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Energy requirements of Malaysian soldiers in a base camp

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ABSTRACT

The energy intake and expenditure of 20 healthy soldiers (mean age, 25 years, weight 61 kg and height 1.67 m) was assessed. Trained personnel stayed in the camp throughout the 5 weeks study period. Each soldier was subjected to a 7-day comprehensive protocol involving anthropometric, food intake, activity pattern and energy expenditure measurements. The mean change in body weight and fat content was minimal, -0.2kg and -0.25%, respectively. Body fat and BMI ranges from 10.0-21.6% and 19.8-24.9, respectively. The mean energy intake of 2190 ± 197 kcal was well below (81%) the recommended allowance of 2700 kcal for the Malaysian Armed Forces. The ration scale analysed chemically provides 2900 kcal thus suggesting a 24% wastage of daily ration. Contribution of protein (15%), fat (25%) and carbohydrate (60%) to energy intake appears to be in line to healthy dietary guidelines. Energy cost of standardised activities were found to be lower in Malaysian soldiers as compared to British soldiers studied under similar environment in the tropics. The mean total daily energy expenditure (TDEE) for soldiers were 2886 ± 222 kcal with a negative energy balance of about 700 kcal. The results suggested that there is a need to review the current provision with regard to food supply and preparation in army camps, to ensure that the menu provided are appealing as well as nutritious for the soldiers.

INTRODUCTION

The most basic nutritional requirement of man is energy and it takes precedence over all other nutritional needs. There are two basic methods for estimating energy requirements; that is, by determining intake and expenditure. The former assumes that the quantity of food consumed by healthy individuals living a normal life represents their requirements. The latter calculates the requirements factorially by summing up the actual daily energy expenditure on various types of activity. It is known that nutritional individuality is a characteristic of mankind and this is as true of energy intakes and needs of other attributes. The minimum physiological needs for energy is certainly a variable, and the necessity to estimate energy requirements from data based on energy expenditure rather than on intake has been advocated by Durnin *et al.* (1973), and more recently emphazised in a joint report of the FAO/WHO/UNU (1985). Furthermore, man’s demand for energy under various physiological states, pathological states and environemntal conditions remain largely unknown amidst controversies that extend to those reponsible for laying down national and international standards of energy requirements (Waterlow, 1986).

To date only few studies on energy requirements of Malaysian has been reported (Ismail & Zawiah, 1988a, 1988b, Ismail *et al.* 1995). In an earlier study, (Chong, *et al.,* 1982) compared energy value of food served in two Malay Regiment camps however, no attempts were made to assess energy expenditure or activity pattern of the soldiers. This paper reports our initial findings on energy requirement of Malaysian soldiers residing in a base camp.

SUBJECTS AND METHODS

Twenty apparently healthy soldiers residing in a base camp was randomly selected for the study. They were briefed on the objectives and the protocol of the study. The duration of the study was 5 weeks and all subjects remained in the camp during the study period. In order to facilitated detailed assessment and at the same time not to disrupt the soldiers daily routine, they were studied in batches of 4 subjects per week.

The height and body weight were recorded daily for 7 days, in light clothings (without shoes) to the nearest 0.5 cm and 0.1 kg, respectively, using the Detecto weighing balance with height attachment. Skinfold thickness measurements were taken using the Harpenden calipers (British Indicators, UK) at 4 sites as recommended by Durnin and Rahman (1967). Body fat, as a percentage of body weight, was calculated from the sum of 4 measurements of skinfold thickness (Durnin & Womersley, 1974). Body mass index (BMI) was also calculated and BMR was derived using the FAO/WHO/UNU (1985) equation.

Each soldier was subjected to a 7-day weighed food intake. Soldiers were advised not to eat out during the experimental days. However those who could not adhere strictly to the rule were requested to record all food and drink taken outside the mess. A duplicate sample of daily menu for 7 days were collected, dried, homogenised for protein and fat determination using AOAC (1984) procedures. Carbohydrate content was calculated by difference and energy content derived using the Atwater factor. The energy intake is reported as a mean of 7 days food intake.

Soldiers were instructed to accurately fill the diary card in order to provide detailed information of their daily activities to the nearest minute. Both position and activity were recorded (e.g. sitting, watching T.V.) and the time spent on different activities was calculated from the diary cards. Day time activities were frequently monitored by the researchers. Soldiers were individually questioned in cases where irregularities in recording were encountered. The activity pattern is reported as a mean of 7 days, carried out on similar days when food intake was measured.

Energy cost of some common activities was measured by indirect calorimetry using the Douglas bag technique. The oxygen content of expired air was measured using a Servomex oxygen analyser, calibrated prior to each experimental session. Volume of expired air was measured using the Gallenkamp Dry Gas Meter and corrected to STP. The energy cost (kcal/min) was calculated using the Weir (1949) formula. Energy cost of activities that were not measured were adopted from previous studies (Passmore & Durnin, 1955; Edholm *et al.* 1955; Durnin & Passmore, 1967). The total daily energy expenditure (TDEE) was calculated by summing up the energy cost for each activity, multiplied by the mean duration of the activity performed. The energy balance was determined from the mean daily energy intake, minus the mean daily energy expenditure.

Table 1. Physical characteristics of soldiers

Subjects n = 20	Mean	SD	Range
Age (yrs)	25.1	3.8	20.0 – 32.0
Weight (kg)	61.1	5.8	48.5 – 74.4
Height (m)	1.67	0.06	1.56 – 1.77
Body fat (%)	16.4	3.4	10.0 – 21.6
BMI (kg/m²)	21.9	1.5	19.8 – 24.9
LBM (kg)	51.0	4.0	43.7 – 61.2
BMR[1] (kcal/day)	1608	86	1421 – 1817

[1] Calculated using FAO/WHO/UNU (1985) Equation

RESULTS AND DISCUSSION

The physical characteristics of the soldiers are shown in Table 1. Out of the 20 soldiers, only two of them weighed less than 56 kg and the range indicated (48.5 kg and 74.4 kg) were the two extreme cases recorded in this study. The mean change in body weight between day 1 and day 7 was - 0.2 kg, while changes in body fat was negligable (-0.25%). Fluctuations in body weight in short term studies such as this would only indicate changes in water balance rather than energy store, hence a poor indication to alteration in energy balance. Their BMI values ranges from 19.8 to 24.9 and were within normal range 20.0-25.0 (Garrow, 1981). The body fat content were also within the range (5-38%) as reported by Dumin and Womersley (1974) in their study on 92 males, aged between 20-29 years with body weight ranging from 50-116kg. It should be noted however, that regular training could modify body composition and hence BMI, largely by decreasing body fat. The BMR values ranges from 1421 to 1817 kcal as derived from the FAO/WHO/UNU (1985) report.

The mean energy intake and contribution of protein, fat and carbohydrate to energy intake is shown in Table 2. The mean daily energy intake was 2190 ± 197 kcal. The intake level is well below (81%), of the recommended allowance of 2700 kcal for the Malaysian Armed Forces (IMR, 1983). This allowance is based on the FAO/WHO (1973) report for moderate activity (46 kcal/kg) for a soldier aged between 29-30 years weighing 58 kg. Using the food composition table (Tee *et al.*, 1988), the normal Armed Forces ration scale provide a daily entitlement of 4064 kcal of uncooked food items for individual soldier. However, Quah (1977) reported a value of 4096 kcal based on earlier food table (unpublished). The ration scale when analysed chemically provides 2900 kcal. Based on the soldiers energy intake, the study revealed on an average, a 24% wastage of daily ration supplied to soldiers. The low energy intake could be due to several reasons. One of the most common complaint is that the menu were monotonous and not appetizing enough.

In an earlier study, Chong *et al.,* (1982) reported two different levels of energy values of food served in two different camps, at Sungai Besi (2793 kcal) and Seremban (2187 kcal). These values however only indicate what is available to the soldiers and not that of intake, since no attempts were made to weight or record individual intake of the soldiers. The contribution of protein (15%), fat (25%) and carbohydrate (60%) to energy intake is in line with healthy dietary guidelines.

Table 2. Mean energy intake and contribution of protein, fat and carbohydrate to energy intake.

Nutrients	Mean	SD	Range
Energy (kcal/day)	2190	197	1834 – 2591
Protein	82 (15)	9 (1)	68 – 103 (12 – 16)
Fat (g)	62 (25)	11 (3)	48 – 88 (20 – 33)
Carbohydrate (g)	325 (60)	27 (3)	268 – 364 (53 – 65)

Table 3. Mean time spent, energy cost of various activities and total daily energy expenditure (TDEE) of soldiers.

Activities	Time Spent (min/day)	Energy Cost (kcal/min)	TDEE (kcal)
Sleep	395	1.00*	395
Lying awake	60	1.04 (15)	62
Sitting	247	1.17 (20)	289
Eating	39	1.59*	62
Writing	7	1.25 (10)	9
Playing carrom	4	2.35*	9
Motor-cycling	3	3.19*	10
Ridding in a truck	7	1.58 (5)	11
Standing inactive	125	1.32 (14)	165
Praying	29	1.68 (8)	49
Ironing	8	1.97 (9)	16
Dressing	18	2.00 (5)	36
Personal necessities	46	2.9*	133
Walking (normal pace)	191	2.36 (14)	451
Washing clothes	11	4.69 (5)	52
Cleaning bed/room	40	4.22*	169
Sports activities	24	4.72*	113
Military activities			
Running	37	5.60*	207
Physical training	39	5.90*	230
Marching	22	4.60*	101
Walking with weapons and ratio	69	4.11 (11)	284
Cleaning weapon	3	1.47 (7)	4
Polishing boots	13	1.40 (9)	18
Weapon training	3	3.75*	11
	1440		2886

1 Values in parentheses denote no. of subjects
* Values adopted from Passmore & Durnin (1955), Edholm et al., (1955) and Durnin & Passmore (1967)

The time spent and energy cost of various activities is shown in Table 3. The mean time spent on light activities accounted for 59% of the day; while moderate and heavy activities accounted for 24% and 17% of the day, respectively. As expected there is obvious difference between the soldiers and civilians, the very much sedentary lifestyle of students (Ismail & Zawiah 1988b) and even national sportsmen only spend about 20% of the day on moderate to heavy activities during centralized training (Ismail *et al.*, 1995). The results lends support to the need to monitor nutrients requirement among soldiers who must cope up with the extra work load. More then half of the recorded daily activities (58%), were determined using indirect calorimetry. Although values for 42% of the day's activities were adopted, sleep accounted for more than 64% of the value. The energy cost of standarised activities were higher when compared to earlier studies on adult Malaysian (Ismail & Zawiah, 1988 a,b). It was also interesting to note that the results were lower than those reported by Haisman (1972) who studied British soldiers in Malaysia. For lying and sitting activities, he reported values of 1.14 and 1.50 kcal/kg/hr, as compared to 1.02 and 1.14 kcal/kg/hr in Malaysian soldiers. The difference is also apparent if calculated on the basis of kcal/kg LBM/min. The British soldiers recorded values of 0.022 and 0.029 as compared to 0.020 and 0.023 kcal/kg LBM/min, respectively. The mean TDEE of the soldiers was 2886 ± 222 kcal.

The results on energy intake and expenditure revealed a negative energy balance of about 700 kcal (Table 4). None of the soldiers energy intake met the requirement value of 2886 kcal/day. The FAO/WHO/UNU (1985) report has emphasized that individual adapt, within limits, to low energy intake levels. This adaptation process however, occurs at a cost of reduced discretionary activity and ultimately, lower work capacity.

Table 4. The mean daily energy balance of soldiers

Subjects n = 20	Energy Intake (kcal/day)	Energy Expenditure (kcal/day)	Energy Balance (kcal)
Mean	2190	2886	- 692
SD	197	222	
Range	1834 - 2591	2510 - 3219	

CONCLUSION

The results suggested that there is a need to review the current provision with regards to food supply and preparation in army camps to ensure that the menu is appealing as well as nutritious for the soldiers.

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