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Autor: Tanner, M. / Lukmanji, Z.
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¹ Swiss Tropical Institute Field Laboratory, Ifakara, Tanzania

² Tanzania Food and Nutrition Centre, Dar es Salaam, Tanzania

Food consumption patterns in a rural Tanzanian community (Kikwawila village, Kilombero District, Morogoro Region) during lean and post-harvest season

M. TANNER¹, Z. LUKMANJI²

Summary

A survey on food consumption was undertaken in 32 out of 260 households of a rural Tanzanian community (Kikwawila village, Morogoro Region) during the lean season (February) and the post-harvest season (August) in 1983. The survey revealed that the staples maize, rice and cassava are equally important food items of the diet during the lean season. In August, the post-harvest season, rice dominated the food pattern and often replaced the porridge made from maize or cassava. Green vegetables, especially cassava leaves, were the main relish dish for the majority of households in February. Fish became a daily item of the diet of most families in August. Concentrated energy sources such as fats, oil and sugar were scarce in both survey periods.

The diets of all age groups of the population surveyed were highly deficient in energy (mean adequacy 58%) and protein (50%) in February. The FAO/WHO-recommended standards (Passmore et al., 1974) were met for protein in August but energy deficiency was still observed (mean adequacy 65%). The variations in energy intake were not only seasonal, but were also age and sex dependent. Young males (10 to 16 years) followed by the infants (6 months to 3 years) and old females (>60 years) were the groups with lowest adequacy (<50%) in February. Males (10 to 60 years) had the greatest energy deficits in August. Iron requirements were generally met in most age groups during both seasons. However, children under 3 years as well as adolescent and adult females (mean adequacy 54–65% in August) were at risk for anaemia. The seasonal pattern of the diet did significantly influence the vitamin A intake. While the requirements were fully met in February, a deficiency was noted in August. The low adequacy (40%) for vitamin A during the post-harvest season could be related to the scarcity of leafy vegetables in the diets.

Correspondence: Dr. Marcel Tanner, Swiss Tropical Institute, Socinstrasse 57, CH-4051 Basel, Switzerland

The data are discussed and related to the health problems observed in the community during the post-harvest season for three consecutive years.

Key words: food consumption; energy and protein adequacy; iron; vitamin A; Tanzania; rural community.

Introduction

The nutritional status of the members of a community is the result of a complex interplay among a variety of factors, such as cultural background, economic status, agricultural and dietary practices, food availability and endemic diseases. The vicious circle of malnutrition, ill health, decreased productivity, poverty and more malnutrition is well established (Jonsson, 1983; Den Hartog and Van Staveren, 1979). The interactions between disease and the intake of nutrients and their biological utilisation have been studied extensively (Longhurst, 1979; Jarrett, 1979; Crompton, 1984). In addition, the relation between food intake, work output and the degree of productivity have been described for different settings, including Tanzania (Schoefield, 1974; Longhurst and Payne, 1979; Bleiberg et al., 1981; Creese, 1985; TFNC, 1980).

Dietary surveys among rural and urban communities have revealed the high incidence of dietary deficiencies, and have described various factors influencing the food intake of an individual (Den Hartog, 1972; Den Hartog and Van Staveren, 1979; Schoefield 1974; Van Steenbergen et al., 1978a, b, 1984; Nnanyelugo, 1982). In Tanzania, severe protein energy malnutrition (PEM) was estimated to cause the death of 10000 children annually and to contribute to another 50000 deaths (TFNC, 1982). Anaemia, due to deficient nutrient intake and parasitic infections (mainly malaria) ranked second, followed by vitamin A deficiency, which was a major cause of blindness among children under 5, mostly in combination with measles.

Dietary surveys have been undertaken in different areas of Tanzania (Malenthera, 1968; Hautvast, 1972; Sheshamani and Schulters, 1982; Malekela, 1983). These studies could not be directly correlated with data about the community health status. The present dietary survey was an integral part of the studies on community health status within a primary health care programme in Kikwawila village, southeast Tanzania (Tanner et al., 1987a, b).

This survey undertaken in 1983 focused on the season when food was scarce and in which the intensity of agricultural labour reached a peak in the Ifakara division (February, during preparation and protection of fields and weeding i.e. long before the harvest of rice and maize), and also in the period just after the harvest (August). A comprehensive report on the survey has already been prepared (Lukmanji and Tanner, 1985). The intention of the study was to contribute to a better understanding of the numerous health problems recorded in the community of Kikwawila (Tanner et al., 1982, 1987a, b).

Materials and Methods

Study area

The present study was undertaken in the Kapolo and Kikwawila sectors of the rural village Kikwawila, Kilombero District (Morogoro Region) 14 km NE of Ifakara in 1983. The study area has been extensively described (Jätzold and Baum, 1964; Tanner et al., 1987a). Zehnder et al. (1986, 1987) investigated the agricultural situation of the village and the findings from the surveys on the community health status are presented by several authors in this volume (Tanner et al., 1987b; Degrémont et al., 1987; Stürchler et al., 1987; Betschart et al., 1987).

Sampling of households

The census of 1982 (Tanner et al., 1987a) served as basis for a stratified sampling according to household size (strata I ≤ 3 members, strata II > 3 members). Forty-four out of 260 households were selected (= sampling ratio $\frac{1}{6}$ representing $\frac{1}{8}$ of the total population) from the sectors Kapolo and Kikwawila. Complete data was obtained from 32 of these 44 households (= $\frac{1}{8}$ of all households with 170 individuals = $\frac{1}{7}$ of total population) and was analysed in February 1983. The same 32 households were visited again in August 1983. Only 28 households with 155 individuals could be surveyed again. The members of two households had left the village and two heads of household refused to take part in a second survey.

Data collection

The food intake of each individual in the 32 selected households was weighed and recorded for 4 days as described in Leitch and Aitken (1950) and Den Hartog and Van Staveren (1979). A weekend was included in order to take into account any variation in food consumption that might occur at weekends. Nine enumerators (7 students from the Medical Assistants Training Centre Ifakara and 2 field workers) undertook the data collection at household level.

The enumerators were thoroughly informed about the objectives and the procedure of the food consumption survey by discussions in the class room and a practical demonstration at the home of a village health worker (VHW) one day before the survey started. The first of the four days of the survey was considered as part of the mutual adaptation. Therefore the data from the first day were not included in the final analysis.

All enumerators were introduced to «their» families by a VHW, who was a ten-cell leader, one day before the survey. The families were also given detailed information about the survey, which was only performed if they gave their consent.

The enumerators did not stay with the families overnight. They went to the households at 11 a.m. and stayed there until the last meal (mostly at about 9 p.m.). On the first day, however, not knowing that the families did not prepare food before 11 p.m., the enumerators arrived at 6.30 a.m. The enumerators were supervised and advised by one of the authors (Z.L.).

The weight of all the food ingredients used for each item of food prepared and the cooked weight of each food item actually consumed by each member of the family were recorded. Salter diet scales weighing up to 2 kg (scale with 5 g units) were used. Those involved in the cooking of food and the heads of households were interviewed. Some families chose to have a separate dish or plate for every individual within the family. For those who ate out of the same plate, the following procedure was adopted: the housewife served the food item (staple) on a big plate and then divided it into a number of servings, i.e. into the amounts requested by each individual. Each serving was subsequently weighed and returned to its original position of the plate. An individual portion of any additional food item (relish) was then weighed and piled up on the staple, which was often rice or maize («ugali» = stiff porridge-like dough).

The following information was also recorded: the number of consumers present, their age and sex, the occupation and educational status of the heads of the households, the amount of land they owned and what was cultivated.

Anthropometric data

To assess the nutritional status, the height and weight of all the individuals who participated in the survey were recorded. A height rod was used for older children and adults, and a length board for children under 2 years of age. Conventional bathroom scales were used for recording weight. In the case of infants who could not yet stand, the weight of an adult was recorded, and then the adult was weighed again holding the infant. The difference in weight was taken as the infant's weight.

Data analysis

For the data analysis the food composition tables by Latham (1978) and Platt (1977) were used. To assess the adequacy of diets, an individual's intake was compared to the FAO/WHO and Tanzanian recommended dietary intakes by age groups and sex (Passmore et al., 1974; TFNC, 1980).

Results and Discussion

Sample structure and factors affecting data collection

A total of 32 households (with 170 individuals) was surveyed in February 1983 and 28 (155 individuals) again in August 1983. This represented $\frac{1}{8}$ of all households and $\frac{1}{7}$ of all inhabitants. The age/sex distribution is given in Table 1. The sample compared well with the census data for the whole population (Tanner et al., 1987a). There were more adult females (17 to 60 years) than males among the surveyed population. This reflects the overall higher proportion of females among the population of the Kikwawila and Kapolo sectors. The

Table 1. Age/sex distribution of the population surveyed in Kapolo and Kikwawila sectors of Kikwawila village during the food consumption survey in 1983

Survey	No. households surveyed	Total No. individuals	Age groups									
			6 months–3 yrs		4–9 yrs		10–16 yrs		17–60 yrs		>60 yrs	
			M	F	M	F	M	F	M	F	M	F
February 1983	32	170	9	8	17	16	19	14	24	47	10	6
August 1983	28	155	5	10	16	18	16	15	20	43	9	3

M = males; F = females

Table 2. Dietary survey Kikwawila village: weight for age according to Harvard standards of the children under five surveyed in February and August 1983

	February	August
Number of children under 5 years	21	22
Number >80% of Harvard standards . .	12	5
Number 60–80% of Harvard standards	8	16
Number <60% of Harvard standards . .	1	1

occupation of all the families was subsistence farming (Table 4). There were two exceptional cases; one household head was a teacher and one a businessman in addition to farming. In 3 cases a woman was the head of the household. The relationship between family size and acres cultivated is presented in Table 12.

Tables 2 and 3 summarize the anthropometric data for the children under 5, with regard to weight for age (Harvard classification, Jelliffe, 1966) and weight for height (wasting) and height for age (stunting). Wasting and stunting were assessed by using the Waterlow classification with the Tanzania adapted standards (KCMC, 1978). Weight for age showed seasonal differences, i.e. 9 out of 21 children were below 80% of the Harvard standard in February, while this proportion rose to 17 out of 22 in August (chi-square, $P < 0.025$). The degree of wasting was similar during both surveys. A significant increase of stunting was

Table 3. Dietary survey Kikwawila village: number of children under five classified by stunting and wasting as assessed in February and August 1983

		Wasting	
		stages 0 and 1	stages 2 and 3
<i>Stunting</i>			
Stages 0 and 1	February	12	2
	August	7	1
Stages 2 and 3	February	6	1
	August	14	0

Table 4. Nutritional status of 65 adults (≥ 17 years) observed during the food consumption survey in Kikwawila village in February and August 1983; assessment by body mass index (BMI)^a

Sex	Survey	Body mass index (BMI) classification			Total
		underweight ^b	normal	overweight	
Males	February ...	17	8	—	25
	August	13	12	—	25
Females	February ...	11	28	1	40
	August	10	26	3	39
Total	February ...	28	36	1	65
	August	23	38	3	64

^a weight kg/height², cf. Bray (1979)

^b BMI ranges underweight; males < 20 , females < 18
 normal; males 20–25, females 18–24
 overweight; males > 25 , females > 24

observed from February to August (stunting stages 2 and 3: 6/21 vs 14/22, chi-square, $P < 0.025$). However, these data, as well as weight for age, must be carefully interpreted, since the age could rarely be assessed from a birth certificate or the MCH card.

The anthropometric results for this sample of children under 5 compare well with the data obtained from the assessment of all children under five in the Kikwawila and Kapolo sectors (Tanner et al., 1987b).

The nutritional status assessed by weight for age was normal among the children between 6 and 15 years of age; 30/31 (February) and 37/41 (August) were above 80% of the Harvard standard.

The nutritional status of adults (≥ 17 years) was assessed by the body mass index (Bray, 1979). Table 4 shows that 17/25 (Febr.) and 13/25 (Aug.) of adult males were underweight compared to 11/40 (Febr.) and 10/39 (Aug.) of underweight females. These differences males/females were significant (chi-square-test) for February ($P < 0.005$). and August ($P < 0.05$). One might speculate that males who are physically weak stay in the village while fitter ones work elsewhere (river, town). To what extent these anthropometric results were due to the low energy intake (see below, Tables 7, 8) as compared with a high energy expenditure and/or to the high frequency of disease, remains to be established. The onset of the wet season is the most critical time of the year in many tropical environments (Schoefield, 1974; Chambers, 1979; Bleiberg et al., 1980; Hurst, 1983). This period often coincides with the peak season for agricultural labour. The amount of food available is small, consumption is low, and exposure to infection is high.

The question remains as to what extent the dietary data collected in this survey fully reflect the everyday situation. Traditionally, all the members of the family eat together from the same plate. However, on the first day of the survey, when the family understood what was being done, a separate dish or plate was produced for each individual during the following three days. This very probably affected the amount of food consumed by each individual. For those who ate from the same plate, unless it was cassava or bananas, one could not be fully certain of the accuracy of the weight of the food actually consumed. The children often picked up some food in between the meals. This could not always be weighed and recorded. It should also be noted that the first age group (6 m to 3 years) included a few children still being breast fed.

The conversion of cooked food to its raw food equivalent partly limits the accuracy of the final data on nutrient intake.

Food preparation, number of meals and food pattern

The cooking facilities consisted of 3-stone fireplaces either outdoors or indoors. Firewood was the chief source of fuel. Lack of firewood was a major constraint for the preparation of large quantities of food or more than two dishes.

Table 5. Average number of meals served per household and day (MHD) in Kikwawila village during lean (February) and post-harvest season (August) in 1983

Season	No. households surveyed	No. individuals surveyed	\bar{X} No. individuals/HH (range)	No. meals observed ^a	\bar{X} MHD (range)	\bar{X} MID (range)
February	32	170	5.3 (1–14)	194	2.01 (0–3)	1.81 (0–3)
August	28	150	5.3 (1–15)	220	2.6 (1–3)	1.9 (1–3)

^a 3 days observation period

HH = household

MHD = meals per HH and day

MID = meals per individual and day, calculated from the average frequencies of eating individuals per HH

\bar{X} = arithmetic mean

The dehusking of rice and the grinding of maize were done manually by women and girls in most households. There was no grinding mill in the village. For the staples, the beans and the vegetables (types see Table 6) the cooking method was boiling. Salt and water were almost always the only additional ingredients both for the staples, beans and vegetables in February; cashewnuts or sunflower- and sesame-seeds were very occasionally used. They were added as a fine powder which thickened the gravy.

Coconuts were seldom used as for they were hardly grown in the village and were very expensive when purchased at the market.

There was no significant difference between the average number of meals per household and day between February and August (Table 5). However, all the families had at least one meal per day in August while there were households with no meal at all in February 1983.

The frequency and distribution as well as the average portion size of the different food items consumed by children and adults are summarized in Table 6. The times at which the meals were eaten varied from one family to another. The first meal was eaten at any time between 11 a.m. and 3 p.m., depending on when the family returned home from their fields. The second meal was eaten between 7 p.m. and 9 p.m. A few families ate three times a day; a first meal at 11 a.m. followed by a second at 3 p.m. and an evening meal at 8–9 p.m. In between the meals snacks were rare; and if eaten often consisted of roasted maize on the cob, raw cassava roots, sugar cane and occasionally fruit.

The dietary pattern of each household was dominated by what was available. Culture/tribe-related factors and taboos did not seem to be important during either survey period.

Three food staples i.e. cassava, rice and maize were equally important in February (Table 6). In August, rice dominated all the families' diets, roots and tuber vegetables were used only for the first meal of the day. Green leafy

Table 6. Dietary survey Kikwawila: Relative frequency (%) of food consumed and amount of food (g) consumed per capita and meal, February vs August 1983

	Frequency %		Consumption per capita and meal in g				Number (%) of families consuming out of	
	Fe- bru- ary	August	February		August		32 February	28 August
			CH	A	CH	A		
Maize and maize products ...	32	7	60	156	9	53	26 (81)	9 (32)
Rice	38	64	87	186	147	240	27 (84)	28 (100)
Root vegetables and bananas	35	25	118	232	170	285	29 (90)	26 (93)
Leafy vegetables ^b	92	7	171	192	30	24	29 (90)	9 (32)
Beans ^c	16	25	43	30	87	100	28 (88)	22 (79)
Chicken and other meat	3	7	0.3	2	27	39	2 (6)	10 (36)
Fish	5	36	5	6	58	89	7 (22)	27 (96)
Sugar	7	9	—	—	—	—	3 (9)	6 (21)
Oil/fat ^d	11	18	6	8	8	10	10 (31)	10 (36)

^a mainly cassava

^b mainly cassava leaves («kizamvu») and spinach («mchicha»)

^c mainly kidney beans («maharagwe») cow peas («kunde») and pigeon peas («mbaazi»)

^d includes coconut-, cashew- and simsim-oil

CH = Children, 6 months – 16 years of age

A = Adults ≥17 years of age

vegetables, mainly cassava leaves («kizamvu») and spinach («mchicha») were consumed more often in February, as they became scarce in August; they were replaced by fresh beans and legumes such as kidney beans («maharagwe»), cowpeas («kunde») and pigeon peas («mbaazi»).

Animal food or fish were seldom consumed in February. However, in August there was more time available for fishing in the nearby Kilombero river and fish was observed to be a daily item of the diet for most families. More families were found consuming chicken or meat in August (36%) than in February (6%). Consumption of sugar depended on its availability, either in the village shop or purchased from town or brought into the house as a gift by visitors. It was rarely consumed in either survey period.

Food consumption patterns, total food intake and nutritional status of the community have been observed to vary with the season (Longhurst and Payne, 1979): This was also observed during the dietary surveys in Kikwawila. Summarizing the results of Table 6 leads to the average composition of the diet per meal and individual (Table 7). In August, the study population consumed 11.3% more energy than in February (5.39 vs 6.0 MJ). Yet, as shown below (Table 8), the mean energy intake was still far below FAO/WHO recommendations.

Table 7. Dietary survey Kikwawila: average composition of the diet per meal and individual in February and August 1983

	February	August
% protein	7.5	14.0
% carbohydrates	90.0	80.0
% fat	2.5	6.0
Mean energy intake (MJ)	5.39	6.00

Table 8. Dietary survey Kikwawila: *mean energy adequacy per day* (MJ) with regard to age and sex when compared to the FAO/WHO recommendations (Passmore et al., 1974), during February and August 1983

Age/sex group	FAO/WHO recommen- dations energy intake MJ	February			August		
		N ob- served	mean MJ (± SD)	% adequacy	N ob- served	mean MJ (± SD)	% ade- quacy
<i>Males and females</i>							
½–3 years	5.69	17	2.79 (1.29)	49	15	3.82 (1.45)	67
4–9 years	8.41	33	5.89 (1.61)	70	34	5.32 (1.67)	63
<i>Males</i>							
10–16 years	11.51	19	5.18 (1.35)	45	16	5.82 (1.49)	51
17–60 years	12.56	24	6.28 (2.43)	50	20	6.48 (1.70)	51
>60 years	8.79	10	5.89 (1.60)	67	9	7.58 (2.26)	86
<i>Females</i>							
10–16 years	10.13	14	7.19 (1.0)	71	15	6.19 (1.54)	61
17–60 years	9.63	47	5.85 (2.05)	61	43	6.28 (2.25)	65
>60 years	8.37	6	4.02 (1.04)	48	3	6.53 (1.98)	78
Average intake/adequacy		170	5.39 (1.38)	58 (11)	155	6.00 (1.09)	65 (12)

The high dietary bulk property of maize and rice restricts the quantity of food one can consume at one time and limits the nutrient intake (Robson, 1974). Cassava is even more bulky and nutritionally of poorer quality than maize or rice (Platt, 1977; Latham, 1978). The increased dietary bulk with low energy density is of particular significance for children's diets (Ljungquist, 1978). The energy density in relation to the dietary bulk could be increased by the addition of fat or oil to the dish. However, these items were rarely found to be used. Most of the cashewnuts were sold. Other oil/fat crops like peanuts, sesame etc. were not grown by most households (Zehnder et al., 1986).

Table 9. Dietary survey Kikwawila: *mean protein adequacy per day* (g) with regard to age and sex when compared to the FAO/WHO recommendations (Passmore et al., 1974), during February and August 1983

Age/sex group	FAO/WHO recommen- dations protein intake (g)	February			August		
		N ob- served	mean g (± SD)	% adequacy	N ob- served	mean (g) (± SD)	% ade- quacy
<i>Males and females</i>							
½–3 years	27	17	15 (6.5)	56	15	31 (14.7)	111
4–9 years	36	33	23 (11.2)	66	34	45 (19.7)	124
<i>Males</i>							
10–16 years	56	19	25 (10.8)	44	16	48 (24.3)	85
17–60 years	62	24	28 (14.8)	39	20	52 (20.7)	87
>60 years	60	10	29 (8.3)	48	9	59 (30.9)	98
<i>Females</i>							
10–16 years	52	14	23 (8.2)	44	15	48 (17.2)	93
17–60 years	50	47	28 (10.0)	56	43	53 (22.0)	106
>60 years	48	6	24 (3.4)	50	3	48 (26.0)	100
Average intake/adequacy		170	24 (5)	50 (9)	155	47 (8)	101 (13)

Table 10. Dietary survey Kikwawila: *mean iron adequacy per day* (mg) with regard to age and sex when compared to the Tanzania recommendations (TFNC, 1980), during February and August 1983

Age/sex group	Tanzania recommen- dations iron intake (mg)	February			August		
		N ob- served	mean mg (± SD)	% adequacy	N ob- served	mean (mg) (± SD)	% ade- quacy
<i>Males and females</i>							
½–3 years	10	17	9.6 (5.7)	96	15	6.0 (3.0)	60
4–9 years	10	33	14.4 (9.5)	144	34	9.4 (4.0)	94
<i>Males</i>							
10–16 years	10	19	12.4 (5.4)	125	16	10.3 (4.8)	103
17–60 years	10	24	14.0 (7.4)	140	20	10.7 (3.8)	107
>60 years	10	10	17.3 (8.9)	173	9	12.6 (4.0)	126
<i>Females</i>							
10–16 years	16	14	11.3 (5.5)	71	15	10.4 (3.6)	65
17–60 years	16	47	13.5 (6.6)	84	43	8.7 (3.2)	54
>60 years	10	6	17.0 (13.2)	170	3	11.6 (5.0)	116
<hr/>							
Average intake/adequacy		170	13.7 (2.6)	125 (38)	155	10.0 (2.0)	91 (27)

Table 11. Dietary survey Kikwawila: *mean vitamin A adequacy per day* (µg) with regard to age and sex when compared to the Tanzania recommendations (TFNC, 1980), during February and August 1983

Age/sex group	Tanzania recommen- dations vitamin A activity µg	February			August		
		N ob- served	mean µg (± SD)	% adequacy	N ob- served	mean µg (± SD)	% ade- quacy
<i>Males and females</i>							
½–3 years	800	17	826 (1194)	103	15	161 (112)	20
4–9 years	800	33	1079 (1000)	135	34	389 (460)	49
<i>Males</i>							
10–16 years	1000	19	694 (764)	69	16	491 (556)	49
17–60 years	1000	24	1387 (1854)	138	20	288 (404)	28
>60 years	1000	10	991 (807)	99	9	584 (884)	58
<i>Females</i>							
10–16 years	1000	14	765 (461)	76	15	302 (429)	30
17–60 years	1000	47	1328 (1358)	133	43	396 (562)	40
>60 years	1000	6	363 (360)	36	3	442 (397)	44
Average intake/adequacy		170	929 (340)	99 (37)	155	382 (131)	40 (13)

Nutrient intake and adequacy

Tables 8–11 summarize the mean nutrient intake per individual with regard to age and sex. These data are further compared to the recommended mean intake. The significance of the use of FAO/WHO recommendations and the application of average energy intake for comparison have been discussed in detail (Reutlinger and Selowsky, 1976; Berg, 1981; Pacey and Payne, 1985).

Table 8 shows that the mean recorded *energy intake* did not at all reach the recommended levels (mean adequacy 58–65%, range 45–86%); neither in February nor in the post-harvest season, August. The variations were not only seasonal but were also age and sex dependent. Young males (10 to 16 years) followed by the infants (6 months to 3 years) and old females (>60 years) were the groups with the lowest adequacy (<50%) in February. Males (10 to 60 years) had the greatest energy deficit in August. The infants (≤3 years) showed a substantial improvement of their energy adequacy in August. This might be explained by the fact that their mothers had a lower work load after the harvest and therefore more time to devote to their children. It is often stated, and has been described (Sheshamani, 1981) that males dominate the food distribution within Tanzanian families, placing females at a disadvantage. However, females had a slightly higher energy adequacy than males in the present study. This difference could be due to the study design, which missed any food taken outside the household. Men often went to other houses, where they might have consumed food and, more important, local beer («pombe») brewed from rice, maize and millet. The energy intake through «pombe» is estimated to contribute

up to 28% of the total energy intake in males (females only 9%, Sheshamani and Schulters, 1982); this estimated proportion is not included in Table 8.

We were unable to assess the amount of cereals used for brewing in each household. Eleven out of the 32 families (34%) claimed to brew «pombe» from maize or rice and finger millet at one time or another.

The *protein* deficit was between 34 and 61% in February; again, the young males and females between 10–16 years had the lowest adequacy (Table 9). While a mean adequacy of only 51% was observed in February, the mean protein intake met the recommendations in August. This was due to the changed food pattern in the post-harvest period of August (cf. Table 6). Much more fish could be consumed in August, rice was available to all families and more beans were consumed as well. The changed food pattern of the post-harvest period not only led to a significant increase of protein intake but also to intake of proteins with a higher biological value; there were both vegetable and animal proteins available. Any assessment of the nitrogen sources must include the amino acid composition of the protein, the proportion of dietary energy derived from protein and the total food intake (Miller, 1974). Estimates of protein intake and adequacy are only valid if the energy requirements are fully met. As soon as the total energy intake is below the requirements, dietary protein becomes an energy source (Passmore et al., 1974). Thus, any protein substitution is of limited efficiency, if the energy needs are not met at the same time. The energy adequacy may be a more relevant basis for the comparison of diets within communities.

The *iron* requirements were met during both survey periods (Table 10). There was a slight decrease from February to August, which could be explained by the dietary pattern (Table 6). Leafy green vegetables («kisamvu» and «micha») were hardly consumed in August, whereas the proportion of cereals (rice, maize) remained stable. Small children (6 months to 3 years) suffered most from this changed pattern, as their maize and rice were often accompanied by leafy vegetables in February. Consequently, their iron requirements were no longer met in August (60%). Adolescent and adult females did not meet their iron requirements during either survey period (54–84% adequacy). They are, thus, at higher risk for anaemia, especially since malaria, hookworm and urinary schistosomiasis are endemic in Kikwawila (Tanner et al., 1987b). The observed iron deficits were not reflected in the haematocrit values (Tanner et al. 1987b).

Important differences were observed for the *vitamin A* adequacy (vitamin A activity in mg) between February and August (Table 11). The vitamin A requirements were met in February but decreased to 40% in August. This can be clearly related to the changed food pattern, i.e. the scarcity of leafy vegetables in the diets in August (cf. Table 6). An analysis of serum retinol levels confirmed the present observations. A high proportion of very low levels (<100 µg retinol/l) was found among the individuals of the Kikwawila community in

Table 12. Relationship between family size, acres of cultivated land and mean energy intake per household during lean (February) and post-harvest (August) season

Family size ^a	N households	Acres cultivated ^b		Energy intake x̄ (± SD) ^c
		x̄ (± SD)	ẋ	
<i>February</i>				
1–3	9	3.3 (2.4)	3.0	6.3 (1.6)
4–6	12	2.9 (1.8)	2.5	5.0 (1.7)
7–9	7	4.0 (2.7)	3.0	4.7 (1.3)
≥10	3	9.7 (5.1)	11.0	5.1 (0.7)
<i>August</i>				
1–3	6	2.0 (1.6)	1.75	7.9 (3.0)
4–6	11	3.2 (1.7)	3.0	5.0 (1.3)
7–9	6	3.0 (2.2)	3.0	6.7 (1.1)
≥10	4	8.3 (5.1)	7.5	6.5 (1.1)

^a No of individuals per household

^b established by interview

^c mean of mean energy intake per household

\bar{x} = arithmetic mean (\pm Standard deviation, SD)

\tilde{x} = median

October (Stürchler et al., 1987). Periods of a vitamin A deficient diets may be relatively short, which could explain the fact that clinical examinations showed a low frequency of vitamin A deficiency in Kikwawila village (Tanner et al., 1982; Degrémont et al., 1987; Stürchler et al., 1987).

Table 12 summarizes the relationship between the observed mean energy intake per household, the family size (number of individuals per household) and the area of cultivated land per household as assessed by interviews. The analysis of the individual paired data per household revealed that there was a positive correlation between the number of individuals per household and the area cultivated (February: $r = 0.476$, $P = 0.007$; August $r = 0.382$, $P = 0.027$). No significant correlation between energy intake and acres cultivated or energy intake and number of individuals per household could be found. This is in contrast to other studies in Tanzania (Malentherma, 1968; Seshamani, 1981). These authors showed a negative correlation between the family size and the mean energy intake per day. Longhurst (1980) reviewing the relationship between family size, farm size and energy consumption, pointed out that family size and nutritional status are not always negatively related and that the relationship can be tribe-dependent. The lack of any correlation between farm-size/family size and energy intake in Kikwawila may have several reasons. The mean energy intake was already far below the recommended standards for rural areas among all surveyed household members (cf. also Table 8) leading to a

range of only 4.7–7.9 MJ mean energy intake per household and per group of family size (Table 12). This in turn seems to be related to the generally low agricultural production (Zehnder et al., 1986, 1987).

It is well established that ill-health affects an individual's appetite and food intake (Jarrett, 1979; Chandra, 1981; Crompton, 1984). The Kikwawila community faces numerous infectious diseases (Tanner et al., 1987b); the community itself rates intestinal problems and the «fever» syndrome first, the latter reflecting partly malaria (Degrémont et al., 1987). The heavy load of chronic and acute diseases in Kikwawila may have influenced the appetite of the villagers and thus contributed to the low intake of nutrients as shown in this study. The individual intake of nutrients is further affected by any spell of illness which results in missed meals. In this respect it is important to note that the two village health posts of Kapolo and Kikwawila recorded an attendance of 15410 in 1984 (STIFL/DHO, 1985). The impact of these very frequent spells of superficial or severe illness on missed meals and reduced food intake can therefore be assumed to be relevant. An in-depth analysis of the morbidity, especially due to parasitic infections among the different households in relation to food consumption and food production would be highly valuable. It could help to establish the important risk factors of these relationships.

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