A COMPARATIVE STUDY OF THE PHYSICAL PERFORMANCE CAPACITY OF RURAL AND URBAN BURMESE WOMEN AGED 19-24 YEARS

HTAY HTAY*, LILIAN PO ** and M. MYA-TU

Physiology Research Division, Department of Medical Research, Rangoon, Burma.

INTRODUCTION

The large variability in maximal aerobic capacity reported for women of different nationalities has usually been ascribed to the activity patterns of the population. The rural population is engaged in a relatively different level of physical activity from that of the urban population. Shephard (1969) stated that rural populations are presumed to be more active than their city brethren. However, contradictory findings have been those of Macek *et al.*, (1971), Bar-Or (1972) and Wyndham (1973) who reported that the rural population do not seem to have a higher maximal aerobic capacity than their urban counterparts.

As the majority of the population of Burma resides in the rural area, this study was undertaken to determine whether there is any difference in the physical performance capacity between the urban and rural Burmese women aged 19-24 years.

MATERIALS AND METHODS

Forty female subjects, aged 19-24 years all screened by medical examination including medical history, physical examination, clinical nutritional status (according to the standardized forms of International Biological Programme) and ECG and haemoglobin estimation, were used as subjects for the study. The urban subjects chosen were from among those attending the School Dental Nurse Training Course, Rangoon, and the rural subjects of the same age group were from Zeegon village, Insein Township, 15 miles from Rangoon.

All the subjects were chosen randomly in each group. Out of 20 subjects for each group, 16 in each group completed the study. The subjects selected were of the same nutritional status and clinically healthy. They were found to have no significant difference in age, height and weight.

Measurements were made on both groups for the following parameters: (1) Anthropometry, (2) Aerobic work capacity, (3) Performance tests, (4) Habitual physical activity pattern.

The assessment of physical performance capacity was done in February 1975, and habitual physical activity from February till July 1975.

Statistical analysis of data was done using student's "t" test to test the significance of difference between means.

Anthropometry : The anthropometric measurements were taken according to the International Biological Programme (IBP) methodology (Weiner and Lourie, 1969).

Aerobic Work Capacity : von *Dobeln type* Monark bicycle ergometer was used for measurement of aerobic work capacity. Resting heart rate was measured from direct ECG recording on the Cardiostat T using bipolar leads placed over the manubrium and

Present address : *Department of Physiology, Institute of Medicine 1, Rangoon, and **Department of Physiology, Institute of Medicine 2, Rangoon.

the 5th left intercostal space, in the mid-clavicular line (CM_5). Blood lactate value was determined using capillary blood and analysed according to Baker and Summerson as modified by Strom (1949).

Resting ventilation was measured by collecting the expired air through a double "J" valve, and corrugated rubber tubing into a Douglas bag for 3 minutes, after the subject became accustomed to the method. The collected expired gas volumes were measured on Parkinson-Cowan dry gas meter and the oxygen content analysed by the Servomex oxygen analyser.

Determination of maximal aerobic power was made on every subject by starting with a work load set at approximately 70 per cent of the $\dot{V}O_2$ max(as predicted from the submaximal test), which was found to be 600 kpm. The starting work load was therefore set at 600 kpm and thereafter it was increased 150 kpm every 2 minutes until the subject become exhausted. The following criteria were adopted in assessing whether $\dot{V}O_2$ max had been reached.

(1) Post exercise lactate value over 90 mg per 100 ml blood.
(2) Cardiac frequency close to the theoretical age related maximal value.
(3) Impressions of the observers (obvious exhausation, unsteady gait, breathlessness and nausea).
(4) $\dot{V}O_2$ max did not increase despite a rising work load. This was not always possible to satisfy because some were unable to work beyond a certain work load.

Lower values in each category were accepted if the other criteria were met.

Performance Tests : The following performance tests, out of a battery of tests proposed by the American Association for Health Physical Education and Recreation (1965) were performed: (i) Standing broad jump–as a measure of leg strength and explosive power; (ii) Hand grip–as a measure of static strength of arm and hand; (iii) Back strength–as a measure of dynamic strength of trunk extensors; and (iv) Situps–as a measure of abdominal and hip flexor muscle strength.

Habitual Physical Activity Pattern : The assessment of habitual physical activity of the rural and urban Burmese women was done by an interviewer administered questionnaire. The reliability of this was tested by comparing answers received at successive interviews, and also by correlation with the diary method estimated from 5 random subjects.

The oxygen consumption during performance of some activities were determined. This was done by measuring the heart rate during a particular activity by direct recording on the Cardiostat T. The oxygen consumption of each subject was then calculated from an individual regression of the heart rate on oxygen consumption. The work intensity of the rural and urban groups was calculated using the concept of the percentage of maximal aerobic power (Astrand, 1967).

RESULTS

Altogether 32 subjects completed the experiment, 16 in each group.

Table 1 shows the comparison of anthropometric parameters between the rural and urban groups. The majority of the anthropometric data of the rural group had a higher mean value compared to that of the urban group and a significant difference in bicondylar humerus, chest and skinfold measurements, indicating that there was a definite difference in body build between the two groups.

Table 2 shows the physical performance capacity measured in the rural and urban groups. Cardiorespiratory capacity para-

Table 1

Anthropometric characteristics of the rural and urban groups (mean and standard deviation).

Parameter	Rural Group	Urban Group	Significant difference
Body weight (kg)	47.15 ± 2.52	49.61 ± 7.20	N.S.
Age (decimal years)	21.36 ± 1.18	20.97 ± 1.26	N.S.
Standing height (cm)	154.49 ± 6.35	156.02 ± 13.40	N.S.
Bicondylar humerus (cm)	6.06 ± 0.44	4.81 ± 0.54	S (2%)
Bicondylar femur (cm)	8.61 ± 0.51	8.19 ± 0.48	N.S.
Circumference (cm)			
Upper arm relaxed	22.41 ± 1.39	21.99 ± 2.50	N.S.
Upper arm contracted	24.02 ± 1.69	23.90 ± 2.41	N.S.
Fore arm	21.10 ± 1.69	20.30 ± 1.57	N.S.
Thigh	43.96 ± 3.12	43.88 ± 3.13	N.S.
Calf	32.53 ± 1.38	32.03 ± 1.47	N.S.
Maximal chest	80.08 ± 0.44	77.51 ± 4.09	S (0.1%)
Minimum chest	76.23 ± 1.55	73.10 ± 3.99	S (1%)
Skinfold thickness (mm)			
Biceps	5.20 ± 1.55	8.35 ± 2.90	S (0.1%)
Triceps	12.42 ± 2.02	14.39 ± 3.95	N.S.
Subscapular	12.68 ± 2.50	14.48 ± 4.00	N.S.
Suprailiac	8.73 ± 1.72	12.73 ± 3.76	S (0.1%)
Calf	11.77 ± 2.12	14.01 ± 3.05	S (2%)
Fat %	24.00 ± 1.70	27.22 ± 3.35	S (1%)

N.S. = Not significant, S. = Significant.

meters include maximal oxygen uptake, expressed as ml/kg/min, maximal oxygen pulse expressed as ml/beat, maximal work load in terms of kpm/min and maximal ventilation as litres/min. The maximal oxygen uptake which expresses the cardiorespiratory fitness was greater in the rural group. This difference in maximal oxygen uptake between the rural and urban groups was significant at the 0.1 per cent level. There was also a difference in maximal oxygen pulse and maximal work load between the two groups, but this was significant only at 2 per cent and 5 per cent levels respectively. Though, maximal ventilation in the rural group had a higher mean value, it was not significant. These results showed that the rural group had a higher cardiorespiratory fitness than the urban group.

The results of some of the AAHPER performance tests used to measure the strength of the rural and urban groups showed no significant difference in the standing broad jump, left and right hand grip, flexed arm hang and back strength scores. The urban group was found to have a significantly higher score in the situps which is supposed to measure the abdominal muscle strength, but which also requires skill and motivation.

Table 2

Physical performance capacity of the rural and urban groups (mean and standard deviation).

Parameter	Rural Group	Urban Group	Significant difference
Cardiorespiratory capacity			
Maximal oxygen uptake (ml/kg/min STPD)	39.21 ± 4.86	32.32 ± 3.37	S (0.1%)
Maximal oxygen pulse (ml/beat)	9.61 ± 1.24	8.47 ± 1.38	S (2%)
Maximal work load (kpm/min)	815.30 ± 76.85	759.00 ± 37.50	S (5%)
Maximal heart rate (beats/min)	192.00 ± 7.43	189.00 ± 6.93	N.S.
Maximal ventilation (litre/min BTPS)	65.05 ± 10.56	62.24 ± 11.54	N.S.
Performance capacity			
Standing broad jump (cm)	152.56 ± 15.39	162.69 ± 21.13	N.S.
Right hand grip (kg)	29.94 ± 3.36	30.56 ± 3.94	N.S.
Left hand grip (kg)	26.50 ± 3.83	27.12 ± 4.54	N.S.
Flexed arm hang (sec)	11.06 ± 6.84	20.96 ± 19.95	N.S.
Situps (time/sec)	4.00 ± 4.75	9.93 ± 7.08	S (1%)
Back strength (kg)	85.19 ± 16.76	81.50 ± 14.87	N.S.

N.S. = Not significant, S. = Significant.

Table 3 shows the activity pattern of the rural group. The activity pattern of this group had a seasonal variation. During March - April, they were all involved in domestic chores which were usually not intensive, except for the water carrying activity. In May and June, they had to work for 10 hours a day to pound glutinous rice. This activity was repeated also in November to February. During the rainy season, they participated in transplanting paddy for 8 hours a day.

Table 4 shows the activity pattern of the urban group. In contrast to the rural group, they had a uniform activity pattern throughout the whole year. Their daily activity pattern consisted of attending lectures, 4 hours a day, and attending a practical class where they had to work on a phantom head lasting for 3 hours. Their leisure time activities consisted of walking, sitting, talking and listening to the radio.

Table 5 shows the work intensity of the rural and urban groups expressed as percentage of the maximal aerobic power. The rural group had a high work intensity of 55.13% during the act of carrying water, and least intensive during transplanting paddy. Even this lowest work intensity of the rural group (27.48%) was greater than the highest work intensity (25.88%) of the urban group.

DISCUSSION

In this study, two groups of Burmese women of the same age group, nutritional

Table 3

Activity pattern of the rural Burmese women.

Activity	Months of the year			
	March-April	May-June	July-October	November-February
	(Duration of activity, minutes per day)			
Pounding glutinous rice	-	600	-	600
Transplanting paddy	-	-	480	-
Domestic chores				
(a) carrying water	120	60	-	60
(b) sweeping (c) setting tables (d) washing dishes (e) washing clothes (f) shopping	300	-	-	-
Personal care				
(a) washing face (b) tooth brushing (c) bathing (d) hair dressing (e) application of cosmetics (f) dressing	120	120	120	120
Meals	60	60	60	60
Leisure				
(a) sitting (b) talking (c) lying (d) reading	240	240	240	240
Sleep	600	600	600	600
Total (min)	1440	1440	1440	1440

status and climatic condition, but having different habitual physical activity pattern were compared.

The present study revealed that there was a difference in anthropometric parameters, maximal oxygen uptake and work intensity in the two groups. It was found that the urban subjects had a preponderance of higher skinfold values in the absence of significant weight difference. Yoshisawa (1972) in his study on the rural and urban subjects of Japan reported a similar finding, so also the studies of Underwood *et al.*, (1967) and Novotny *et al.*, (1971).

Greater bicondylar humerus measurement was found in this study in the rural group. This could be due to the constant usage of the arm in drawing water from the well since

Table 4

Activity pattern of urban Burmese women.

Activity	Months of the years	
	January	December
	(Duration of activity, minutes per day)	
Attending lecture	240	
Practical-working on phantom head	180	
Studying	180	
Personal care		
(a) washing face	150	
(b) tooth brushing		
(c) hair dressing		
(d) application of cosmetics		
Meals	90	
Leisure		
(a) walking	30	
(b) sitting	90	
(c) listening to radio		
(d) talking		
Sleep	480	
Total (min)	1440	

Table 5

Estimated work intensity of the rural and urban groups.

Activity	Work intensity ($\%$ of $\dot{V}O_2$ max)
Rural group	
Carrying water	55.13
Pounding glutinuous rice	44.47
Drawing water from the well	40.17
Transplanting paddy	27.48
Urban group	
Walking	25.88
Practical	
Working on phantom head	21.00
Attending lecture	12.30
Studying	12.30

these rural girls have been doing this from the age of 8 years. Adams (1938) demonstrated that constant exercising by hard labour could result in growth and development of that part. Ingelmark (1957) also showed an increase in thickness of connective tissues which covered the articular surfaces of bones by constant usage.

In the present study there was a significant difference in the maximum and minimum chest measurements. As these were a standard measure of size and physique (Landiss and Barker, 1969) and were more influenced by chest capacity than by superficial muscle and fat layer (Uytvank and Vrijen, 1966), it showed that there was a definite difference in body structure and chest capacity between the two groups. That hard working women had greater chest measurements than those of the non hard-workers, had also been reported by Adams (1938).

It is well known that physical activity increases the maximal values of oxygen consumption per kg body weight (Astrand, 1952). In this study, a significantly higher maximal oxygen uptake was found in the rural group. Similar findings have been reported by Yoshisawa (1972) and Cumming *et al.*, (1973) for the Japanese and Canadian rural and urban subjects.

The maximal oxygen uptake of 32.32 ml/kg/min of the Burmese urban subjects was found to be comparable to the Malaysians (Duncan and Chan, 1974), Canadians (Cumming *et al.*, 1973), and Japanese urban subjects (Yoshisawa, 1972). They were however, low compared to the Scandinavians (Astrand, 1960; Hermansen and Andersen, 1965) and British (Pugh, 1974). On the other hand, the rural Burmese subjects having a maximal oxygen uptake of 39.21 ml/kg/min were found to be comparable to the Scandinavians and British.

The physical fitness and well-being of a person depend on his every day physical acti-

vity. The fact that the rural subjects had a higher maximal oxygen uptake could be explained by their work intensity of 55.13% of the maximal aerobic power exerting a training effect. Kilbom (1971) and Huibregtse *et al.*, (1973) have reported that a work intensity of 50 per cent of the maximal aerobic capacity had a training effect.

In the present investigation, a positive training effect of habitual physical activity of the rural subjects could not be observed with regard to muscle strength. Skill, determination and motivation may be more important explanations of the observed differences than attributing the poor test scores to lack of strength. As the higher scores expected in the strength test were not seen in this test design using the AAHPER performance tests, it is possible that these tests might not be measuring the actual strength of the muscle groups involved in the daily activities of the rural group.

Thus, it can be concluded that the habitual physical activity of the rural Burmese subjects was strenuous enough to exert a positive training effect on the maximal aerobic capacity, yet its effect on the performance scores could not be observed by the tests employed.

SUMMARY

A comparative study of the physical performance capacity of 32 Burmese women aged 19-24 years of the rural and urban area was conducted. Difference in physique was found between the two groups.

Maximal oxygen uptake of the rural group was 39.21 ml/kg/min and that of the urban group was 32.32 ml/kg/min, the difference being significant at 0.1% level. Maximal oxygen pulse and maximal work load were significant only at 2% and 5% levels respectively. Though maximal ventilation in the rural group had a higher mean value it was not significant. These showed a higher cardiorespiratory fitness in the rural group, which was attributable to their high work intensity of 55.13% of the maximal aerobic power. However, a positive training effect of habitual physical activity on muscle strength could not be observed in this study.

REFERENCES

ADAMS, E.H., (1938). A comparative anthropometric study of hard labour during growth as a stimulator of physical growth of young coloured women. *Res. Quart.*, *9* : 102.

AMERICAN ASSOCIATION FOR HEALTH, PHYSICAL EDUCATION AND RECREATION, (1965). *AAHPER Youth Fitness Test Manual.* The Association, A Department of the National Education Association, Washington D.C.

ASTRAND, I., (1960). Aerobic work capacity in men and women with special reference to age. *Acta Physiol. Scand.*, Suppl. 169.

ASTRAND, I., (1967). Degree of strain during building work as related to individual aerobic work capacity. *Ergonomics, 10* : 293.

ASTRAND, P.O., (1952). *Experimental studies of physical working capacity in relation to sex and age.* E. Mungard, Copenhagen. p. 118.

BAR-OR, O., (1972). A comparison of responses to exercise and lung functions of Israeli Arabic and Jewish 12-14 year old boys. 4th International Symposium on Pediatric Work Physiology, 14.3.72. In: *Abstracts of Scientific Papers.* Wingate Institute for Physical Education and Sports.

CUMMING, G.R., DEFRESNE, C. and SAMM, J., (1973). Exercise ECG changes in normal women. *Canad. Med. Ass. J., 109* : 108.

DUNCAN, M.T. and CHAN, K.Y., (1974). Aerobic work capacity in young untrain-

ed Asian women. *Quart. J. Expt. Physiol.*, *59* : 181.

HERMANSEN, L. and ANDERSEN, K.L., (1965). Aerobic work capacity in young Norwegian men and women. *J. Appl. Physiol.*, *20* : 425.

HUIBREGTSE, W.H., HARTLEY, L.H., JONES, L.G., DOOLITTLE, W.H., CRIBLEZ, T.L. and MASS, N., (1973). Improvement of aerobic work capacity following nonstrenuous exercise. *Arch. Environ. Health.*, *27* : 12.

INGELMARK, B.E., (1957). Morphological aspects of gymnastic exercise. *Bull. Fed. Int. d'Educ. Physique.*, *27* : 49.

KILBOM, A., (1971). Physical training in women. *Scand. J. Clin. Lab. Invest.*, *28* : Suppl. 119, 1.

LANDISS, C.W. and BARKER, D.G., (1969). A note on chest measurements. *Res. Quart.*, *40*: 417.

MACEK, M., CERMAK, V., HANDZO, P., JIRKA, Y., ROUS, J., SELIGER, V., ULBRICH, J. *et al.*, (1971). Comparison between 12, 15 and 18 year old groups of country and urban boys and girls. In : *Physical Fitness.* Proceedings of a Satellite Symposium of the XXV International Congress of Physiological Sciences held in Prague, Czechoslovakia, August 3-5, 1971. Ed. Seliger, V. Universita Karlova Praha. p. 244.

NOVOTNY, V., CERMAK, V., NANZO, P., HORAK, J., JIRKA, Z., MACEK, M., ROUS, R., SELIGER, V. and ULBRICH, J. *et al.*, (1971). Somatometric signs in the 12, 15 and 18 year old population in Czechoslovakia. In: *Physical Fitness.* Proceedings of a Satellite Symposium of the XXV International Congress of Physiological Sciences held in Prague, Czechoslovakia, August 3-5, 1971. Ed. Seliger, V. Universita Karlova, Praha. p. 299.

PUGH, L.G.C.E., (1974). The aerobic capacity of forty British women aged 17-27 years. *Ergonomics*, *17* : 185.

SELIGER, V., CERMAK, V., HANDZO, P., HORAK, J., JIRKA, Z., MACEK, M., PRIBRIL, M., ROUS, J., SKRANC, O., ULBRICH, J. and URBANEK, J., (1971). Physical fitness of the Czechoslovak 12 and 15 year old population. *Acta Paediat. Scand.*, Suppl. *217* : 37.

SHEPHARD, R.J., (1969). *Endurance Fitness.* University of Toronto Press.

STROM, G., (1949). The influence of anoxia on lactate utilization in man after prolonged muscular work. *Acta Physiol. Scand.*, *17* : 440.

UNDERWOOD, B.A., HEPNER, R., CROSS, E., MIRZA, A.B. and KALLUE, A., (1967). Height, weight and skinfold thickness data collected during a survey on rural and urban populations of West Pakistan, *Amer. J. Clin. Nutr.*, *20* : 694.

UYTVANCK, P.V. and VRIJEN, V., (1966). Investigations about some body circumference measurements for the appreciation of physical fitness in adolescence. *J. Sports Med. & Phy. Fitness.*, *6* : 176.

WEINER, T.S. and LOURIE, J.A., (1969). IBP Handbook No. 9. Human Biology–A guide to field methods. Section IBP/HA. Oxford: Blackwell Scientific Publ.

WYNDHAM, C.H., (1973). The working capacity of rural and urban Bantu in South Africa. *S. Afr. Med. J.*, *47* : 1239.

YOSHISAWA, S., (1972). A study of aerobic work capacity in urban and rural adolescents. *Jap. J. Phy. Fitness Sports Med.*, *21* : 161.