Food intake and energy expenditure of male and female farmers from Upper-Volta

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1. The energy balance of eleven male and fourteen female adult farmers was measured for 6 d after the harvest, in December–January. Their energy intake was recorded by weighing their food consumption and their energy expenditure was determined using indirect calorimetry.

2. Body-weight, expressed as percentage of expected weight-for-height was 91 and 86% of the Inter-departmental Committee on Nutrition for National Development (1963) standard for women and men respectively.

3. The staple foods were sorghum (*Sorghum vulgare*) and millet (*Pennisetum typhoïdes*); carbohydrates, fat and protein supplied approximately 80, 13 and 12% of the total energy of the diet respectively.

4. In the male group, the mean energy intake (9·0 MJ (2148 kcal)) was in good agreement with the average energy output (8·91 MJ (2130 kcal)). By contrast, in the female group, the mean energy expenditure (8·11 MJ (1941 kcal)) exceeded the mean energy intake (6·3 MJ (1515 kcal)) and the deficit was statistically significant.

5. This study allows an evaluation of the adequacy of food intake for subjects living in a particular hostile environment, by using their actual energy output instead of current standard values. The energy deficit found for female farmers whose energy intake was similar to that reported in other developing countries emphasizes the need for a better understanding of the regulation of energy balance in such conditions.

Several studies carried out in developing countries reported very low energy intakes especially in lactating and pregnant women (Maletnlema & Bavu, 1974; Norgan *et al.* 1974; Gebre-Medhin & Gobezie, 1975; Edmundson, 1977; Paul *et al.* 1979). The measured intakes often ranged from 60 to 70% of the FAO/WHO requirements (FAO/WHO, 1973). Energy needs can also be determined from the assessment of energy expenditure but few measurements of energy output have been made particularly in Africa. In some studies, it was found that food intake and energy expenditure were in close agreement (Edmundson, 1977; Schutz *et al.* 1980) whereas in other studies a negative balance was reported (Norgan *et al.* 1974).

In Upper-Volta, we found previously that some of the male farmers and most of the female farmers consumed less than 6·27 MJ (1500 kcal) daily (Bleiberg, 1979). However, these values were obtained by using theoretical coefficients from groups of subjects of the same sex, eating from a common dish. Indeed individual food consumption surveys are often difficult to carry out because of local habits. We also measured the daily expenditure of the same subjects and found for most of the farmers, an energy deficit which was much higher in the rainy season than in the dry season (Bleiberg, 1979). The aim of the present study was to verify, using individual food consumption measurements, that energy intakes, especially those of female farmers, were as low as those previously found in Upper-Volta. In the instance of a positive finding, it would be interesting to know if the subjects could still equilibrate their energy balance.

MATERIALS AND METHODS

Ecological setting

The study was carried out in Nam-Ymi, a village located 40 km south of Ouagadougou. It was performed in December–January and started at the end of the harvest. The mean daylight temperature was 31° and the mean barometric pressure was 733 mm Hg.

The main crops cultivated in the area and the disposition of the fields have already been described in a previous paper (Brun & Bleiberg, 1980).

The only agricultural activities that were recorded were the harvesting of sweet potatoes (*Impomea batatas*) and straw. A number of social activities usually take place during this period of the year, in particular weddings which provide an opportunity to increase the amount and the quality of normal food intake.

Market day was every 3 d in a village approximately 4·8 km from Nam-Ymi.

Subjects

Twenty-five Moslem farmers, eleven male and fourteen female adults, were involved in the study with their full consent. Most of them had already been investigated three times in the past. The subjects were all peasant farmers but were also engaged in trading, specially in the dry season.

None of the female subjects was pregnant and those who were lactating had been feeding their child for more than 6 months. This selection was made in order to avoid measurements from a very heterogeneous group of women.

METHODS

Energy intake and pattern of activity. Twelve families were studied for 6 d. The selected subjects were asked to eat from an individual calabash which did not change the habits of most of the family heads who habitually take their meals alone. Small groups of women usually share a common dish with their children.

A native investigator was responsible for recording the composition of the meals of three families by weighing to the nearest 5 g the ingredients used by the housewife and then, when applicable, the pot filled with cooked food. The pot filled with hot sorghum (*Sorghum vulgare*) or millet (*Pennisetum typhoïdes*) porridge was too heavy to be weighed hence a sample was taken in order to determine the dry weight, to estimate the total amount of cooked food.

Simultaneously, another investigator followed one subject from each of the families throughout the waking day and weighed accurately the amount of food consumed either at home or anywhere else (at the market, at a feast or in the bush). The time devoted to each activity was recorded simultaneously using a chronometer.

We decided to perform the measurements during a period of 6 d in order to take into account the usual frequency of market days. Six families were studied for six consecutive days; in the other six families the study was divided into two parts for practical reasons.

Frequent visits to the families were made in order to supervise the investigators. Every day the recording of activities and of food consumption was checked.

Energy expenditure. The energy cost of the main activities was measured using a Kofranyi-Michaelis respirometer to determine the volume of expired air and a Servomex analyser (OA 240) to measure its percentage of oxygen. The O_2 consumption was transformed to energy values using the Weir formula (De Weir, 1949). Total energy expenditure was derived from the sum of the amount of time spent in each activity multiplied by its energy cost. The metabolic rate for sleeping was computed according to Fleisch's tables (Fleisch, 1951).

The O_2 consumption was measured in the subjects involved in the survey as well as in other farmers living in the same village. Values which could not be measured were either estimated or taken from the literature; these estimations accounted for less than 20% of gross daily energy expenditure.

In order to calculate the energy expenditure for each subject, the mean of all O_2 consumption measurements for each activity was used instead of individual results; values obtained during previous investigations (Bleiberg, 1979; Bleiberg *et al.* 1980; Brun *et al.* 1980) have been included.

Gross energy expenditure was expressed for standard weights of 55 and 60 kg for women and men respectively in order to compare these results with the values obtained during previous surveys. Gross energy was then calculated for the average weight of the subjects.

Composition of foods. Samples of basic foodstuffs such as sorghum, millet, beans (*Vigna unguiculata*), peas (*Voandzeia subterranea*) and of the ready-cooked food purchased at the market (various kinds of doughnuts) were frozen and flown back to Paris to be analysed for their water, nitrogen, fat and ash content. Total N was determined using a micro-Kjeldahl procedure and fat measured by the Kumagawa technique modified by Sautier (1973). Samples of food were dried using a vacuum oven at 100° for 5 h to determine their moisture. Protein, fat and carbohydrate intakes were converted into energy values using the factors given by Merril & Watt (1955) for each type of foodstuff (FAO & Department of Health, Education and Welfare, 1970).

The composition of the other foodstuffs was derived from several tables (Périssé & Le Berre, 1957; McCance & Widdowson, 1960; Toury *et al.* 1967; FAO & Department of Health, Education and Welfare, 1970; FAO & Department of Health, Education and Welfare, 1976).

Statistical analysis. Results are given as mean values ± 1 SEM. Analyses were made using the distribution-free Mann and Whitney U test (Tables 2 and 3) and the paired Student's *t* test (Tables 5 and 6).

RESULTS

Physical characteristics

With a mean weight of 56·5 kg and a mean height of 1·69 m the male subjects (28–58 years) were 86% of the weight for height standard (Inter-departmental Committee on Nutrition for National Development 1963) whereas with a mean weight of 49·9 kg and a mean height of 1·58 m the female subjects (19–48 years) were 91% of the standard values (Table 1).

Food intake

Description of the diet. There was usually a hot meal in the evening, the remainder being consumed the next morning. The diet consisted basically of sorghum or millet porridge eaten with a spiced sauce prepared with green vegetables cultivated in the fields or collected in the bush (sorrel (***Hibiscus sabdariffa***), jute (***Corchorus*** spp), ladies-finger (***Hibiscus esculentus***)), with leguminous seeds such as fermented African locust bean (*Parkia* spp), peppers and miscellaneous products picked up by the female farmers (Bombax flower-cup (*Bombax angulicarpum*)). Sometimes dried fish or meat were added. A mixture of raw millet flour and water was often eaten at noon instead of a warm meal, especially in the rainy season. Grains of millet or sorghum were also cooked with beans (*Vigna unguiculata*) or green vegetables.

The peasants also consumed to a lesser extent beans (*Vigna unguiculata*) or peas (*Voandzeia subterranea*) prepared with butter made from the butterseed fruit (*Butyrospermum parkii*), a stewed mixture of beans and wild leaves, couscous, maize (*Zea mays*), and sweet potatoes. During the day they used to eat some peanuts.

When people attended a feast, they were mainly offered rice with sauce.

At the market, the farmers bought doughnuts made of sorghum, millet, beans or wheat, sorghum or millet girdle-cakes, bread, grilled meat and some cooked dishes.

Energy and nutrient intakes. The mean energy intake was 9·0 MJ (2148 kcal) and 6·3 MJ (1515 kcal) in the male and female groups respectively. This difference was statistically significant ($P < 0.01$) (Table 2).

Table 1. *Physical characteristics of male and female farmers from Upper-Volta*

(Mean values with their standard errors)

Subjects	No. of subjects	Age (years)		Height (m)		Wt (kg)	
		Mean	SE	Mean	SE	Mean	SE
Men	11	45·0	3·32	1·69	0·020	56·5	1·75
Women	14	30·6	2·63	1·58	0·012	49·9	0·92

Table 2. *Mean energy and nutrient intakes measured for 6 d in male and female farmers from Upper-Volta*

(Mean values with their standard errors)

Subjects	No. of subjects	Energy				Protein				Carbohydrates		Fat	
		MJ		kcal		Animal origin		Vegetable origin					
		Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Men	11	9·0**	0·77	2148**	184·7	10·3***	2·52	57·5	6·71	413·9*	35·23	34·9*	3·72
Women	14	6·2	0·35	1515	82·6	0·8	0·29	44·8	2·90	302·5	16·17	22·0	1·79

* $P < 0·05$, ** $P < 0·01$, *** $P < 0·001$.

A comparison of food intake in the two groups showed that the amount of protein of animal origin, fat and carbohydrates were significantly higher for the male than for the female subjects.

Total protein supplied approximately 12% of the energy intake. The percentage of the total protein which was accounted for by animal protein was 15·7 for men and 1·9 for women. This significant difference ($P < 0·001$) resulted mainly from the fact that men were privileged in the division of meat inside the family and that they profited by feast meals.

As expected, since the staple food was sorghum or millet, carbohydrates contributed approximately 80% of the total energy of the diet whereas fat supplied on average 13% of the energy intake.

Pattern of activities

The male and the female farmers dedicated an important part of the day to resting activities: 69·2 and 67·8% of their time respectively. This difference was not statistically significant (Table 3).

Women spent 13 min/d tending children. In fact, this task was underestimated as it only included feeding, washing or dressing. Nursing time was reported as: lying, sitting or standing, as it required little or no motion.

Female farmers spent 221 min/d in housework while this type of activity took only 15 min for male farmers.

As reported previously (Bleiberg *et al.* 1980), men spent more time than women at the market (118 min *v.* 66 min); the difference was not significant: $P = 0·06$ and more time in social activities (92 min *v.* 23 min; $P < 0·001$), because only male farmers attended most of the feasts.

Table 3. *Mean duration (min) of daily activities of male and female farmers from Upper-Volta*

	Mean duration		
Activities*	Men	Statistical significance of difference between means	Women
Resting activities	997	NS	977
Sleeping	617	—	639
Lying	39	—	18
Sitting	280	—	239
Standing	61	—	81
Walking	34	NS	35
Personal activities	37	NS	17
Tending children	—	—	13
Social activities	92	$P < 0.001$	23
Housework	15	$P < 0.001$	221
Handicraft for house needs	29	NS	35
Trading at home (including handicraft)	47	NS	53
Market	118	NS	66
Walking to and from	6	—	18
Cycling to and from	9	—	—
Selling products	51	—	12
Miscellaneous activities	52	—	36
Agricultural activities	39	—	—
Walking to and from the fields	8	—	—
Cycling to and from	1	—	—
Driving a donkey cart to and from	2	—	—
Agricultural activities	28	—	—
Breeding	13	—	—
Religious activities	19	—	—

NS, not significant.

* The periods of rest were not included in the different activities except in social activities and at the market but were indicated as lying, sitting or standing; personal activities consisted of washing, dressing and praying; social activities including visiting friends, getting to feasts; housework including cooking meals, collecting wood and foodstuffs in the bush, fetching water from the well, housekeeping and washing clothes; handicrafts for household needs included repairing tools, roofs, walls, building granaries and huts, cleaning or sewing calabashes, sewing clothes by hand or knitting; miscellaneous activities consisted of chattering, walking, eating, purchasing products; religious activities included teaching the Koran, solemnizing a marriage.

Men and women spent the same amount of time doing handicrafts (approximately 30 min).

Men and women participated in trading; products for sale were made at home and sold there or at the market. For men the following activities were recorded: weaving, sewing, cleaning calabashes, making dippers and shoes from old tyres, plaiting straw for making into ropes, selling petrol, sugar and crops. Women cooked doughnuts or hot meals (including rice with sauce, sorghum or beans mixed with leaves). They also husked paddy rice. Male and female farmers spent 47 and 53 min respectively at home in these activities. At the market, male subjects spent 51 min selling their products whereas female subjects spent only 12 min in trading; the difference was not statistically significant on this small sample.

Agricultural activities did not fill an important amount of time (39 min for men) as in December the harvest was almost entirely completed. None of the female subjects was involved in those tasks.

Table 4. *Mean daily energy expenditure expressed for a standard weight of 60 kg for male farmers and 55 kg for female farmers from Upper-Volta*

(Mean values with their standard errors)

		Energy expenditure			
		MJ		kcal	
Subjects	No. of subjects	Mean	SE	Mean	SE
Men	11	9·5	0·28	2261	67·4
Women	14	9·0	0·21	2144	49·1

Table 5. *Individual energy intake and output† of male farmers from Upper-Volta*

(Mean values with their standard errors)

	Energy intake				Statistical significance of difference between means	Energy output			
	MJ		kcal			MJ		kcal	
Subject no.	Mean	SE	Mean	SE		Mean	SE	Mean	SE
1	10·1	1·51	2408	360	NS	9·75	0·11	2334	25·6
2	9·0	1·12	2163	267	NS	9·42	0·19	2255	46·1
3	11·6	2·03	2766	486	NS	8·98	0·44	2148	104·3
4	4·8	1·16	1155	278	NS	7·77	0·09	1860	22·1
5	11·6	1·65	2787	394	NS	11·82	0·45	2827	107·2
6	9·7	2·00	2321	478	NS	9·10	0·16	2178	38·9
7	8·9	1·00	2128	240	NS	7·70	0·16	1841	38·8
8	9·0	1·08	2158	257	NS	9·74	0·15	2329	35·5
9	5·4	0·52	1282	124	NS	7·21	0·28	1724	67·5
10	12·4	1·47	2975	352	$P < 0·05$	8·06	0·21	1929	50·5
11	6·2	0·80	1481	191	NS	8·37	0·29	2002	68·8
Mean	9·0	0·77	2148	185	NS	8·91	0·39	2130	93·6

NS, not significant. † Measurements carried out for 6 d.

Daily energy expenditure

The mean ± SE daily energy expenditure expressed for a standard weight of 60 and 55 kg for male and female farmers respectively was 9·5 ± 0·28 MJ (2261 ± 67·4 kcal) for men and 9·0 ± 0·21 MJ (2144 ± 49·1 kcal) for women.

According to the classification given by FAO/WHO (1973), the male subjects fell far below the category light activity which corresponds to an energy output of 10·5 MJ (2520 kcal). The female farmers were classified between categories of light and moderate activity for which 8·4 MJ (2000 kcal) and 9·2 MJ (2200 kcal) respectively are the values set up by the FAO/WHO (1973) committee for these two levels of activity.

Energy balance

Male farmers. The values for energy intake ranged from 4·8 to 12·4 MJ (1155–2975 kcal) (Table 5). Variations between individuals were important as were day-to-day variations. By contrast, measurements of energy expenditure were associated with a low standard error of the mean for each subject, although the results of energy output varied widely between subjects (range of variation: 7·2–11·8 MJ (1724–2827 kcal)).

Table 6. *Individual energy intake and output† of female farmers from Upper-Volta*

(Mean values with their standard errors)

Subject no.	Energy intake				Statistical significance of difference between means	Energy output			
	MJ		kcal			MJ		kcal	
	Mean	SE	Mean	SE		Mean	SE	Mean	SE
1	4·5	0·78	1066	186	$P < 0·005$	9·11	0·11	2180	25·6
2	5·6	0·50	1341	119	$P < 0·001$	8·72	0·25	2086	59·6
3	7·7	1·39	1832	333	NS	9·87	0·43	2361	102·8
4	5·7	2·45	1361	587	NS	6·94	0·13	1660	30·3
5	6·1	2·03	1471	486	NS	7·41	0·14	1772	32·5
6	6·6	0·61	1577	146	NS	8·38	0·21	2004	49·5
7	8·9	1·63	2134	390	NS	7·32	0·22	1751	52·1
8	4·9	0·94	1184	224	$P < 0·05$	8·35	0·17	1998	41·6
9	4·6	0·73	1097	174	$P < 0·01$	8·18	0·26	1957	61·8
10	7·0	0·83	1669	199	NS	7·73	0·19	1850	44·9
11	7·2	1·63	1721	390	NS	8·29	0·21	1984	50·3
12	6·9	0·83	1642	199	NS	7·58	0·39	1813	92·9
13	5·4	0·72	1302	173	$P < 0·05$	8·00	0·18	1913	43·0
14	7·5	0·66	1806	159	NS	7·69	0·14	1839	32·4
Mean	6·3	0·35	1515	83	$P < 0·005$	8·11	0·21	1941	49·4

NS, not significant.

† Measurements carried out for 6 d except for the subjects numbers 4 and 6 who had been investigated for 3 d.

For most subjects and for the whole group energy intake was in good agreement with energy expenditure. Subjects nos. 4–9 and 11 had intakes below 6·3 MJ (1500 kcal); however, these deficits were not significant.

Moreover, the situation of three of these farmers was unusual since subject no. 4 complained of a very bad harvest, and subjects nos. 9 and 11 were suffering from bronchitis and from headaches respectively. Subject no. 11 was the chief of the village and we had previously recorded high energy intakes for him even in the rainy season. Hence, it is likely that the relatively low energy intakes were temporary at least for subjects nos. 9 and 11. When expressed for a standard weight of 60 kg, their outputs were the lowest of the whole group.

When excluding subject no. 10, there was a significant positive correlation (r 0·75, $P < 0·05$) between energy intake and output.

Female farmers. The mean energy intake was 6·3 MJ (1515 kcal) with values ranging from 4·5 to 8·9 MJ (1066 to 2314 kcal) (Table 6). As noted for the male subjects, the daily variation in the average intake seemed very high as compared to the mean output. The mean energy expenditure was 8·1 MJ (1941 kcal); the values rose from 6·9 to 9·9 MJ (1660 to 2361 kcal) indicating a rather similar level of activity among the female farmers.

When the whole group was considered, there was a significant negative mean energy deficit ($P < 0·005$) since for seven women the difference between intake and expenditure exceeded 1·67 MJ (400 kcal). The energy output was systematically higher than the food intake in all but one of the women (subject no. 14).

There was no significant correlation (r −0·18) between energy intake and expenditure.

DISCUSSION

The finding that the standard error of the mean for energy expenditure was much lower than that for average energy intake, both for individuals and for the groups, might be explained in two ways. First, the pattern of activities was monotonous after the harvest as no heavy and urgent work was required from the farmers. Secondly, the methods of measurement were different since food consumption was assessed individually whereas output was calculated from mean values of energy expenditure. As Edmundson (1977) mentions, this procedure might partially explain that energy balance is in equilibrium only when mean results are examined instead of individual values.

Unfortunately, in a short field study, it is very difficult to measure for each individual the O_2 consumption of his or her main activities, especially if the experiments are repeated several times for the same task. Most subjects would not wear the respirometer more than a few times, particularly the women. This behaviour led to the use of mean values for the energy cost of various activities and for the estimation of the metabolic rate of secondary tasks which did not take up much time or energy or both. However, the use of mean values was considered to be as accurate as individual values obtained from a single measurement for a given activity. Indeed, Durnin & Namyslowski (1958) emphasized the importance of individual variations for a task repeated several times daily by the same subject. Recently, Acheson *et al.* (1980), assessed the energy output of a group of men for periods varying between 6 and 12 months. In order to calculate the daily energy expenditure, they used two types of values: (1) individual measurements of O_2 consumption and (2) values taken from the literature. A comparison of the two methods showed no statistical difference although the daily output was slightly lower in the second instance (by less than 10%). Hence, as the mean energy cost of the activities used in the present study were mainly derived from measurements carried out in the investigated population, the error was assumed not to be important.

As energy balance can be equilibrated over 5–7 d for a group of ten or more subjects (Edholm *et al.* 1970), we tried to determine whether the fact that the investigation had been carried out for six consecutive days or had been divided into two parts had influenced the results. We found no evidence of such an effect in the male and female groups.

Several authors (Edholm *et al.* 1970; Acheson *et al.* 1980) have mentioned that the methods of assessing energy expenditure were much more accurate when applied to groups than to individuals; in the present study, this finding applied to results for male farmers.

Despite the inaccuracies of the measurements of energy output (Durnin & Brockway, 1959) and to a lesser extent of food consumption, we could say that in our sample most of the men equilibrated their energy balance. However, their very light level of activity might be a means of adaptation to low intakes.

By contrast, in the female group, subject no. 14 showed well balanced energy intake and expenditure whereas the remaining thirteen women showed an energy deficit which exceeded 1·67 MJ (400 kcal) for seven of them. This discrepancy concerning the whole group suggested incomplete measurements of food consumption or an over-estimation of energy expenditure.

When analysing the possible sources of underestimation of energy intake concerning specifically women, the following were considered: (1) the changes involved in food habits when asking the women to eat individually; (2) the incomplete recording of food consumption; (3) a refusal to cooperate and a tendency to eat secretly. This could be explained by the fact that women are responsible for food division inside the family and might be embarrassed to show the amount of food eaten by them.

We have no means of evaluating the influence of individual consumption on the level of energy intake. We can only argue that the female farmers participated freely in the survey and that most of them had already been involved in previous studies. They were therefore aware of the purpose of the investigation, which meant in particular that they did not expect material assistance such as the supplying of cereals.

As an observer was following each subject throughout the day, it is unlikely that the recording of any food consumption, including snack food might have been omitted. The only possibility is that the female farmers ate after the investigator left the house late in the evening when people were in bed. In that situation, they would have taken food from the other family members' dishes since their own calabash was weighed after dinner and again early in the morning before breakfast.

It was observed that for a standard weight of 60 kg, women expended as much energy when resting as men (Bleiberg, 1979). Very high heart rate values were recorded in the female group; presumably this extra expenditure of energy resulted from apprehension and nervousness during the experiments. However, it is unlikely that this phenomenon explains completely the discrepancy between intake and output. There were no other methodological difficulties concerning women.

Examination of published values for food consumption of women in developing countries, indicated that results of individual consumption surveys are very similar to those reported in the present study. In New Guinea, Norgan *et al.* (1974) found intakes of 5·85 MJ (1400 kcal) in lactating and pregnant women; in Tanzania, Maletnlema & Bavu (1974) reported values of 7·72 MJ (1850 kcal) in pregnant women. Gebre-Medhin & Gobezie (1975) reported intakes of 6·44 MJ (1540 kcal) in low-income Ethiopians during pregnancy. In Gambia, Paul *et al.* (1979) measured intake levels ranging from 5·54 to 6·91 MJ (1325–1652 kcal) and from 4·85 to 8·81 MJ (1184–2107 kcal) during 1 year in pregnant and lactating women respectively. Finally, in Guatemala, Schutz *et al.* (1980) found values ranging from 5·35 to 10·37 MJ (1280–2840 kcal) and from 6·27 to 10·85 MJ (1501–2596 kcal) for lactating and non-lactating women respectively.

The question that could be raised is whether women can meet their energy needs by daily food intakes averaging 6·27 MJ (1500 kcal). Among the few studies in which energy intake and expenditure were assessed on individuals belonging to low-income groups, Norgan *et al.* (1974) reported a mean daily energy deficit of 1·70 MJ (406 kcal) for a period of 9–10 months.

Ashworth (1968) fed ten subjects (five males and five females) for 1 week with their usual diet recorded previously in their homes. The basal metabolic rate, the energy expenditure while sitting, step-testing, brick-carrying, body-weight and N balance were assessed. Seven subjects received less than 7·11 MJ (1700 kcal) and among them two subjects lost more than 1 kg, three others lost more than 0·5 kg; this finding suggests that intakes might have been underestimated. Surprisingly, two women could sustain intakes of 5·15 and 4·95 MJ (1232 and 1185 kcal) respectively without significant weight change. However, Ashworth's (1968) subjects could not be compared to women from Upper-Volta: the first woman in Ashworth's (1968) study had the lowest basal metabolic rate of all the subjects (26 kcal/m^2 per h) and the lowest energy expenditure while sitting, step-testing and brick carrying. The second woman was greatly underweight and lethargic. Ashworth (1968) concluded that surveys reporting very low intakes must be suspected of underestimation and that it is possible that in Jamaica people live and work on energy intakes which represent only approximately 60–70% of the FAO requirements.

These conflicting results provide arguments in favour of a negative balance as well as in favour of the inadequacy of the methods of assessing food intake and energy expenditure.

The women in our sample were on average slightly thinner than the subjects investigated by Norgan *et al.* (1974). However, except for their relatively low body-weight, the women performed a number of everyday tasks, some of them being energy-consuming; moreover, comparison of the energy cost of homework or daily activities (Bleiberg *et al.* 1980) with the values published by Schutz *et al.* (1980) suggests that in Upper-Volta the metabolic rate of walking and grinding corn is twice as high as that recorded for the women from Guatemala. Hence no significant effect of low intakes on the reduction of the output of everyday activities could be demonstrated.

The results of energy expenditure were slightly lower than those found in March–April and much lower than the values recorded in the rainy season (Bleiberg, 1979; Bleiberg *et al.* 1980; Brun *et al.* 1980); by contrast the pattern of food consumption did not seem to show a marked annual variation. Despite the relative availability of food after the harvest, energy intake was much lower than expected, especially in the female group.

Although time consuming, the assessment of output of the male group gave satisfactory results as energy intake and expenditure were balanced. Unfortunately, without any logical explanation, this conclusion was not applicable to women.

The present study confirms previous results showing that in Upper-Volta very low intake levels could be found particularly for women. This finding also corroborates several studies carried out with female subjects in other developing countries. Unfortunately, the difference between expenditure and intake cannot be explained on the basis of present knowledge and needs further investigation since it deals with a problem which concerns an important part of the active population in those countries.

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