

The Cardiorespiratory Fitness and Energy Expenditure of the Temiars

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Abstract

A PRIMITIVE SETTLEMENT OF Temiars was selected for a study of their physical work capacity in their natural environment. Twenty boys and 10 men were subjected to exhaustive exercise on a step-ergometer and their maximal oxygen consumption, heart rate and blood lactate levels were observed. The boys aged between 12 - 18 years, were found to have a mean maximal oxygen uptake of 45.9 ± 6.7 ml/min/kg body weight, a mean maximum heart rate of 94.4 ± 4 beats per min., and a mean lactate level of 75 ± 18 mg%; whilst the men showed a higher maximum oxygen consumption of 53.2 ± 2 ml/min/kg, a lower maximum heart rate of 187 ± 10 beats per min. and a variable blood lactate level of 94.4 ± 32.4 mg%. These results are comparable to those found in city dwellers and those studied in other primitive populations. The health of the subjects was good and their dietary intake sufficient in Calorie intake. There was little evidence of obesity although their staple diet was tapioca root, but telemetric monitoring of their routine daily activity revealed that jungle dwellers seldom tax their oxygen transport system to induce any adaptive changes.

Introduction

In-depth study of 'pure' primitive societies forms an important part of the International Biological Programme in their efforts to delineate the effects of urbanisation on man. Studies on such communities are rare and have been reviewed by (Andersen, 1966; Andersen, 1967 and Lammert, 1972).

The orang asli of Malaysia have not been studied with regard to their cardiovascular fitness, but their sociological classification, and the efforts of the Ministry to uplift their standards of health and living have been described (Williams-Hunt, 1952; Jimin Idris, 1972).

This is the first study of the Temiar in which their cardiovascular fitness has been assessed in their natural environment along the Ninggiri tributary of the Kelantan River, just east of the central main range. A study of their physiological and metabolic responses to maximal exercise, a look at their general health and nutrition, and their daily routine activity was carried out.

Materials and Methods

Subjects

The subjects selected at random were 25 Temiar boys attending a Government school at Gemalah and 10 Temiar men from the surrounding settlements within a three-mile radius. Most of the schoolboys were born in the region, but the men were not very sure of such details.

Medical Examination

All subjects underwent a physical medical examination in which a history of malaria, filariasis and yaws were especially asked for. Urine and electrocardiographic examination on a portable Cardiostat T (Siemens) Electrocardiogram were carried out.

Maximum Aerobic Capacity

The maximum aerobic power was taken as the International Reference Standard for cardiovascular fitness (Shephard *et al*, 1968) and the direct method of estimation was employed. All subjects were made to exercise on a double-step ergometer of 0.4 m high per step. Whilst on the single step, electrocardiographic monitoring was carried out until a heart rate of about 160 beats/min was attained. The subjects were then made to exercise on the double-step to the point of exhaustion, as indicated by a heart rate of 180 beats/min or more. Expired air was collected through a one-way valve into a Douglas Bag during the last minute of exercise, or for a timed period until the limit of exercise tolerance had been reached. The volume of gas was measured using a calibrated gasometer, and two samples of the gas were taken in 50 ml syringes and kept for later analysis in the laboratory by a Haldane Gas Analyser. Four minutes after cessation of exercise, 0.1 ml of blood from a finger-prick was taken and kept in a deep freeze for later analysis of lactate level using a standard Sigma Kit which used the enzymatic method for lactic dehydrogenase.

Telemetric Monitoring of Routine Daily Activity

The daily routine activity of four men from the sample of 10 subjects tested were observed from 0645 hours to 1530 hours. One subject had his heart rate monitored by a transmitter device attached to a head band from two chest leads at V_1 and V_5 , and received by a standard Sony tape-recorder. The other three subjects were monitored by auscultation at crucial intervals.

Nutritional Assessment

A cursory investigation into the diet of the Temiar boys and men was done by observing 24 hours of the eating habits. For the boys, it was much simpler in that they received daily rations from food dropped by helicopter, with known supplements of tapioca from doting villagers. The food was weighed and photographed and re-evaluated in the Medical Faculty. For the men, it was more difficult and the same method of photography and reproductive analysis was carried out. The Calorie intake per day was calculated using the Food Composition Tables (1968).

Observations and Results

Medical Examination

The medical examination did not reveal as many illnesses as was found in the Polunin (1953) study. There were no signs of malaria or enlarged spleens, elephantiasis or yaws. Skin affectations were common (60% for both men and boys) carious

teeth (50% in men and 30% in boys). One boy was disqualified from testing due to consolidation of the lower lobe of the right lung and was referred to the Hospital at Kota Bharu. There was a high incidence of upper respiratory tract infection (80% for men and boys) of varying degrees.

There was also a high incidence of alkaline urine (pH 8) as found by litmus paper and concomitant trace albuminuria (albustix) in 70% of men tested, but only in 2 out of 25 boys tested.

The mean blood pressures are given in the table below:

Table I
Systolic and diastolic blood pressure in Temiar men & boys.

Subject	n	Age Range (yr)	Systolic Blood Pressure (mm Hg)	Diastolic Blood Pressure (mm Hg)
Temiar Boys	25	12 - 18	112 ± 7.9	68.0 ± 10.3
Temiar Men	10	19 - 40	126 ± 7.8	79.0 ± 9.4

Aerobic Capacity

The maximum aerobic capacities between Temiar men and boys about the fringe ages of 18 and 19 showed very little differences. The subjects were divided according to whether they were still schooling or whether they were working in the *ladangs*. However, the subjects aged between 12 - 14 years were significantly different only in somatotype but not in maximum aerobic power. The heart rate of boys were higher than that for men, as especially demonstrated by the 40 year-old subject (167 beats/min). This lowering of maximal heart rate has already been commented upon (Astrand, 1960). The physiological and metabolic responses observed are presented in Table 2.

Nutrition

The diet of the Malayan aborigine (*Orang Asli*) and their agriculture and food taboos have been well documented (Williams-Hunt, 1952; Jimin Idris, 1972) as well as their sociology (Wilkinson, 1913). The observations of this study are presented in Tables 3 & 4 for what they are worth. The schoolboys have the regulation three meals a day with snacks in between, whilst the adults have only two set meals, and eat at will thereafter. It was also observed that there was an abundance of fruit, fish and birds. It can be seen that the WHO recommended Calorie intake for boys aged 10-12 years (2,280 Calories) and that for semi-sedentary men (3,000 Calories) was well met by the range of food intake by boys (2,256-4,916 Calories) and men (2,533-5,477 Calories) as seen in this study.

Table 2
Cardiovascular and Metabolic Responses of Temiars

Subjects	$\dot{V}E$ (l/min)	$\dot{V}O_2$ (ml/min/kg)	$\frac{\dot{V}E}{\dot{V}O_2}$ (l/l)	R	HLa (mg %)	Hf (beats/min)	$\frac{\dot{V}O_2}{Hf}$ (ml/beat)
Temiar boys	65.44	45.9	34	1.20	75	194	10
S.D.	±11.0	± 6.7	± 7	±0.1	±18.2	± 4	± 2
range	(40.9 – 89.3)	(29.8 – 52.4)	(27 – 50)	(0.98 – 1.38)	(36 – 109)	(180 – 205)	(5 – 13)
Temiar Men	15.5	53.2	30	1.16	94.4	187	14
S.D.	±19.5	±14.9	± 7	±0.15	±32.4	± 10	± 3
range	(45.1 – 86.3)	(38.1 – 77.5)	(24 – 46)	(0.84 – 1.31)	(57 – 155)	(167 – 196)	(11 – 19)
Urban Schoolboys*	71.08	46.9	34	1.11	77	196	11
S.D.	±26.6	± 7.5	± 6.6	±0.10	±28	± 8	± 3
range	(34.3 – 132.5)	(31.3 – 62.7)	(25 – 46)	(0.9 – 1.4)	(36 – 136)	(180 – 212)	(6 – 16)

*Thinakaran et al (1974)

Table 3
Calorie Intake of Temiar Estimated Minimum and Maximum Intake of Temiar Boys

Meal	Food Item	Ration		Maximum Seen		Possible Maximum	
		Wt.	Cal.	Wt.	Cal.	Wt.	Cal.
Breakfast	Tea (sugar and milk)	7g	28	14g	56		
	Biscuits	120g	480	200g	826		
Lunch	Boiled rice	140g	182	420g	764		
	Salt fish	100g	192	150g	288		
	Tapioca leaves	10g	6	10g	6		
	Banana (medium)	100g	88	200g	176		
Dinner	Boiled rice	140g	182	420g	764		
	Canned sardines	100g	309	150g	464		
	Tapioca leaves	10g	6	10g	6		
	Banana (medium)	100g	88	200g	176		
Snacks	Tapioca					454g	695
						454g	695
			1,561		3,526		
With regular snacks			695		695		
Totals			2,256		4,221		4,916

Calorie values derived from Food Composition Tables for use in West Malaysia, published by the Department of Social and Preventive Medicine, University of Malaya, Kuala Lumpur, 1968.

Table 4
Calorie Intake of Temiars Estimates of Minimum and Maximum Intake of Temiar Men

Meal	Food Item	Minimum		Maximum		Supplements	
		Wt.	Cal.	Wt.	Cal.	Wt.	Cal.
Breakfast	Tea (sugar and milk)	7g	28	14g	56		
	Tapioca	454g	695	681g	1,043		
Lunch	Tapioca	454g	695	200g	1 043		
	Sugar cane juice (1 cup)		146		146		
Dinner	Tapioca	454g	695	681g	1 043		
	Fresh fish	200g	142	400g	284		
	Banana (large)	150g	132	300g	264		
Supplements	Petai (legumes)					50g	60
	Bamboo shoots					100g	27
	Bananas					150g	132
	Tapioca snacks in the middle of the night					454g	695
Occasional	Wild Boar or other meat					150g	684
Total			2,533	3,879			
With minimum supplements			3,447	4,793			
With maximum supplements				5,447			

Calorie values derived from "Food Composition Tables for use in West Malaysia" by the Department of Social and Preventive Medicine, University of Malaya, 1968.

Routine Daily Physical Activity

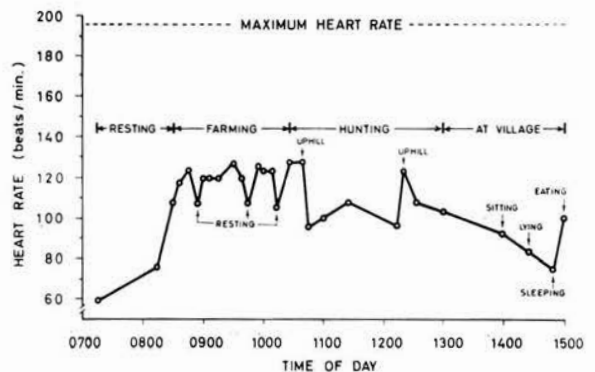
The routine daily physical activity as measured by the change in heart rate (which is used as a measure of oxygen consumption or Calorie expenditure) revealed that the Temiar men did not require to extend themselves very much in their jungle environment to survive. The mornings were spent in clearing the jungle and planting of tapioca, bananas and hill padi. There was a short break for lunch which consisted of two pieces of baked tapioca root, then they set about hunting with their blowpipes. Their heart rates seldom exceeded 130 beats per min. (See Fig. 1)

Discussion

Although many sociological and anthropological studies have been carried out on the Orang Asli, this is the first investigation into their cardiorespiratory fitness. The study has clearly shown that there is no difference between the cardio-respiratory fitness of these primitive people with that of selected populations, whether primitive or urban (Andersen,

1966) as shown in Table 5. The Temiar has been subjected to disease as much as, if not more so than his urban counterpart (Polunin, 1953), and although Burns-Cox *et al.* (1972) have suggested that coronary heart disease is less frequently encountered the

TELEMETRY MONITORING OF HEART RATE OF A JUNGLE DWELLER DURING DAILY ACTIVITY.



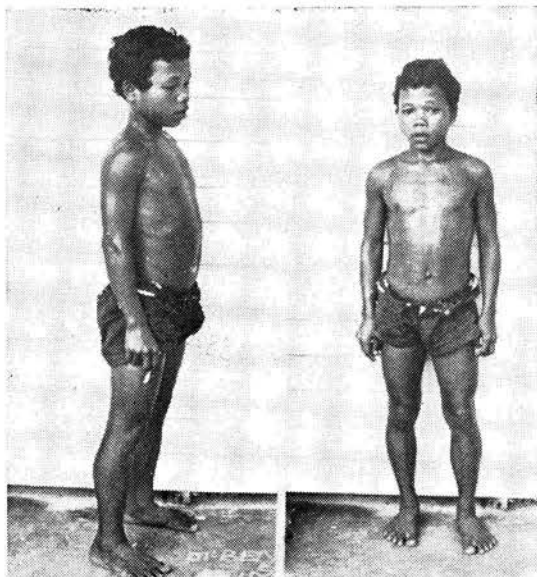


Figure 2
The average Temiar Boy (Aged 14 years)
Somatotype 1½: 4½ 1:

further into the jungle one goes, his study has been confined to an urban hospital, and contradicted by that of Prathap (1974) who found no difference in the incidence of cholesterol content of the Orang Asli, wherever they may have come from or even when compared with some urban communities.

That cardiorespiratory fitness is a function of a purposeful effort to obtain it is indicated by this study, whether the subject be a jungle dweller or a city dweller. Thinakaran *et al* (1974) showed that there were no significant differences between Temiar or urban schoolboys, and for that matter, with Japanese or European schoolboys (Andersen *et al*, 1971). Studies in men are also similar (See Table 5). However, one Temiar subject had an extremely high aerobic capacity (77.5 ml/min/kg) whilst his brother had an aerobic capacity of 47.3 ml/min/kg. This showed extremes of variability within the group tested itself. The second highest figure found was 75.0 ml/min/kg and the lowest, the 40 year-old subject was 38.1 ml/min/kg. It seems from these figures that there is some evidence to support the statement that there is no racial predisposition to high maxima in aerobic power, although there is some genetic pre-disposition found (Klissouras, 1971). But most champion long distance runners, skiers and swimmers have aerobic capacities of about 70-90 ml/min/kg. A group of trained Norwegian skiers showed an average aerobic power of 71 ml/min/kg (See Table 5).

Table 5
Comparison of Maximum Aerobic Power of Different Peoples

Subject	Age (years)	Vtt max. (ml/min/kg)	Hf (beats/min)
Bantu Negroes	20 - 40	48	180
Eskimos	20 - 40	44	173
Nomadic Lapps	20 - 40	54	191
Arctic Indians	20 - 40	49	-
Kalihar Bushmen	20 - 40	47	-
Eskimo Hunters		38	-
Alucaluf Indians		38	-
Norwegian skiers		71	178
Temiar Men	19 - 40	53	187
Norwegian students	18 - 24	44	-
Malaysian Medical Students	18 - 24	35	182
Japanese Boys	12 - 18	47	-
Malaysian Malays	12 - 18	49	193
Malaysian Indians	12 - 18	47	198
Malaysian Chinese	12 - 18	44	196
Temiar Boys	12 - 18	46	194

It has already been shown that jungle dwellers rarely need to tax oxygen transport capacity in order to survive in their natural environment, and therefore, no adaptive changes can be expected. However, there are several striking differences between the Temiar schoolboy and his counterpart in the city. The physical appearance is one area where the Temiar is predominantly mesomorphic, rather short and devoid of fat. This can be hardly said of the city dweller (Chan *et al*, 1974). There seems to be no evidence of malnutrition, as the Temiar have shown great skill with the blowpipe whose dart is tipped with a poison which has been described by Chan & Chang (1971). Besides food taboos found prevalent in the culture (Bolton, 1972) the children were also found to be well nourished by Robson *et al* (1973).

Two questions remain unanswered. The question of the alkaline urine which could possibly be due to eating *buah petai* which was in season at the time, and the fact that for all the carbohydrate consumed by the men, there was very little sign of obesity. This could possibly be because of the great energy expenditure entailed in their frequent all-night bomo dances.

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