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Physiology

COMPARATIVE STUDY OF AEROBIC POWER BETWEEN SPORTSMEN AND SEDENTARY CONTROL GROUP

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ABSTRACT **Introduction:** Maximal oxygen uptake is the fundamental measure of exercise physiology.VO2 max is widely recognized as a depiction of functional limitation of the cardiopulmonary system as well as a degree of aerobic fitness. VO2 max is the maximum capacity of an individual's body to transport and utilize oxygen during exercise, which reflects the physical fitness of the individual. Persons with higher cardiovascular efficiency like sportsmen, have the capacity to yield more amount of energy and perform better.

Aim and objective: To find out and compare aerobic power in sportsmen and control group.

Material and methods: It was calculated using Harward's step technique and Astrands-Rhyming nomogram. The present study was a cross sectional study. 50 sedentary medical students as control group were selected from a medical college. 50 sportsmen in the age group of 18-25 years, who were playing that particular game for 3-5 years, were selected from a local sports institute.

Result: VO2 max in sportsmen (4.48±0.31) lit/min was significantly higher than in control group (3.29±0.29) lit/min.

Conclusion: Regular physical exercise like sporting activity improves cardio-respiratory fitness (Vo2 max).

KEYWORDS : sportsmen, aerobic power, VO2 max, Harward step test

Introduction

Civilization and industrialization have made living pleasant, jubilant and luxuriant. Indeed, automation and other technologies have added greatly to lessening of physical activities at work place and home. Assessment of cardiopulmonary efficiency has been growing in significance because several data link the VO_2 max with sportsman's fitness. Maximal oxygen uptake is the vital measure of exercise physiology.VO_2 max is widely recognized as a representation of functional limitation of the cardiopulmonary system as well as a measure of aerobic fitness. VO_2 max is the maximum capacity of individual's body to transport and utilize oxygen during exercise, which reflects the physical fitness of the individual. Persons with higher cardiovascular efficiency like sportsmen, have the capacity to yield more amount of energy and perform better. VO_2max (maximum oxygen uptake) denotes the intensity of aerobic process and actually signifies the maximum capacity to transport and utilize oxygen during exercise done at increasing intensity.[1] It is highest rate of oxygen consumption achievable during maximal/ exhaustive exercise. It reflects physical health of an individual having athletic capacity. Exercise training also brings about specific metabolic and physiologic adaptations that involve cellular as well as gross physiological changes.[2] The aim of this study was to find out aerobic power in sportsmen and control group.

Material and Methods

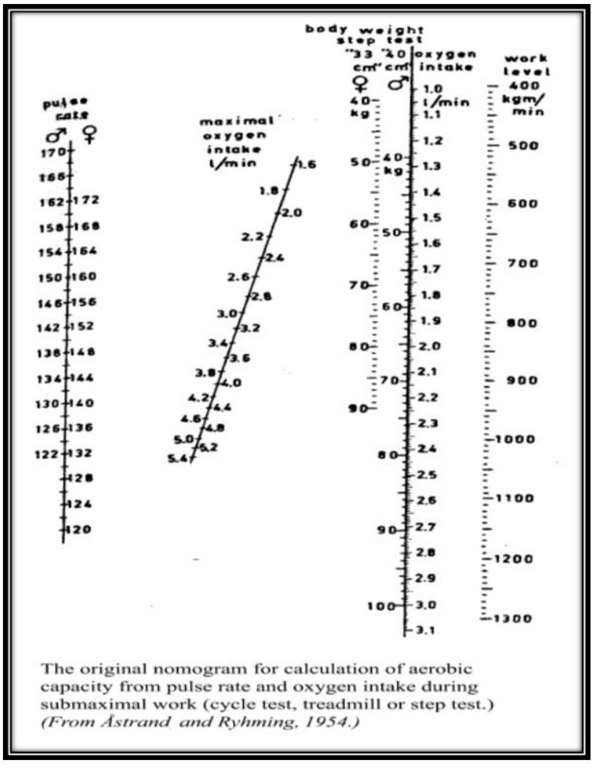
Study design -

The present study was a cross sectional study. The synopsis of study protocol was submitted to the institutional ethics committee and approval was obtained. Study was conducted in department of physiology of a government medical college from August 2009 to 2011.

Selection criteria - 50 sedentary medical students as control group were selected from a medical college. 50 sportsmen were selected from a sports institute (Krida Probhodhini) in Pune. Healthy non-smoker, non-alcoholic and non-tobacco chewer sportsmen in the age group of 18-25 years playing that particular game for 3-5 years and without history of any major illness in past and were included. Subjects with any cardiopulmonary disease, smokers, alcoholics and tobacco chewers and medical students doing regular exercise were excluded from the present study.

A written consent regarding voluntary participation in the study was taken from all subjects.

Maximal oxygen consumption (VO_2 max) was calculated in all subjects using Harward's step technique and Astrands-Rhyming nomogram. The subject was asked to step up and down on a 16 inch bench, 30 times per minute for 5 minutes. The rate was adjusted with the help of a metronome. The pulse rate for one full minute was noted immediately after the exercise. This was matched with the weight of the subject on Astrands-Rhyming nomogram to obtain Vo_2 max.[3]



Photograph – Astrand- Ryhming nomogram

Statistical analysis –

The detailed data was entered into the Microsoft excel sheet and subsequently analysed by using SPSS (Statistical package for social science) 11.5 software. Values were reported as Mean ± SD. Sportsmen and control group comparison was analyzed by applying unpaired "t" test. Significant P-value was set at less than 0.05 ($P < 0.05$).

Results

Table I: Mean values of physical characteristics in Sportsmen and Control Group

Sr. no.	Parameters	Sportsmen Mean ±SD	Control group Mean ±SD	p value
1	Age (years)	21.06± 0.5115	21.86±1.399	p > 0.05
2	Height (cm)	168.9±2.597	167.88±0.872	p > 0.05
3	Weight (kg)	65.38±0.923	64.50±1.164	p > 0.05
4	Pulse rate (beats/min)	64.94± 4.61	80.72±7.71	p < 0.0001

Table no. I shows mean values of physical characteristics in sportsmen such as age in years (21.06± 0.5115), height in cm (168.9±2.597), weight in kg (65.38±0.923) and pulse rate/min (64.94± 4.61).

The mean values of physical characteristics in control group were age in years (21.86±1.399), height in cm (167.88±0.872), weight in kg (64.50±1.164) and pulse rate/min (80.72 ± 7.71).

There was no significant difference in mean values of age, height and weight ($p>0.05$) between the two groups and hence both the groups were comparable with respect to these parameters. Pulse rate was significantly lower for sportsmen group as compared to control group ($p<0.0001$)

Table II - Comparison of VO2 max between Control & Sportsmen.

	Vo_2 max (liters/min)	
	Control	Sportsmen
Mean	3.296	4.484
SD	±0.29	±0.31
SEM	0.042	0.045
P	**P<0.001 (Significant)**	

Graph I: Comparison of VO2 max between control and sportsmen

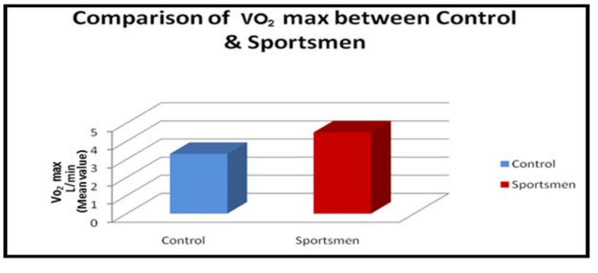


Table II and graph I shows comparison of VO_2 max between control & sportsmen.

Mean value of VO_2 max in sportsmen was higher than control group. The difference between mean value of VO_2 max in sportsmen and control group was statistically significant ($p<0.001$).

Discussion

Table 1 shows that there was no significant difference in mean values of age, height and weight ($p>0.05$) between control group and sportsmen. That means the two groups were comparable with respect to these basic parameters. However the pulse rate was significantly lower in sportsmen compared to control group. This might be attributed to higher vagal tone in sportsmen.

Table no. II and Graph I shows comparison of VO_2 max in control group and sportsmen.

VO_2 max in sportsmen (4.48±0.31) lit/min was significantly higher than in control group (3.29±0.29) lit/min.

The difference between mean value of VO_2 max in sportsmen and control group was statistically significant ($p<0.001$). The most advanced information regarding the energy output is by aerobic processes. This may be clarified by the fact that means for qualitative measurement of energy output by the human combustion engine have been existing ever since Lavoisier's discovery for oxygen utilization by living animals.

Astrands I and Hermansen L found that in young sedentary men, VO_2 max was strongly associated with body weight and height.[4,5] Benget, Satin and Astrand in their experiment for measurement of maximal oxygen uptake in athletes have shown that aerobic work power is the main factor for good performance in endurance events. From this view point, it is natural that highest values for VO_2 max are achieved by cross-country skiers, long distance runners, speed skaters and cyclists[6].Saltin and Ekblom B have shown that training rises VO_2 max by increasing the cardiac output secondary to greater stroke volume and increase in A-V oxygen difference.[7] AWS Watson found maximum VO_2max in Gaelic footballers and J. Meszaros et al observed high VO_2 max in international level Hungerian athletes.[8,9] Aziz AR, M Chia and K C Teh studied the relationship between maximal oxygen uptake and repeated sprint performance indices in field hockey and soccer players. They found high VO_2 max levels in hockey and soccer players.[10] William J Kraemer et al noticed that resistance training caused significant increase in VO_2max in women tennis players in contrast to the control group.[11] Tomasz Boraczynski and Jersy Urniaz showed significant increase in VO_2 max and anaerobic power in handball players after the 4 week training programme.[12]L. Vidal Andreato et al estimated aerobic power, muscular strength and flexibility in elite Brazilian jiu- jitsu athelets. They observed that the Brazilian athletes had medium aerobic power.[13] Mustafa Kurahan evaluated aerobic power in handball, basketball and volley ball female athletes. There was a significant difference between Vo_2 max of basketball and handball players.[14] Some researchers like Hermansen and Anderson, P.K.Das Gupta and De AK, Saltin B and Astrand PO, Thomas SG observed higher values of VO_2 max in athletes. [5,15,16,17]

Swimming Department State Central Institute of physical culture, Moscow observed more values of VO_2 max in national level swimmers as compared to college level swimmer.[18] Smita S. Bute et all got more values of $V0_2$ max in female athletes as compared to non-athletes.[19] Dr.S.P.Surwase et all observed more values of VO_2 max in football players as compared to control.[20]

The VO_2 max provides a quantitative assessment of an individual's capability for aerobic transfer. It is the most vital factor that determines one's ability to bear high intensity exercise for more than 4-5 minutes.[21] The higher value of VO_2 max in athletes is due to training, besides some genetic endowment on them. Priest JW and Hagan RD in there study found that he maximum steady state exercise resulted in increase in VO_2 max by 8.9 %. [22]

Training leads to increase in VO_2 max by increasing the cardiac output, secondary to raised stroke volume and increased arterio-venous oxygen difference. It is likely that physical training increases the VO_2 max by about 50% and rest 50% due to raised extraction of oxygen by working muscles which is indicated by an increased arterio-venous oxygen difference.[23]

Severe aerobic endurance training can lead to significant enlargement of all the cardiac chambers and a change in the cardiac configuration.[24] The density of capillaries of the skeletal muscles is raised by training. Hence raised capacity to irrigate the muscle with blood because of increased vascularisation should be one of the factors leading to increased aerobic capacity.[5]

Mitochondria of trained skeletal muscles have more capacity to generate ATP aerobically by oxidative phosphorylation.[20]

There is a selective hypertrophy of both slow twitch and fast twitch muscle fibers depending upon training type and activity.[25]

Persons with higher values of VO_2 max have the ability to yield greater amounts of energy and are also capable of enhanced performance in athletic activities. Klissouras V attributed the raised values of VO_2max in athletes to some genetic endowment on them. [26]

Conclusion

There was significant higher value of VO_2 max in sportsmen as compared to control group

Our study was mainly designed to show the effect of training on VO_2 max, aerobic power. It showed that the physical activity has an effect on the cardio- respiratory functions. VO_2 max can be taken as an index of cardio-respiratory fitness.

The result of this study strongly recommends regular physical exercise for the medical students. Medical students are always under tremendous stress which affects their work output and this is precipitated by sedentary life style. Regular physical exercise will definitely improve their cardio-respiratory fitness and will help them to lead a better quality of life.

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