



The nutritional status of the Fur people of Jabel Marra

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Summary

The nutritional status of the adult Fur people of Jabel Marra of Western Sudan was assessed by means of physical anthropometry, haematologic and serum protein measurements.

The results of the anthropometric survey show a high incidence of low weight for height in comparison with caucasian standards. The muscle mass as indicated by the upper arm circumference is also smaller than expected by European standards. The upper arm muscle circumference, however, is only marginally lower than the above standards. Subcutaneous adipose tissue is found to fall within the lower range of normal in comparison to available standards. The results are discussed in the light of findings in other African countries with similar ecology and socio-economic conditions.

The haematological and serum proteins results reveal a high incidence of anaemia especially in women. As the R.B.C. count was not done in this work the type of the anaemia cannot be ascertained.

The value of cross-sectional nutritional surveys for the establishment of baseline data for future assessment of development is indicated.

Résumé

L'état nutritionnel des Furs adultes habitant la région du djebel Marra (Soudan occidental) a été évalué à l'aide de l'anthropométrie physique et des mesures hématologiques et de sérum-protéine.

Les résultats de l'étude anthropométrique montrent qu'il existe chez les sujets une haute tendance au manque de poids en comparaison des normes caucasiennes. La circonférence de la masse musculaire

du bras est aussi inférieure aux mesures européennes. Les tissus adipeux sous-cutanés sont au dessous de la moyenne reconnue. Les résultats sont discutés en lumière des résultats obtenus dans d'autres pays africains ayant une écologie et des conditions économiques semblables.

Les résultats hématologiques et de sérum-protéine révèlent une haute tendance à l'anémie, surtout chez les femmes. Comme dans ce travail, le compte des globules rouges n'a pas été effectué, il est difficile de déterminer la type de l'anémie.

Dans cet exposé, on discute aussi de la valeur d'études nutritionnelles dans les pays en voie de développement afin d'établir des références de base.

Introduction

This is an anthropometric and haematological investigation of a sample of the Fur tribe residing in the Jabel Marra range and its western plateau.

The region of Jabel Marra (12°-16°N 23°-27°W) lies in the centre of the Province of Dar Fur of the Democratic Republic of the Sudan. Dar-Fur (Arabic = the land of the Fur) is the western-most province in the Sudan having common borders with the Republic of Libya, the Republic of Chad and the Central African Republic (Fig. 1). The Jabel area is composed of volcanic rock surrounded by a plain consisting mainly of precambrian basement.

The climate of Jabel Marra and the neighbouring plain is characterized by moderate rainfall of 12-25 in mainly during the months of May to October. The mean monthly temperature range from 22.5°C in December to 30.0°C in May (Records for 30 years 1931-60). The vegetation of the mountain range is composed of open woodland savannah with occasional thick woods in the upper reaches. The plateau has open thorn savannah mainly of acacia bushes. To

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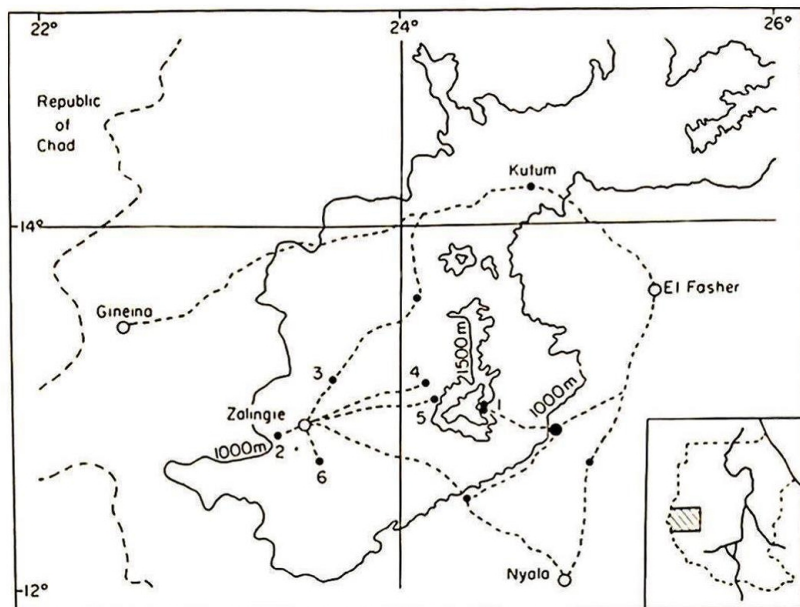


FIG. 1. Map of survey area showing survey routes and contours.

the south of Jabel Iic dense savannah and Sudan plains (marshy lands).

The Jabel Marra range forms part of the eastern water-shed of the Lake Chad basin. Most of the westward flowing rivers are comprised of the Wadi Azum and its main affluent, Wadi Kaja. Seasonal streams run the western slopes of the main range and cross the western plateau. The upper reaches have mountain streams which originate in mountain springs and flow throughout the year. These mountain springs have clear water with low solid content of 140–300 p.p.m. (Lebon & Robertson, 1961). There are also a few warm springs.

The Fur tribe inhabit the volcanic range and much of the surrounding lowland. They are of negroid stock believed to originate in Jabel Marra. The plains of Dar Fur province are occupied by tribes of Arab origin. For the purpose of the present survey the Jabel area was selected as the main settlement of the Fur people. To the south of the Fur, live Baggara arabs (cattle owners). To the north-east live the camel owning tribes of Dar Fur. To the west of the mountain range live negroid tribes of the Masalit, Gimir and Tama along the borders of the Republic of Chad and Central African Republic. These neighbouring tribes are ethnically unrelated to the Fur and speak

different dialects. There is little intermarriage between them which ensures a degree of ethnic homogeneity of the Fur people.

Agriculture is the main occupation of the Fur. Dura (*Sorghum Vulgare*) and Dukhun or bulrush millet (*Pennisetum typhoideum*) are the two main cereals grown in this area. Fruit orchards and vegetable farms are found where mountain streams run the whole year. Citrus fruits are the main types of fruit grown here. Vegetables such as onions, beans and tomatoes are grown especially in the upper reaches of the mountains range and in areas of abundant water supply.

Live stock, mainly cattle and goats, are not kept on a large scale and do not seem to do very well at the higher altitudes. The villagers tend to rear chickens in their homesteads.

Materials and methods

Clinical and Anthropometric Observations

The sample of the Fur people examined was selected from volunteers who turned up at the examination centres. These centres were in seven villages: Gawa and Suni, 1650 m; Guldu and Nyer-tetti, 1300 m; Sulu, Abata and Korolle, 1000 m; and

one small town, Zalingie, 1000 m. The survey was carried out during the month of April, 1969. The villages were visited as far as possible on market days when large numbers of people come from the surrounding places. A village notable or chief was usually approached to accompany the team for the purposes of communicating with the people and convincing them to undergo the examination. A total of 634 individuals were examined. Of these 359 men and 202 women were Fur, while fifty-nine men and fourteen women came from other neighbouring tribes. The age distribution of the sample of Fur people was as follows: age 15-35 years, 174 men and 128 women; age 36-55 years, 132 men and sixty-three women; age 56 and above, fifty-three men and eleven women.

A general clinical examination was conducted by M. Y. Sukkar and special note was made of signs of avitaminosis, and enlargement of the liver and of the spleen. As this region is known to be endemic for goitre, enlargement of the thyroid was also noted.

The anthropometric measurements of body weight, height, middle upper arm circumference

and skinfold thickness were carried out as described by Jelliffe (1966). The subjects were weighed in the minimum of clothing on a beam balance. Heights were taken in the standing position using a vertical scale with a sliding horizontal rod. A non-stretch tape measure was used for the measurement of mid-upper arm circumference. Skinfolts were measured by means of the Harpenden skinfold calipers. Two sites were selected: the sub-scapular skinfold just below and lateral to the angle of the left scapula and the triceps skinfold half way down the left upper arm midway between the acromion process of the scapula and the olecranon process of the ulna.

Haematologic and serum protein investigation

Blood samples were obtained by venepuncture from an antecubital vein. Haemoglobin was estimated by the MRC Grey Wedge photometer using a 0.04% ammonia solution as diluent. The packed cell volume was measured using heparinized micro-

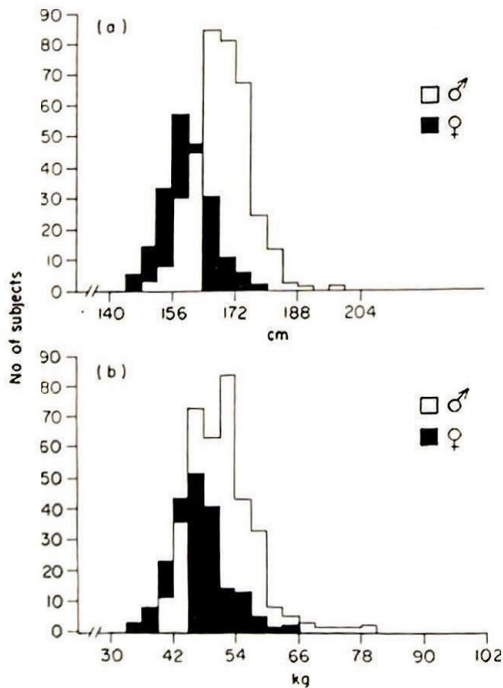


FIG. 2. Distribution of (a) heights and (b) weights.

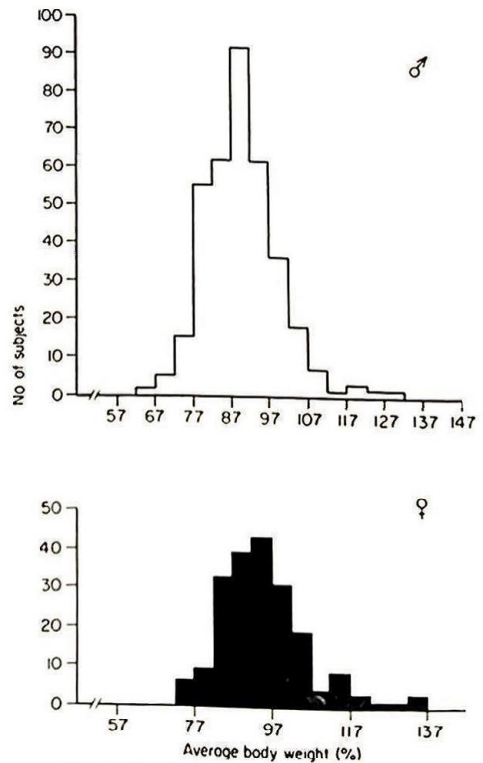


FIG. 3. Distribution of body weight rating.

haematocrit tubes and a micro-haematocrit centrifuge. A sample of blood was allowed to clot and the serum was collected and kept frozen until on a subsequent date the serum proteins were estimated.

Total serum protein was estimated by the Biuret method as described by Wootton (1964). The samples were read against a standard protein solution at 540 m μ using a Unicam S.P. 500 spectrophotometer. The serum proteins were separated by electrophoresis on cellulose acetate paper using a horizontal Shandon tank and Oxoid 10 \times 5 cm strips. The volume of serum added to each strip was 1 m μ per cm width. The buffer used in the electrophoresis had pH 8.6 and was of the following composition: diethylbarbituric acid 1.66 g; sodium diethylbarbiturate 12.76 g; in one litre of distilled water. The electrophoretic run was continued for 2 h using a current of 0.4 mA per cm width of strip. After electrophoresis the strips were removed and placed in the staining solution (Amido-Schwarz 10B 0.25 g; trichloroacetic acid 3 g in 100 ml methanol) for 10 min. Excess dye was removed by washing for 20 min in two changes of a solution containing nine volumes of methanol and one volume of glacial acetic acid. The washing was completed with pure

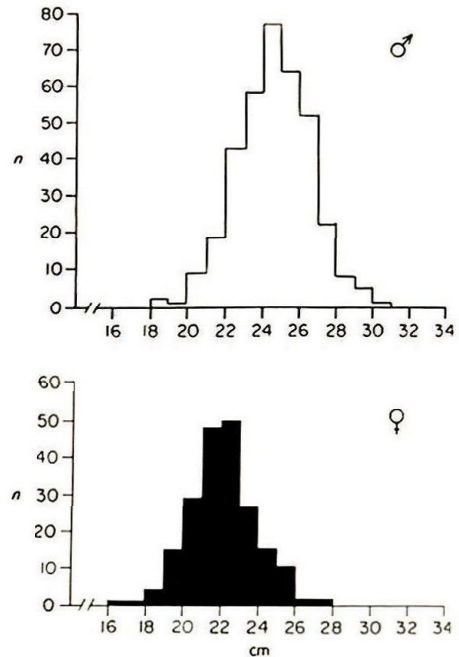


FIG. 4. Distribution of mid-upper arm muscle circumference

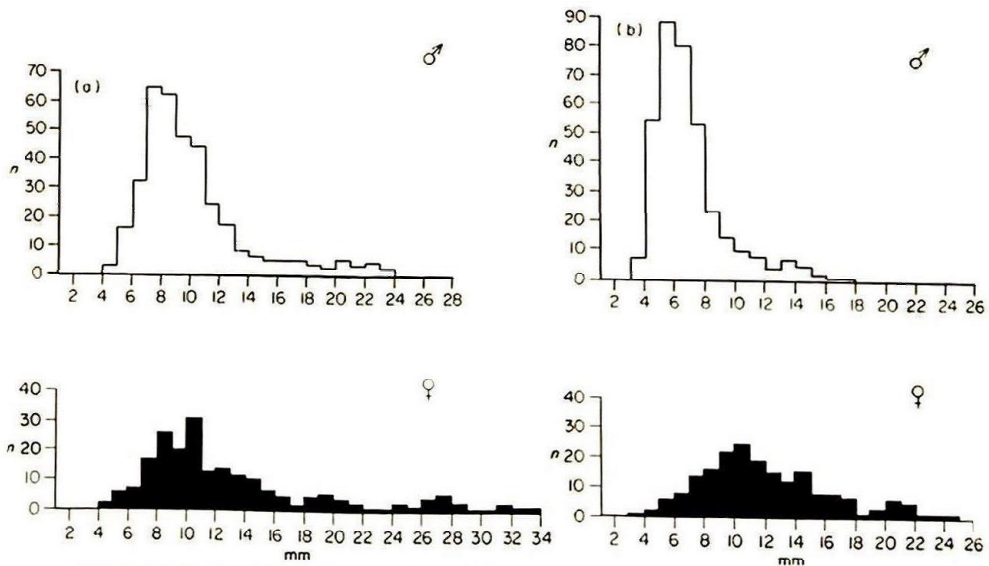


FIG. 5. Distribution of skinfold measurements. Note skewing to the left. (a) Subscapular; (b) triceps.

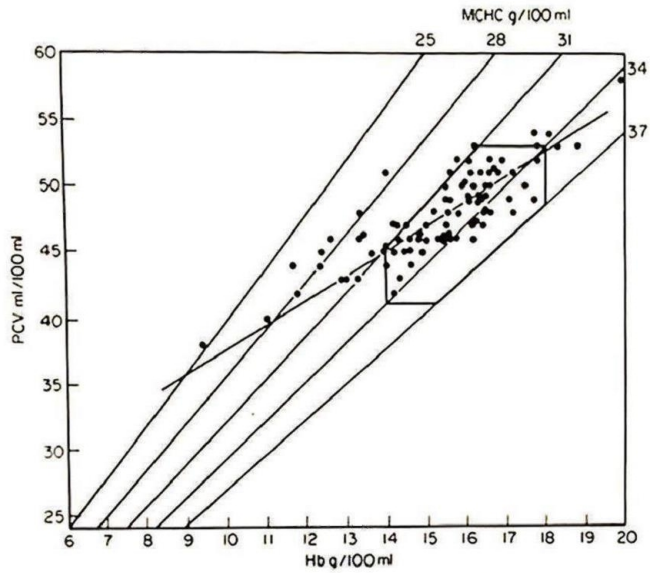


FIG. 6. An evaluation of the haematologic findings in men. $n = 92$; $y = 19.9 + 1.853x$; $r = 0.87$.

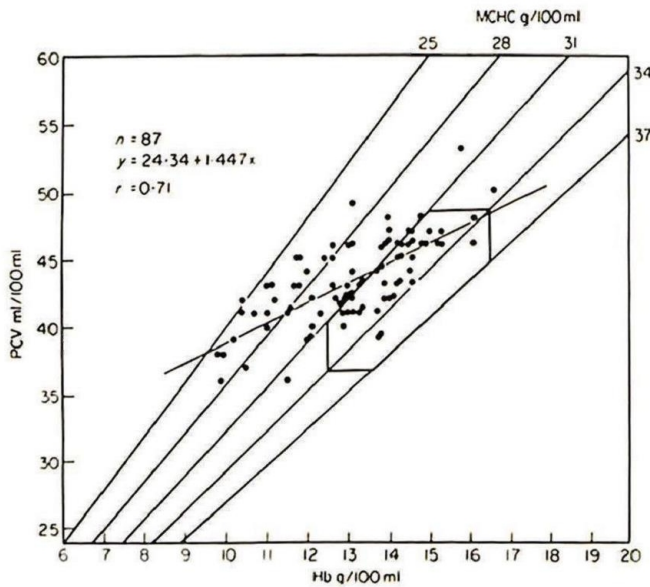


FIG. 7. An evaluation of the haematologic findings in women. $n = 87$; $y = 24.34 + 1.447x$; $r = 0.71$

methanol and the strips dried between blotters under pressure. Scanning for the fractions was done by an Elphor Integrator (Bender & Hobein).

Results

Clinical findings

The results of the clinical examination are shown in Table 1. The incidence of goitre is found to be higher in women than in men. In a larger survey conducted in this area previously (Kambal, 1968), the incidence of grade II and III goitre was 12.3% in males and 31.7% in females of a similar age group.

The liver was enlarged in about 10% of the population examined. Only 5% of males and 2.5% of females showed an enlarged spleen.

Anthropometric findings

The means, standard deviations and standard errors of the means for the anthropometric measurements are shown in Table 2.

The percentage of average body weight for height was calculated using the standards supplied by Jelliffe (1966) as adapted from the Society of Actuaries and modified for average frame size and nude measurements. The distribution of heights and weights and of the body weight rating are shown in Figs. 2 and 3 respectively.

The mid-upper arm circumference measurements are reported together with the calculated muscle circumference of the mid-upper arm. The muscle circumference was calculated using the formula of Jelliffe & Jelliffe (1960). Fig. 4 shows the distribution of the mid-upper arm muscle circumference.

Fig. 5 shows the distribution of skinfold thickness.

Haematologic and serum protein findings

A complete haematologic examination: Hb., P.C.V., MCHC and serum proteins were performed on a sample consisting of ninety-two men and eighty-seven women. Table 2 shows the mean, standard deviation and standard error of the mean for these

TABLE 1. Incidence of clinically detectable pathology

Sex	Avitaminoses		Enlarged liver		Enlarged spleen		Enlarged thyroid grade II & III	
	no.	%	no.	%	no.	%	no.	%
Male	2	1.11	34	9.47	18	5.01	31	8.64
Female	4	1.98	21	10.40	5	2.48	68	33.66

TABLE 2. Results of anthropometric and haematological study

	Men			Women		
	\bar{x}	s.d.	s. \bar{x}	\bar{x}	s.d.	s. \bar{x}
Height (cm)	167.9	6.67	0.33	159.2	5.78	0.41
Weight (kg)	57.59	7.64	0.40	51.77	7.01	0.49
% av. body weight	87.71	9.83	0.52	92.27	10.82	0.76
Upper arm circumference (cm)	26.9	2.64	0.20	25.9	2.23	0.16
Upper arm muscle circumference (cm)	24.7	1.97	0.10	22.0	1.77	0.12
Triceps skinfold (mm)	7.0	2.95	0.16	12.3	4.94	0.35
Subscapular skinfold (mm)	10.1	4.16	0.22	12.2	5.46	0.38
Hb (g/100 ml)	15.3	1.89	0.17	12.3	1.57	0.16
P.C.V. %	47.6	4.10	0.16	43.3	3.15	0.34
MCHC	32.1	2.22	0.23	30.3	2.56	0.27
Serum protein (g/100 ml)	7.77	1.11	0.10	7.76	1.05	0.11
Albumin (g/100 ml)	3.43	0.72	0.07	3.39	0.69	0.07
Globulin (g/100 ml)	4.34	0.77	0.07	4.37	0.78	0.08

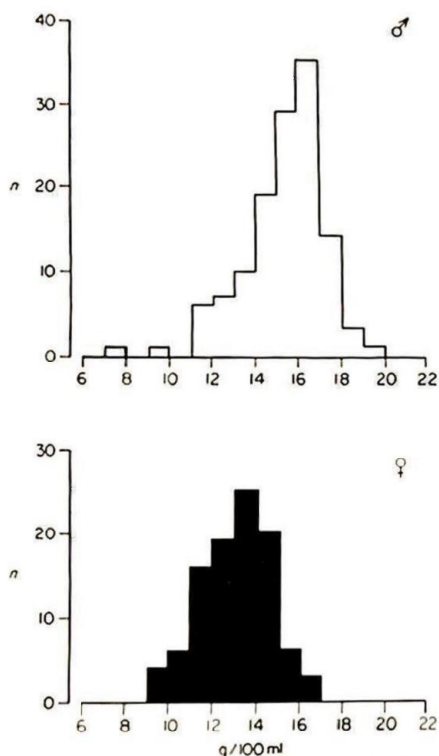


FIG. 8. Distribution of haemoglobin concentrations.

parameters. Only people belonging to the Fur tribe were included in this study.

Figs. 6 and 7 give a comprehensive presentation of all the haematological findings, *viz* Hb concentration, P.C.V. and MCHC for males and females respectively. The range of normal values is given by the hexagonal fields. Figs. 8, 9 and 10 show the distribution curves for Hb, MCHC and P.C.V. respectively.

Discussion

The anthropometric survey

The body weight for height results in the Fur adult indicate a high incidence of underweight (less than 90% of average body weight, using caucasian standards, Jelliffe, 1966). More than half the men's sample showed weights less than 90% of the average body weight for their height and about 40% of the women were also underweight. There are no local standards for stature and body weights in the Sudan.

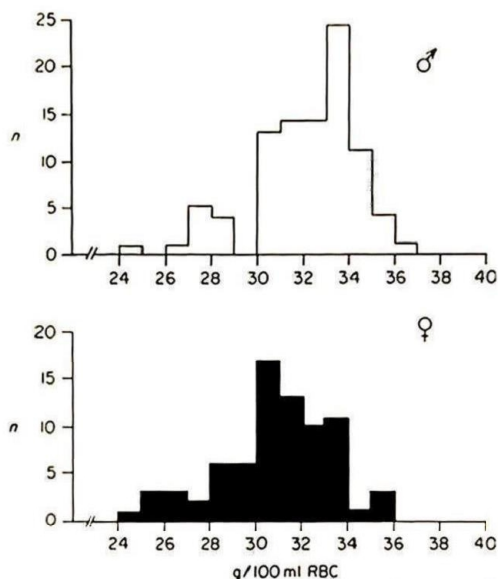


FIG. 9. Distribution of mean corpuscular haemoglobin concentrations.

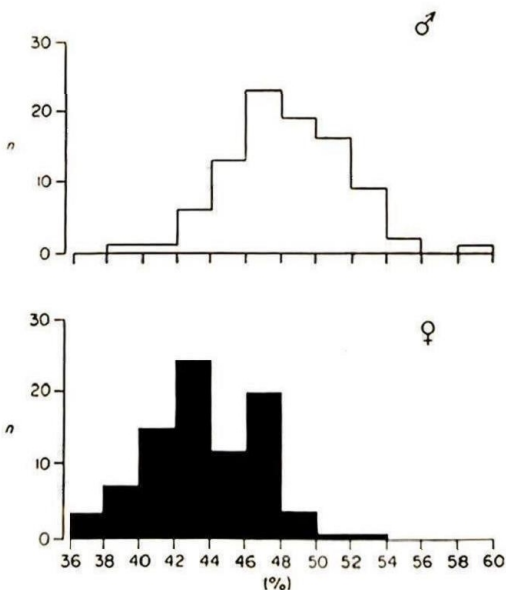


FIG. 10. Distribution of packed cell values.

Culwick (1951) reported adult heights and weights in the Gezira irrigated scheme of the Blue Nile Province in the Sudan. The population of this region come mainly from western Sudan and other western

neighbouring countries. The data show that the men had comparable heights ($\bar{x} = 168$ cm) with the Fur sample but their weights were less (range 54.8–57.4 kg). The women were smaller both in stature and weight ($\bar{x} = 156$ cm, range for weight: 45.5–47.5 kg). The stature of the Fur people is found to be shorter than that of the Nilotic tribes of the Sudan (Roberts, 1960).

Comparison was sought with tribes in neighbouring countries with similar ecology. It has been demonstrated several times that African children show lower weight for height, when compared to Europeans (Roberts, 1960; Hiernaux, 1964; and Sukkar *et al.*, 1971). Different ethnic groups show characteristic tendencies in their mature adult stature. In the present study it is observed that the Fur tribe, unlike the Nilotics, attain shorter adult stature. Data from Rwanda on the Tutsi and Hutu tribes (Hiernaux, 1964) show that the Tutsi men are taller (\bar{x} height 176.52 cm \pm 7.29 s.d.) but not heavier than the Fur (\bar{x} weight 57.42 kg \pm 6.81 s.d.). The Hutu men, however, show comparable heights and weights to the Fur men (167.08 cm \pm 6.79, 57.51 kg \pm 6.36). No data on women were reported in this communication. Hiernaux (1972) reported on the stature and other anthropometric parameters of adult males in the Republic of Chad. Heights of 173.69 cm and 176.15 cm were found in rural and urban men respectively. No weight record has been reported. This communication reports that the urban men had more fat and less muscle than their rural counterparts.

Comparison of mid-upper arm circumference with the above sample from the Republic of Chad shows that the mean for Fur males (26.9 mm \pm 2.64 s.d.) is comparable to that of urban dwellers (27.15 \pm 1.73) and less than that of rural dwellers (28.32 \pm 1.87). According to standards based on results of anthropometric surveys in the United States and some Mediterranean countries (Jelliffe, 1966), both the Sudan and the Chad samples are found to be low. This standard gives values of 29.3 for men and 28.5 for women. The men's value for the Fur sample is graded as 90% of the standard and that for the women falls just below 90%. The calculated upper arm muscle circumference, however (Table 2), shows that the Fur men are much closer to the standard (25.3 mm) and higher than the 90% figure (22.8 mm). This observation is also true for the women. This can be explained by the fact that the present sample had less subcutaneous fat than that of the standards.

The skinfold thickness results (Table 2) show mean values for below the standards given by Jelliffe (1966), (12.5 mm for men and 16.5 mm for women). The Fur men are less than 60% of this standard and the women are about 75%. This finding confirms the above observation on middle upper arm muscle circumference.

The above findings of low body weight for height, low body fat and low muscle mass are in agreement with previous findings in tropical regions (Roberts, 1953; Newman & Munro, 1955). It is well known that man living under hot desert conditions shows morphological changes which reduce his susceptibility to heat. The factors at work in this situation are environmental influences, genetic adaptation and probably selective migration (Baker, 1958). The muscle mass, which is a good indicator of the adequacy of protein intake is comparable to European standards as stated above. The present study can therefore relate the anthropometric findings more to climatic and genetic factors than to nutritional deficiency. The interpretation of anthropometric data using European and American standards has to be done with caution.

The haematologic survey

It was thought originally that the well-known effect of altitude could influence the haematologic results. A detailed evaluation of the data collected at different altitudes did not show this possible effect because of the incidence of a comparatively high number of pathological findings. There is a high incidence of anaemia especially in females. Only the packed cell volume is normal. In the histograms of both haemoglobin (Fig. 8), and MCHC (Fig. 9), an accumulation of low values is seen. The slope of the regression line in Figs 6 and 7 indicates a haemoglobin deficit. Since red-cell counts were not done, it is not possible to describe the type of anaemia fully.

In the clinical findings a few cases of enlargement of the liver and spleen were found. These signs indicate an underlying infection, probably bilharzia or malaria. An attempt to correlate these findings with the incidence of anaemia has shown that these subjects were not different from the others. The high incidence of anaemia among the women is most probably due to iron deficiency.

Blood samples were taken at random during the survey. Therefore, a similar distribution of findings

can be expected in all persons who were examined anthropometrically. This distribution, however, does not represent the state of health of the Fur population, as the survey was not conducted on a carefully selected random sample of the population. Since the people volunteered for the examination, the proportion of subjects who turned up because they felt ill or because they were treated in the health centre before, was probably higher in this sample than in the whole population.

Total serum proteins show a tendency towards high values. Thus 25.0% of the men and 24.4% of the women showed values higher than 8.5 g/100 ml. Serum protein fractions (Table 3) were compared to normal standards. The albumin fraction was low in 16% of the men and 13% of the women. A wide distribution of α -globulins was observed with skewing towards the low side. The β -globulins were high. Thus 75% of the men and 79% of the women showed values above 1.1 g/100 ml. This observation is also true of the γ -globulins (79% of the men and 83% of the women showed values above 1.5 g/100 ml).

TABLE 3. Distribution of plasma protein fractions compared to normal standards*

	Sex	Low	Normal	High
Albumin	M	18	87	7
	F	11	72	3
α -globulins	M	24	73	15
	F	16	56	14
β -globulins	M	0	28	84
	F	0	18	68
γ -globulins	M	0	23	89
	F	0	15	71

* Normal ranges (Putnam, 1960) Albumin 2.8-4.5 g/100 ml, α -globulins 0.7-1.5 g/100 ml, β -globulins 0.6-1.1 g/100 ml, γ -globulins 0.7-1.5 g/100 ml.

No explanation can be offered for the high γ -globulin fraction in this population. The γ -globulins, however, are expected to be high. This region is endemic for malaria and there are pockets infested with bilharzia. Other parasitic infestations and infectious diseases also occur. The prevalence of malaria has been reported to correlate with high serum immunoglobulins in Tanzania (Voller, Lelijveld & Matola, 1971). Also serum immunoglobulins have been found to be raised in patients with

schistosomiasis (Bassily *et al.*, 1972) and schistosomal liver fibrosis (Ghanem *et al.*, 1973).

The data available from various African countries on nutritional status of the population is rather limited. The cross-sectional survey provides a simple tool for the accumulation of such information. As development plans are underway in most African countries, baseline data on nutritional status will be required for future assessment of development.

Acknowledgments

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