CHANGES IN THE BODY-WEIGHTS AND SUBSCAPULAR SKINFOLD THICKNESSES OF MEMBERS OF AN ANTARCTIC EXPEDITION*

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Changes in the body-weights of members of polar expeditions who wintered in the polar regions have been reported by several workers.[1-4]

Wilson[1] found a seasonal variation in the body-weights of members of the Norwegian-British-Swedish Expedition (1949 - 1952) to Queen Maud Land. The weights rose to a maximum during the winter months and decreased during spring. The progressive decrease in body-weights during spring coincided with an increase in outdoor activity, and was apparent even before dog-sledging started. Wilson attributed the weight increase during the polar night to the sedentary indoor life and did not regard it as a function of cold-acclimatization.

A similar seasonal variation in body-weights was noted among the members of the British North Greenland Expedition, by Lewis *et al.*[2] These authors also maintained that the variations were inversely associated with the degree of activity, and were directly associated with an exaggerated positive calorie balance during periods of reduced activity in winter.

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The average individual increase in body-weight of a group of 13 men who were mainly engaged in sedentary occupations at the polar station Little America V, was 3·8 kg. compared with a body-weight increase of 0·86 kg. in 13 normally active men out of doors.[4] The estimated food intake of the latter group was twice as great as that of the indoor group. It appeared that, outdoors, the metabolic rate was increased not only by activity, but also by the exposure to extremely low temperatures.

Studies on calorie balances were carried out by Milan and Rodahl[3] on 9 scientists and 4 Navy personnel during the International Geophysical Year in 1957 at Little America V in the Antarctic. The scientists were studied in March, June and September, and the Navy personnel were studied in September only. It was found that the calorie intakes were on the whole in excess of actual calorie requirements under Antarctic conditions. On this regimen all the subjects gained weight during their Antarctic stay. These two workers thought that the increased appetites may have been caused by psychological factors.

Further, Lewis *et al.*[2] found that the increase in weight of men living in polar regions was associated with an increase in the thickness of the subcutaneous fat. They found a close positive correlation between body-weights (adjusted to standard heights) and skinfold thicknesses, measured at each of 6 body sites. The increases in these parameters were due not only to excess calorie intake but also to diminished activity.

Indications of a positive relationship between subscapular skinfold thicknesses and body-weights have also been found by one of us (v.d.M.).

The above findings were reinvestigated by studies on the body-weights and skinfold thicknesses of members of the 8th South African National Antarctic Expedition (1967 - 1968) to Queen Maud Land.

MATERIALS AND METHODS

The 1967 - 1968 South African National Antarctic Expedition arrived at the SANAE base towards the end of January 1967, and departed in mid-February 1968. Body-weights and skinfold thicknesses of 12 members of the expedition were measured regularly at monthly intervals.

Control measurements could not be obtained before the departure of the team for the Antarctic, nor after its return, owing to the fact that the members of the team worked in different parts of the country, often widely separated.

The men were weighed naked once every month at 0800 hours, after they had urinated. The same balance (Sensitive, type 184, made by C. W. Brecknell Ltd, England) was used throughout the year, and body-weights were determined to within 0·05 kg.

The subscapular skinfolds were measured on or within 3 days of weighing, dependent on the activities of the member. A pair of Harpenden skinfold calipers with a jaw pressure of 10 G/sq.mm. was used.

Skinfold thickness was measured immediately below the tip of the inferior angle of the scapula in a diagonal plane at an angle of 45° while the subject stood with his hands on his hips, and with his shoulders relaxed.

Several readings were taken on both the left and right sides on each occasion. The average of three readings which corresponded to within ± 0·1 mm. was noted for consideration.

RESULTS

The results of the measurements are shown in Table I and the mean values of the body-weights and the skinfold thicknesses are plotted in Figs. 1 and 2.

A general increase in body-weight was apparent during the first 6 months at the Antarctic base. The maximum mean weight was attained in July when the mean increase in body-weight was 3·4 kg. For the remainder of the year body-weights remained approximately at the July level, except in October when they decreased by 1·0 kg. During

TABLE I. MEAN MONTHLY BODY-WEIGHTS AND RIGHT AND LEFT SUBSCAPULAR SKINFOLD THICKNESSES (WITH STANDARD DEVIATIONS) OF MEN DURING 11 MONTHS STAY AT SANAE BASE

	Body-weight (kg.)		*Subscapular skinfold measurements (mm.)*			
Month	*Monthly mean*	*SD*	*R monthly mean*	*SD*	*L monthly mean*	*SD*
Feb.	74·4	7·13	11·6	2·64	11·8	3·37
Mar.	75·0	7·61	11·1	2·74	11·4	3·23
Apr.	76·5	7·29	10·9	2·48	11·0	2·43
May	76·6	7·21	11·1	1·95	11·6	2·97
Jun.	77·7	6·89	12·0	2·39	11·9	2·42
Jul.	77·8	7·31	11·5	1·71	11·9	2·43
Aug.	77·7	7·69	11·7	2·23	12·2	2·18
Sept.	77·6	7·67	12·1	2·29	12·8	2·74
Oct.	76·8	9·21	11·6	1·92	12·5	3·09
Nov.	77·7	9·19	12·0	2·26	12·4	2·23
Dec.	77·4	8·46	12·4	1·75	13·1	2·52

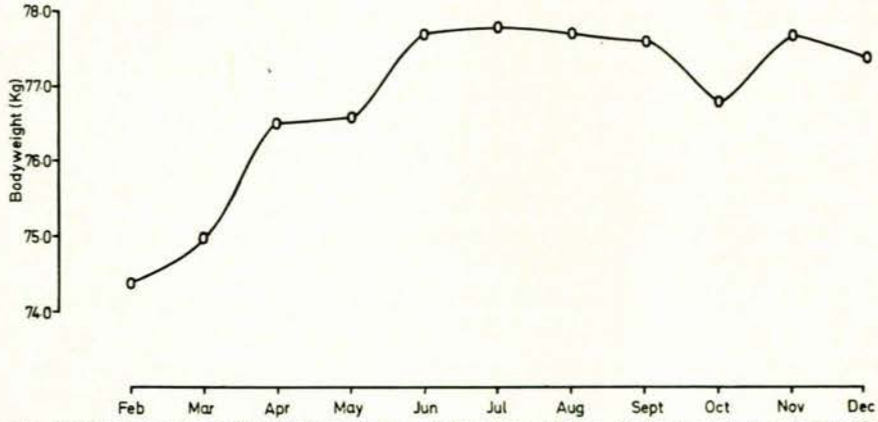

Fig. 1. The mean monthly body-weights of the men during their stay at the Antarctic base.

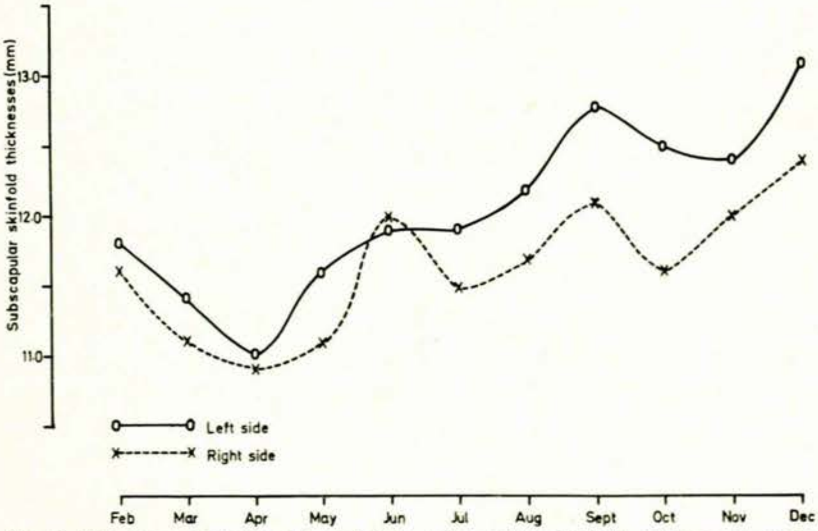

Fig. 2. The mean monthly left and right subscapular skinfold thicknesses of the men during their stay at the Antarctic base.

the full year's stay in Antarctica the average net gain in weight was 3·0 kg.

During the first 3 months at the base the subscapular skinfolds decreased in thickness (Fig. 1). During the remainder of the year, with the exception of October, they increased at a substantially constant rate to values higher than the initial thicknesses recorded in February 1967. The skinfold measurements taken on the left side of the body were generally higher than those taken on the right side.

No significance could be attached to the decrease in the mean body-weights and skinfold thicknesses observed in October, as during this month 4 of the men were unduly exposed to cold when their tents were destroyed in a storm.

DISCUSSION

The steady gain in body-weight during the first half of the year confirmed the observations of other workers.[1-4] In the observations under discussion body-weight also attained a maximum level in the winter. A reduction in body-weight in spring, which was observed with other expeditions,[1,2] did not occur, the average weight of the SANAE members remaining approximately at the July level. Except for sledging, the pattern of physical activities remained essentially unchanged throughout the year. The SANAE base had been established for 5 years, was well below the snow surface, and required much indoor maintenance work. During the polar night, outdoor work such as digging, restacking supplies, and feeding of the dogs was done at midday. In addition, a few members participated in strenuous weight-lifting and physical-fitness courses during the winter months.

It appeared that the food intake at regular meals was less in the second half of the year than in the first, particularly at breakfast and the midday meal. The decrease of food intake during the main meals could be partially attributed to the fact that as time elapsed the men ate more snacks between meals and at bedtime.

In spite of a decrease in subscapular skinfold thickness, a general increase in body-weight was observed during the first 3 months at the base. It can be assumed that this initial increase in body-weight was due to an increase in musculature.

Before departure, the men were unaccustomed to hard physical work. The environment was entirely new to them, and unnecessary energy was expended when they performed outdoor tasks before they had become accustomed to the irregularity of the snow surface.

During this initial period it appeared that the amount of food taken at regular meals was very high. In spite of this, a loss of superficial body fat occurred, which indicated that the high food intake was not excessive.

During the following two months body-weights and skinfold thicknesses increased, indicating a more pronounced positive calorie balance.

The subscapular skinfold thicknesses continued to increase during the second half of the year, although the body-weights remained stationary. This phenomenon indicated a relative loss of muscle mass and a proportionate increase of body fat. The relative decline in muscle mass could be explained by assuming that the men became more efficient in performing their various tasks as the year progressed. This would result in the expenditure of less energy in the second half of the year, assuming that the same tasks were undertaken.

The high positive correlation between changes in body-weight and skinfold thicknesses which was observed by Lewis *et al.*[2] and indicated by one of us (v.d.M.—unpublished data) was not confirmed by this study ($r = 0·29$, $p > 5\%$).

In spite of the reduced calorie intake during the second half of the year, the body-weights remained stationary while the skinfold thicknesses increased. This can be ascribed to the fact that the calorie intake was still excessive in relation to calorie expenditure. Fatty deposits were thereby increased, as is indicated by the increased skinfold thicknesses. However, the increase in the deposition of subcutaneous fat could also have been augmented as the result of an adaptive mechanism providing protection against cold. That the latter was possible has been demonstrated on members of the same team.[5]

The question of the discrepancy between the present results and those of Lewis *et al.*[2] remains unsettled, due to a lack of detail on living and eating patterns. It is postulated that the variation in the calorie balances was greater in the test subjects of previous surveys than those of the present study. It could also be deduced that reduced caloric intake accompanied by increased fat deposition at the expense of the muscle mass may be a necessary expedient to provide additional insulation of the body against cold.

SUMMARY

The body-weights and subscapular skinfold thicknesses of 12 members of the 8th South African National Antarctic Expedition were recorded regularly once every month for 11 months during 1967.

A sharp increase in body-weight was observed during the first 5 months at the base. The subscapular skinfold thicknesses, however, decreased during the first 3 months in the Antarctic, which indicated that, although the apparent food intake was high, it was not excessive. The increase in body-weight during these 3 months was ascribed to an increase in musculature.

During the following 2 months the skinfold thicknesses started to increase, indicating a more pronounced positive calorie balance.

During the second half of the year the skinfold thicknesses increased while the body-weights remained approximately at the level attained in July. This phenomenon indicated a relative loss of muscle mass and a proportionate increase in body fat. This can be ascribed to the fact that the calorie intake was excessive in relation to calorie expenditure. However, the increase in the deposition of subcutaneous fat could also have been augmented as a result of an adaptive mechanism providing protection against cold.

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