Physical fitness in Sri Lankan students

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Summary

Maximum oxygen uptake (VO_2 max) was determined in a group of sedentary medical students of both genders and in a group of University students and school children engaged in regular sports practices. The subjects were selected on a voluntary basis. The steady state heart rate during submaximal exercise on a bicycle ergometer was used to predict the VO_2 max from the Astrand nomogram. The fitness index calculated as VO_2 max in ml/kg body weight was used to determine the fitness level adjusted for age from the Astrand table.

The male sedentary and sports groups had fitness indices which corresponded to 'poor' and 'average' fitness levels, respectively. The female sedentary and sports groups had fitness indices which were not significantly different from those of the corresponding male groups and which corresponded to 'average' and 'good' fitness levels, respectively. Weight-lifters had a fitness level similar to that of the male sedentary group.

Key words: Physical fitness indices, sedentary individuals, sportsmen and sportswomen

Introduction

Cullumbine and his colleagues (1) were the first to assess the physical fitness of Sri Lankan subjects. They determined the following aspects of dynamic fitness in about 7000 subjects of both genders from age 10 to 40 years: fitness for a) moderate exercise using the Harvard step test b) severe exercise using the endurance step test and c) prolonged moderate exercise by performing the Harvard step test to exhaustion; strength and speed.

Fitness for moderate exercise gives an indication of the aerobic capacity of an individual. In assessing this, they used post-exercise recovery pulse rates and blood pressure readings to determine fitness indices for pulse and blood pressure. They found that at most ages, both these indices were significantly higher for male subjects, except at 17 years when the fitness index (pulse) for the 2 genders was the same.

More recently, maximal oxygen uptake (VO_2 max) has been recognised as the best index of aerobic fitness (2, 3). This applies to the endurance athlete as well as to the sedentary individual (4). There is no sex difference in VO_2 max in children, but after puberty, the average for females is 65-75% of that for males. In both genders, the peak is reached at 18-20 years of age (5).

Direct assessment of O_2 uptake during maximal exercise is a very exhausting procedure. Therefore, indirect methods have been devised by various workers to predict VO_2 max from pulse rates during submaximal exercise (6, 7, 8, 9). One of the commonly used methods is the prediction of the VO_2 max from the Astrand nomogram using the steady heart rate during submaximal exercise. Either a standard bicycle ergometer test or a step test could be used as the submaximal load (6). The VO_2 max thus determined, expressed in terms of body weight (ml kg^{-1} min^{-1}), gives the fitness index. This index is used to determine the fitness level adjusted for age from the Astrand fitness table which gives 5 levels of fitness – very poor, poor, average, good and excellent (7).

Dias and others used the Astrand nomogram to determine the fitness index of a group of Sri Lankan athletes from the national pool (10). The submaximal load used was the standard step

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test. According to their findings, the mean fitness indices (ml kg^{-1} min^{-1}) of male non-army athletes considered separately for sprinters and long distance runners were 48.8 ('average' range) and 55.1 ('good' range) respectively. The army sprinters and long distance runners had fitness indices of 60.4 and 74.9 respectively, both being in the 'very good' range. These were significantly higher than the indices for non-army athletes ($p < 0.05$). The female athletes had a fitness index of 44.4 ('good' range).

The results of a study of 3 tests of physical fitness on 10 sedentary males [mean age – 24.6 years (sd 3.3)] have been reported earlier (11). The tests used were (a) Harvard step test where the recovery pulse rate was used to determine the fitness index, (b) physical working capacity at a heart rate of 170 using the bicycle ergometer test and (c) VO_2 max from the Astrand nomogram using the bicycle ergometer test. The mean fitness index of this group as determined from the Astrand nomogram was 50.6 ('average' range). Almost all these subjects preferred the bicycle ergometer test to the step test as it is less exhausting. It was decided to use this test to determine the fitness of a sample of Sri Lankan students.

Subjects

A total of 83 subjects – 42 males and 41 females – who were selected on a voluntary basis were studied.

They were divided into 5 groups according to gender and level of activity. The age distribution of the subjects by gender and group is shown in Table 1.

The male and female sedentary groups comprised first year medical students who were engaged in their studies most of the time without much physical activity.

The male sports group comprised subjects who engaged in regular sports activities. There were 20 schoolboys who attended the gymnasium for sports practices and 8 University students in this group. 16 of them were sprinters who practised for 10-20 hours per week and the others practised one of several games such as cricket, football, table-tennis for 5-10 hours per week.

The weight-lifters group consisted of University students who practised for 3-8 hours per week.

The female sports group consisted entirely of University students. All of them were sprinters who practised for 10-20 hours per week.

Method

A group of medical students was trained as observers. The submaximal load which would give a steady state heart rate within the limits of the nomogram was determined by several trials. The workloads to be used were fixed at 100 Watts for males and 65 Watts for females.

The bicycle ergometer (Godart-Statham nv) was used for exercising the subjects. All the sedentary subjects exercised in the laboratory of the Department of Physiology for collection of data. The room temperature varied from 26°C to 28°C during this period. Electric fans were switched on during the exercise and the data were collected between 9 am and 11 am.

The sports group and the weight-lifters were exercised in a room in the Gymnasium when they came for practice. Data from this group were collected between 4 pm and 5 pm and the room temperature varied from 27°C to 28°C during this period.

The seat of the ergometer was adjusted for each subject and the procedure explained. The subject, after resting for 5 minutes, started to cycle at the fixed workload at a fixed rate of 50 revolutions per minute. The carotid pulse was counted by a trained observer for the first 10 seconds of every minute of exercise until 2 consecutive readings did not differ by more than one. The exercise was then stopped. The reading multiplied by 6 was taken as the steady state heart rate for that workload. In all subjects, the 10 second reading was steady by the 5th minute.

Results

Student's 't' test was used to test for difference between groups.

Table 2 gives the results of analysis of data.

In males, the mean age of the sports group was significantly lower than that of the sedentary group ($p < 0.001$). The mean age of the sedentary group was significantly lower than that of the weight-lifters ($p < 0.001$).

The difference between the mean ages of the 2 female groups was not significant ($p > 0.5$).

The mean fitness index of the sports group was significantly higher than that of the sedentary group in both genders ($p < 0.001$).

The mean fitness index of weight-lifters was not significantly different from that of the male sedentary group ($p > 0.1$).

There were no significant differences between the mean fitness index of males and females in both sedentary and sports groups ($p > 0.1$).

The mean fitness index for females is 95% of that for males in both groups.

Table 1 – Age (Years) Distribution of Subjects by Group and Sex

Group	Male	No.	Female	No.
Sedentary		26		19
Minimum	20.6		21.2	
Maximum	25.5		23.8	
Mean	22.8		22.6	
SD	1.1		0.7	
Sports		28		22
Minimum	14.8		20.0	
Maximum	27.0		24.5	
Mean	19.5		22.4	
SD	3.5		1.2	
Weight-lifters		8		
Minimum	22.0			
Maximum	32.0			
Mean	26.5			

Table 2 – Fitness Index of Subjects by Age and Group

Sex	Group	No.	Fitness index [VO_2 max (ml.kg^{-1}, min^{-1})] Mean	SD	Minimum	Maximum	Fitness level
Male	Sedentary	26	39.0	5.9	23	49	Poor
	Sports	28	47.8	5.8	35	57	Average
	i. adults	8	44.0	6.1	35	56	Average
	ii. adolescents	20	49.7	4.8	42	57	Average
	Weight-lifters	8	37.0	7.3	24	46	V. poor
Female	Sedentary	19	37.0	6.9	24	49	Average
	Sports	22	45.4	4.3	37	53	Good

The fitness levels of both female groups are higher than those of the corresponding male groups.

Discussion

The mean fitness index of the sports group is significantly higher than that of the sedentary group for both genders ($p < 0.001$). Weight-lifters, whose aerobic training is minimal, have a fitness index which is not significantly different from that of the male sedentary group ($p > 0.1$). Both the female groups have a higher fitness level in the Astrand fitness table than the corresponding male groups.

The mean fitness indices of the male and female sports groups are not significantly different from those of the different groups of male athletes and the female athletes respectively in Dias' study ($p > 0.1$) and the fitness levels are comparable.

Twenty of the subjects in the male sports group are schoolboys who are under 19 years of age. When the mean fitness index is determined separately for the University students (adults) and the schoolboys (adolescents) in this group (Table 2), there is no significant difference between the two ($p > 0.1$). Both these indices are significantly higher than that of the sedentary male group ($p < 0.05$ and $p < 0.001$ respectively for the adults and adolescents). The fitness level has not changed in either group.

The values for fitness indices obtained for females are about 95% of those for males (and higher than values reported in textbooks) in both the sedentary and the sports groups, but the differences are not statistically significant.

Grantham and others obtained similar results in a study on Canadian medical students, where the VO_2 max was determined from the Astrand nomogram using the bicycle ergometer test (12). The male and female students had mean fitness indices of 47.3 ('average' range) and 45.2 ('excellent' range) respectively. They consider it noteworthy that the males had a lower relative level of cardiorespiratory fitness than their female counterparts. The Astrand fitness level is based on data obtained from Scandinavian subjects. Therefore, even though the Astrand fitness index may be used to assess physical fitness, the Astrand fitness level may not be applicable to Sri Lankan subjects.

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