nutritionist, available for assisting with the training of personnel and to do the analysis of all quantitative diet surveys and to assist with the analysis of other dietary information.

4. Four team leaders—three men and one woman. These had all had experience in
teaching and in social welfare. At the time of commencement of the survey, they had had eight months' training, first in theoretical nutrition and then practical experience in the carrying out of dietary and budget surveys.

(5) Three nutrition assistants—female. These were School Certificate standard in education and had subsequently had training in theoretical and practical nutrition and special training in carrying out quantitative dietary survey work.

(6) Four laboratory attendants—male. These had had six months' training in a hospital laboratory in Accra and were satisfactory in elementary techniques, i.e. haemoglobin estimation and microscopy of blood films for malaria parasites and of stool specimens for ova.

(7) The rest was made up of males and females of the clerical assistant grade, i.e. an educational standard some two to four years below School Certificate.

The work of the survey was distributed as follows:

The two physicians and the nutritionist were jointly responsible for the planning. The physician (surveys) was responsible for organization and training other than the training already stated. He then continued with the supervision of the teams in the field, the carrying out of clinical examination on a proportion of the selected sample, and the supervision of the analysis of the data collected other than that done by the nutritionist.

Each team collected basic information of name, age, occupation, and in the case of women obstetric history and details of the age at death of such of her children as had died. Dietary information was collected from everyone in the sample on the basis of the 24-hour recall frequency-of-use method. Each person had their weight, height, length of upper arm from acromion process to external epicondyle, and circumference of the upper arm in the middle of its length measured, also skin fold thickness over the triceps, biceps and the scapula. Clinical examination was made for all the physical signs listed in the United States Department of Defence Manual for Nutrition Surveys. Laboratory tests for haemoglobin, malaria parasites and ova of intestinal parasites were performed on samples of varying sizes, usually one-fifth to one-half of the total.

The three nutrition assistants, although attached to one team, worked independently under the supervision of one team leader and were responsible for the quantitative dietary survey work.

The initial training was carried out in the field in a village near Accra. With the exception of the nutrition assistants, everyone in each team was taught to do all the jobs, except for the clinical examination and laboratory tests.

Certain valuable lessons were learnt during this training period. At first the 24-hour diet recall was collected separately and the information written in note books. It was found that it was often difficult to see the same person again for collecting information on weight, height, etc. It was also found that collecting information in the note books made analysis more difficult, as (a) when the information was collected for a whole household the names of some people in the household were omitted and (b) in the same way it was never clear which members of the household took of the different meals. In the second village visited for training purposes, therefore, all the information was collected on printed forms and the whole team entered a household and remained until all the data had been collected, i.e. some collecting dietary data and the others data of weights, heights, etc.

In the second training village weekly accuracy tests were conducted on all team members for accuracy both in collecting dietary information and in taking measurements of weights and heights. It was interesting to notice the gradual improvement in the standard of accuracy in all personnel except one, who had to be discharged. The final standard of accuracy showed less than 2% of errors of all sorts, including errors of omission.

It is worth recording that the female clerical assistants developed this standard of accuracy quicker than the males.

Following the initial training, a pilot scheme was carried out in three villages in the Winneba district—some 40 miles from Accra. Three teams were formed and the fourth team, composed of the nutrition assistants and one team leader, was attached first to one team and then with the second.

Here, for the first time, the teams were actually living in the village in which they were working, instead of travelling to and fro daily. This was found to be much better for collecting information and, in particular, it was possible to see a much higher proportion of men either before or after they had gone to their farms or other work. In the case of the quantitative dietary surveys living in a village is essential. Accuracy tests were carried out twice during this pilot survey and the same standard was maintained, except by one individual who was proving himself temperamentally unsuitable for this type of life and had to be replaced. One laboratory attendant also resigned during this period and the female team leader announced that she was getting married and
leaving the survey work at the end of the pilot survey.

The important part played by the team leaders should be stressed. Apart from day-to-day supervision and carrying out of work they are also responsible for discipline in the teams and maintaining co-operation with the villagers. As such they require a combination of personal qualities in which tact, sympathetic nature and determination are all compounded.

To a certain extent these qualities can be seen at interview, but the real test comes in the field. Anyone with a ‘superiority complex’ or tendencies to bureaucratic dictatorship is worse than useless. To a lesser degree the same remarks are applicable to the survey assistants, but it is no exaggeration to say that in the long run success or failure will depend largely on the team leaders.

The equipment issued to each team was as follows:

One Land-Rover station wagon, complete with roof rack, for transport (each Land-Rover had its own driver, who, therefore, became an additional member of the team). One camp bed for each person. Two or three hurricane lamps for each team; one ‘Flit’ spray gun for each team. Two 5-gal. plastic water containers were given to each team to avoid infection from drinking dirty water to which they were not accustomed. Clean water was normally available within 20 or 30 miles and was collected by the truck as required. Each team member was given regular doses of chloroquin to prevent malaria and this was most effective.

Preliminary arrangements to work in each village were made by the physician in charge in consultation with the local chief and elders. No difficulty was encountered in obtaining full co-operation. Free accommodation for the team was invariably provided and in return the physician provided free elementary medical treatment whenever he visited the village and the team leader was given small supplies of simple medicines in tablet form.

It was found necessary to provide team leaders with money to buy petrol for their trucks, as, although Government supplies are available throughout the country, the distance to the nearest supply often entailed a long journey which was itself a waste of petrol.

Separate scales were used (a) for weighing adults and children and (b) for weighing babies. The latter were of a standard pattern and gave no trouble. At first the Salter bathroom type scales were used for adults and children, but it was found that carrying them from house to house, standing them on rough ground (which was inevitable), caused the balancing system to go wrong very quickly. In consequence simple spring-type bathroom scales are now in use. These last for about three months. All the scales are checked daily against standard weights, several times daily, for any major irregularity by weighing one team member, and corrected to zero after each weighing. It was found impossible to devise a height-measuring scale which (a) could be taken easily in the truck and (b) could be used on irregular ground. Height measurement is therefore taken with the 25-ft. tape measure, with subject standing against the wall on the flattest piece of ground available. One team member uses a straight-edge to mark the patient’s head against the wall and holds the tip of the tape measure at this point whilst the second reads off the height to the ground.

One Zeiss travelling microscope was issued to each team, together with the necessary slides, cover slips, stains, spirit and other solutions.

Two printed forms are used for each person, one for recording basic information, measurements, clinical examinations and laboratory tests, and the other for the dietary data. When the information has been collected in each household, the two forms for each person are then stapled together.

For the quantitative dietary surveys, foods are weighed on the Salter household scales, reading to 10 lb. by 1 oz. This information is also recorded on separate printed forms. The latter method of recording was adopted after a trial both of this and of recording in note books, and it was found that the printed forms had two advantages: (a) there was less likelihood of essential items of information being omitted and (b) subsequent analysis was made easier.

Planning and Pilot Survey

In planning the nutrition survey three factors had to be borne in mind. The first was that the survey should be completed in two years; the second that it should aim to be representative of the whole country, and the third that it could only use the personnel detailed above.

To cover the whole country in the time available meant that essentially a horizontal cross-section type of survey must be performed. It was decided, however, that any coverage must be planned to include seasonal variations as far as possible.

With the personnel available it was estimated that a sample of some 35,000, i.e. just over 1/90 of the total population, could be seen four times each in two years.

To select this sample the following factors were taken into consideration:

(1) Type of country.
(2) Tribe.
The possibility that unexpected factors might make their appearance was borne in mind. It was fortunate that a population census had been carried out in 1960. At the time of planning information was only available as to the total population in every village and town. No information was available as to sex and age distribution, tribal distribution or occupations. Very little information is available on economic status of any section of the population and such information was not collected in the course of the population census.

It was, therefore, decided to take the sample as a number of whole communities. Communities up to 1,000 people were seen in their entirety, and in communities over 1,000 people a sample of 1,000 was to be taken in the form of an area cross-section of the town.

In this way it was hoped that all economic strata would be seen even though one could not classify the levels.

It was also decided to conduct a survey through at least one large Ministry and one large commercial organization, in both of which economic levels can be obtained.

To select the villages and towns the geographical areas (i.e. coastal plain, forest and northern savannah) were divided into tribal areas on the basis of personal knowledge. From the census list the population in each area was estimated and the percentage of the population living in villages and towns of different sizes was calculated. From this the number needed for a 10% sample was estimated. Each place was then numbered on the census list and places sufficient to give a 10% sample for each of the different community sizes selected from random tables.

During the course of the pilot survey it became apparent that another factor must be taken into consideration. This was the distance between a village and the main road. To cover this factor, therefore, it was decided that whenever a main road village was seen a village of comparable size between two and 10 miles off the main road should...
be seen at the same time. This course is being pursued for all villages up to 1,000 people.

In this way it was hoped that a reasonably representative sample of the whole country would be seen. It was realized that the sampling was weak on the economic factor, but since in order to make this accurate an extensive economic survey lasting several years would be necessary, it was decided that further action in this respect was impossible.

Pilot Survey

This was undertaken in the Winneba district, some 40 miles from Accra. Here for the first time the teams were living in the villages where they were working.

The pilot survey was undertaken for three reasons:

(1) As a check on the living and working conditions for the teams.

(2) As a final check on training.

(3) To gain an assessment of the possibilities of finding statistical significances between different groups.

One team was placed in each of three different villages, the first being a fishing village (Mankwadze), the second an inland village some 12 miles from the coast (Ekhamkrom), situated on a main road and close to a town. In this village there was a mixed farming and wage-earning population and supplies of food from outside, including fish from the coast, were reasonably good. The third village (Mankessim) was a wholly farming community situated some 25 miles from the coast, in the forest area, and 10 miles from any main road by a rather rough track. Supplies of food coming in from the outside to this village were poor.

The team concerned with quantity dietary surveys spent two weeks in each of the second and third villages.

The results of the pilot survey can be summarized as follows:

The arrangements for living and working conditions for the teams were found to be satisfactory and, as anticipated, living in the village made it much easier to see a very high proportion of the population.

Two tests were carried out as a check on training during the pilot survey and again, in each case, the overall degree of error and the individual degree of error were both less than 2%. Errors of commission, e.g. the mistakes in weighing, etc., were less than 1% in all cases.

It is worth noting here that, whilst this standard has been maintained throughout the survey to date, it has been found advisable to carry out spot checks at fairly frequent intervals. These are done by the physician, who frequently repeats the weighing, measurement, etc., on an individual to check for accuracy, and never misses an opportunity to test that the accuracy of scales is maintained.

From the statistical point of view, it was found that standard deviations for weights and heights were such that in comparing groups of 100 adults (male or female) differences of 10 lb. in weight and 1 in. in height were significant, and that for groups of 250 people (male or female) differences in weight of 4 to 5 lb. and ½ in. in height would be significant; this was regarded as quite satisfactory.

Considerable attention was devoted to devising a method whereby in the quantitative dietary survey accurate estimations of individual intakes could be obtained. Estimates for family intakes, though valuable, have the great disadvantage that the distribution of nutrients within the family is not known. In Ghana, where protein is in short supply, and where it is customary to give a disproportionate share of animal foods to adults, especially males, this was obviously a problem to be tackled. The disadvantage is the disruption of household routines which occurs when an individual share is weighed before being eaten and the loss of co-operation which may result very quickly from such inconvenience. In addition, several people often eat from one plate.

As a compromise the nutrition assistants were trained to estimate by eye the allocation of the prime constituents of each meal to members of the family. It was found by testing that a reasonable degree of accuracy (within 5 to 10%) could be achieved by this method. This does not eliminate the difficulty caused by plate-sharing, but fortunately this occurs more commonly between children of comparable ages, and an estimate of the actual intake of two children is regarded as an improvement on a total family measurement. Furthermore, it is in any case usual for the head of the family, who is more likely to receive the lion's share of the animal protein, to eat by himself from a single plate.

It is not claimed that this method produces a high degree of accuracy, but it has been found that in practice it gives very useful information. It has, therefore, been adopted as a routine procedure throughout the dietary survey as an integral part of the method. This also includes weighing the food as purchased and when prepared for cooking and recording the cooking methods.

Results

It is not the intention of this paper to discuss the results of the survey, which will, in any case, be published at a later date. However, for interest, graphs of the growth in weight for boys in the
three different villages of the pilot survey are appended (Fig. 3), together with tables for height and weight and clinical signs in male and female adults in the three communities (Tables 1 and 2). Also appended are tables showing the distribution of calories and protein within families in the farming villages (Table 3) and the amino-acids supplied by a diet of a group of children aged six to seven in one of these (Table 4).

Certain outstanding points have remained constant in the survey so far. Most marked is the decline in growth rate of children between the ages of one and two. This is also the age at which signs of kwashiorkor and frank clinical cases are most commonly seen. The adults of fishing villages are consistently taller and heavier than those of farming communities. Amongst adults the occurrence of clinical signs of malnutrition is appreciably higher in those with a weight/height index (measured in pounds and inches) of less than two.

Discussion

The value of nutrition surveys in providing information on which national nutrition policies can be based has been constantly stressed (FAO, 1953, 1959). The difficulty in many of the newer countries lies in finding staff with the necessary experience to conduct such a survey. One object of this paper has been to show how, by breaking down the jobs suitably, imposing strict limitations on the type of information collected, and devoting great care to the selection, training and, where necessary, rejection of junior staff, much useful information can be collected. Great stress is laid on two points. The first, that team leaders should be above average intelligence and should have an aptitude for field work; the second, constant and repeated checks for accuracy at all levels must be carried out. On the whole, it has been found with junior staff that an equable disposition and a respect for their fellow humans at all levels is more important than a high academic standard.

The problem for which we have found no solution is accurate assessment of an individual’s age. Whilst the method of aligning birth with prominent events is most useful, there is no doubt that many discrepancies occur in all age-groups above five. Nor is there any way of checking whether these discrepancies are self-cancelling, although in children this is probably so, since above or below average children will tend to get placed in an upper or lower age-group when mistakes occur.

Another problem which arises, especially in children, is comparing heights and weights with some recognized standard for good nutrition. Except when dealing with tribes of exceptional physique, like the Watusi or the various pigmy tribes, it seems quite probable that European or American standards may apply, but this will never be certain until studies have been done on a large
group of African children living under optimum conditions for the whole of their period of growth.

There are no accepted recommended dietary allowances for the Ghana population, nor is there any work we know of aimed at evolving such standards, but it is felt that until these have been developed the FAO recommended allowances (FAO, 1957a, 1957b, 1958) should be used for comparison with diet survey results.

The system of calculating calorie allowances includes adjustments for weight, excessive thinness or fatness, age and environmental temperature; that for protein allowances takes into account age, weight and the essential amino-acid content of the diet. The recommended allowances for other nutrients are in several cases a good deal closer to the known realities of tropical diets than are those of the N.R.C. or B.M.A. However, the fact remains that, while a diet which meets the recommended allowances is probably satisfactory, we do not know whether a moderate drop below these standards constitutes an outright deficiency or a reduction in the margin of safety.

One large gap in our knowledge concerns activity, a major factor in determining calorie requirements. A man who obtains 140% of his 'allowance' may be simply working a good deal harder than the FAO 'reference man'. On the other hand, he may be putting on weight, or eating more food than usual in order to impress the investigators, or he may have an unusually rapid metabolism. Much more information is needed about calorie expenditures before we can distinguish between these possibilities. There is also no very satisfactory method of estimating the calorie requirements of people believed or known to be underweight through malnutrition.

In our opinion, however, these difficulties do not materially lessen the usefulness of the information gained from a nutrition survey. This usefulness may be summed up as, firstly, providing the necessary data on which national policies may be based and, secondly, providing a baseline against which the effectiveness of these policies may be judged after they have been in operation for some length of time.

Our thanks are due to Chief Medical Officer, Ministry of Health, Ghana, and Principal Secretary, Ministry of Agriculture, Ghana, for permission to publish.

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### Table 1

**Mean Weights and Heights of Adults**

<table>
<thead>
<tr>
<th></th>
<th>No.</th>
<th>Mean Weight (lb.)</th>
<th>Range (lb.)</th>
<th>Standard Deviation (lb.)</th>
<th>Mean Height (in.)</th>
<th>Range (in.)</th>
<th>S.D. (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mankwadze</td>
<td>98</td>
<td>136</td>
<td>100–176</td>
<td>14</td>
<td>67</td>
<td>60–73</td>
<td>2</td>
</tr>
<tr>
<td>Ekhamkrom</td>
<td>205</td>
<td>126</td>
<td>90–172</td>
<td>14</td>
<td>66</td>
<td>59–72</td>
<td>2</td>
</tr>
<tr>
<td>Mankessim</td>
<td>192</td>
<td>120</td>
<td>90–170</td>
<td>13</td>
<td>65½</td>
<td>59–71</td>
<td>2½</td>
</tr>
<tr>
<td>Females:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mankwadze</td>
<td>103</td>
<td>121</td>
<td>88–164</td>
<td>14</td>
<td>63</td>
<td>57–68</td>
<td>2</td>
</tr>
<tr>
<td>Ekhamkrom</td>
<td>299</td>
<td>112</td>
<td>80–157</td>
<td>16</td>
<td>61</td>
<td>56–67</td>
<td>2½</td>
</tr>
<tr>
<td>Mankessim</td>
<td>270</td>
<td>110</td>
<td>78–162</td>
<td>17</td>
<td>61½</td>
<td>56–66</td>
<td>2</td>
</tr>
</tbody>
</table>

### Table 2

**Clinical Signs of Malnutrition in Adults**

(shown as a percentage of total number examined)

<table>
<thead>
<tr>
<th></th>
<th>No.</th>
<th>% with Clinical Signs</th>
<th>% Commonest Signs, All Adults</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>All Adults</td>
<td>Men</td>
</tr>
<tr>
<td>Mankwadze</td>
<td>201</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Ekhamkrom</td>
<td>504</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>Mankessim</td>
<td>462</td>
<td>16</td>
<td>15</td>
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</tbody>
</table>
### Table 3

**DAILY CALORIE AND PROTEIN INTAKES IN TWO GHANAIAN FARMING VILLAGES IN RELATION TO FAO RECOMMENDED ALLOWANCES, NOVEMBER 1960**

#### ADULTS

<table>
<thead>
<tr>
<th>House No.</th>
<th>Men</th>
<th>Women</th>
<th>House No.</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Calories (% FAO allowance in brackets)</td>
<td>Protein, g. (% FAO allowance in brackets)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>3,544 (168)</td>
<td>3,040 (166)</td>
<td>10</td>
<td>121 (224)</td>
<td>84 (172)</td>
</tr>
<tr>
<td>15</td>
<td>2,543 (92)</td>
<td>2,311 (106)</td>
<td>15</td>
<td>72 (141)</td>
<td>57 (121)</td>
</tr>
<tr>
<td>48</td>
<td>3,297 (152)</td>
<td>2,666 (142)</td>
<td>48</td>
<td>106 (226)</td>
<td>69 (101)</td>
</tr>
<tr>
<td>102</td>
<td>2,317 (82)</td>
<td>2,122 (92)</td>
<td>102</td>
<td>69 (130)</td>
<td>52 (101)</td>
</tr>
<tr>
<td>131</td>
<td>2,508 (90)</td>
<td>1,594 (80)</td>
<td>131</td>
<td>107 (212)</td>
<td>48 (118)</td>
</tr>
<tr>
<td>168</td>
<td>2,705 (102)</td>
<td>2,505 (112)</td>
<td>168</td>
<td>109 (242)</td>
<td>88 (187)</td>
</tr>
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#### CHILDREN

<table>
<thead>
<tr>
<th>House No.</th>
<th>Calories</th>
<th>House No.</th>
<th>Calories</th>
<th>House No.</th>
<th>Protein g.</th>
<th>House No.</th>
<th>Protein g.</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>1,303 (63)</td>
<td>10</td>
<td>41 (87)</td>
<td>29</td>
<td>29</td>
<td>25 (71)</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>1,657 (83)</td>
<td>15</td>
<td>37 (67)</td>
<td>48</td>
<td>30 (65)</td>
<td>33 (66)</td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>1,170 (59)</td>
<td>48</td>
<td>22 (52)</td>
<td>102</td>
<td>24 (57)</td>
<td>169</td>
<td></td>
</tr>
<tr>
<td>102</td>
<td>1,141 (57)</td>
<td>102</td>
<td>22 (52)</td>
<td>131</td>
<td>44 (112)</td>
<td>45 (112)</td>
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<tr>
<td>131</td>
<td>918 (65)</td>
<td>131</td>
<td>44 (112)</td>
<td>168</td>
<td>49 (104)</td>
<td>188</td>
<td></td>
</tr>
<tr>
<td>168</td>
<td>1,398 (66)</td>
<td>168</td>
<td>971 (55)</td>
<td></td>
<td></td>
<td>20 (72)</td>
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</table>

#### COMPARISON OF MEAN % OF RECOMMENDED ALLOWANCES

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th>Women</th>
<th>Children</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calories:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ekhamkrom</td>
<td>114</td>
<td>116</td>
<td>65</td>
</tr>
<tr>
<td>Mankessim</td>
<td>76</td>
<td>89</td>
<td>59</td>
</tr>
<tr>
<td>Protein:</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Ekhamkrom</td>
<td>198</td>
<td>145</td>
<td>72</td>
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<tr>
<td>Mankessim</td>
<td>128</td>
<td>138</td>
<td>72</td>
</tr>
</tbody>
</table>

**Notes:**

1. Calorie allowances calculated according to methods given by FAO (1957b). These take into account weight, physique, age and environmental temperature, but not activity, for which no data are available in the present instance. These allowances are not strictly intended to apply to individuals, but to large groups in which the effects of individual variations would be likely to cancel out. This applies to all systems of recommended allowances. The FAO system, by taking into account certain factors known to influence calorie requirements, makes it possible to compare groups differing with respect to these factors (in the present instance principally age and weight) and differences due to other factors are thrown into relief. It can be seen from this table that people in Ekhamkrom obtained more calories in relation to the recommended allowances than those in Mankessim, and that children in both places fell far short of the recommended allowances even when the adult diet met or surpassed these.

2. Interpretation of individual differences is very doubtful. The statement that a man gets 140% of his 'recommended allowance' may well mean that he works more strenuously than the FAO 'reference adult' of similar weight, physique and age at the same environmental temperature, but there are several other possible explanations.

3. Protein allowances are calculated by the method given in FAO (1957b) which takes into account age, weight and the dietary content of essential amino-acids. It does not take into account the possibility that the person may be underweight and this may have led to low estimates in the present instance. The FAO method usually leads to estimates rather lower than other systems of recommended allowances, especially for adults.

4. Most of the men of Mankessim were away on cocoa-farms in other parts of the country.
### Table 4

#### Intake of Essential Amino-acids among Children 6-7 Years Old: Gomoa Mankessim

<table>
<thead>
<tr>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn-dough</td>
<td>171</td>
<td>1.16</td>
<td>61</td>
<td>398</td>
<td>462</td>
<td>1,290</td>
<td>288</td>
<td>185</td>
<td>130</td>
<td>454</td>
<td>610</td>
<td>510</td>
</tr>
<tr>
<td>Rice</td>
<td>7</td>
<td>0.10</td>
<td>6</td>
<td>23</td>
<td>28</td>
<td>51</td>
<td>23</td>
<td>11</td>
<td>8</td>
<td>30</td>
<td>27</td>
<td>42</td>
</tr>
<tr>
<td>Bread</td>
<td>50</td>
<td>0.85</td>
<td>50</td>
<td>155</td>
<td>200</td>
<td>225</td>
<td>125</td>
<td>7</td>
<td>21</td>
<td>65</td>
<td>190</td>
<td>200</td>
</tr>
<tr>
<td>Plantain</td>
<td>120</td>
<td>0.23</td>
<td>12</td>
<td>35</td>
<td>73</td>
<td>78</td>
<td>65</td>
<td>7</td>
<td>21</td>
<td>65</td>
<td>86</td>
<td></td>
</tr>
<tr>
<td>Cassava</td>
<td>100</td>
<td>0.19</td>
<td>16</td>
<td>33</td>
<td>34</td>
<td>49</td>
<td>50</td>
<td>7</td>
<td>14</td>
<td>34</td>
<td>22</td>
<td>37</td>
</tr>
<tr>
<td>Leaves</td>
<td>5</td>
<td>0.03</td>
<td>3</td>
<td>10</td>
<td>10</td>
<td>15</td>
<td>13</td>
<td>3</td>
<td>4</td>
<td>10</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>Garden eggs</td>
<td>5</td>
<td>0.01</td>
<td>—</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>—</td>
<td>2</td>
<td>—</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Tomatoes</td>
<td>10</td>
<td>0.02</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>1</td>
<td>—</td>
<td>4</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Onion</td>
<td>2</td>
<td>—</td>
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<td>—</td>
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<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Pepper</td>
<td>3</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Smoked fish</td>
<td>20</td>
<td>1.09</td>
<td>68</td>
<td>294</td>
<td>346</td>
<td>516</td>
<td>600</td>
<td>198</td>
<td>92</td>
<td>247</td>
<td>184</td>
<td>362</td>
</tr>
<tr>
<td>Salt cod</td>
<td>8</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Tinned fish</td>
<td>3</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>3.68</td>
<td>217</td>
<td>954</td>
<td>1,160</td>
<td>2,314</td>
<td>1,171</td>
<td>537</td>
<td>369</td>
<td>1,121</td>
<td>1,042</td>
<td>1,256</td>
<td></td>
</tr>
</tbody>
</table>

Comparing this with the FAO provisional pattern of amino-acids the limiting substance is found to be tryptophane.

This diet supplies 59 mg. tryptophane per g. nitrogen, compared with 90 mg. per g. nitrogen in the provisional pattern.

Therefore the protein score is $\frac{59}{90} \times 100\% = 66\%$

**Notes:**

1. In calculating the quantities of essential amino-acids the tables of Orr and Watt (1957) were used.
2. The method of calculating protein scores by comparison with a provisional pattern of amino-acid make-up is given in FAO (1957b).
3. Foods: Corn-dough is made from soaked maize and left to ferment two to three days. It contains about 50% water and is cooked in a variety of ways. Garden eggs: Solanum melongenum. Pepper: Capsicum spp. Leaves: those of cocoyam (Xanthosoma sagittifolium). Smoked fish: produced in Ghana; herring and larger fish, smoked in small kilns. Salt cod: imported from Scandinavia.
4. This diet supplied about 900 calories. There were four children in the group, all from the same household (House No. 188, the chief's house).
5. Diets of other age-groups in both villages gave a similar protein score.
6. The recommended safe allowance of this age-group for protein having an average score of 66% is 1.6 g. per kg. Mean weight of this group in Mankessim was 16 kg.: therefore recommended safe allowance would be 26 g. The diet actually supplied 22 g.

**REFERENCES**


--- (1957): Calorie Requirements.

--- (1957b): Protein Requirements.


A National Food and Nutrition Survey Project

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