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VO2 MAX AND ANAEROBIC POWER IN TRAINED & UNTRAINED SUBJECTS, EFFECT OF IRON, THIAMINE, AND ASCORBIC ACID.

Physiology

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ABSTRACT

This study shows the importance of physical training, which improves the VO2-max and anaerobic capacity significantly ($p<0.0005$ & $p > 0.05$). Determination of Hb is important in athletics fitness, which should be corrected by iron supplementation, which is increased significantly ($p<0.001$) 6. Thiamine & Ascorbic acid did not increase VO2-max & anaerobic capacity ($p>0.05$), hence emphasis should on the normal balanced diet and not on the extra vitamin supplementation.7, 8

KEYWORDS

Vo2-max, Iron, Thiamine, Ascorbic Acid

Introduction:
We live in automated and highly technologic society that does not require exercise. This results in the development of obesity & heart problems. Physical fitness is the ability to carry out daily task with vigor & alertness, without undue fatigue and to meet unforeseen emergencies. Physical fitness involves 4 components- (1) Cardio-respiratory endurance (2) Muscular strength (3) Muscular endurance (4) Flexibility

For aerobic capacity- Vo2-max (Maximal Oxygen Uptake) is accepted as the best single measure for functional capacity of the respiratory and cardiovascular system. It is important in performance of prolonged activity.

For anaerobic capacity- lewis Nomogram is used. Performance of exercise of short duration (few sec. to 1 minute) and high intensity can be found out.

Aerobic capacity & anaerobic capacity are the measure of physical fitness.

Anemia is reported in athletes commonly in female endurance athletes .Some authors suggested the supplementation of iron, ascorbic acid, and vitB1 (thiamine). Hence aim of this study.

(1) To find out Vo2-max & aerobic power in young trained & untrained subjects. (2) Effect of iron supplementation on Vo2-max & anaerobic power in anemic subjects. (3) Effect of B1 & ascorbic acid supplementation.

Vo2-max (Aerobic power):- Is the volume per minute (V), of oxygen (O2), which can be consumed by the organism at the maximum (max) workload which can sustained for a criterion period of time. It is represented as volume per minute (Lit/min). Some activities like racquet sports &team sports require burst of highly intense energy release separated by lower intensity recovery.

Anaerobic power:-Is the ability to develop power by utilization of phosphogen systems without using oxygen. If very powerfull efforts are required for a period of few seconds, the maximum rate of working is determined by the ability to split phosphogen and translate the released energy into mechanical work. It is tested by jump reach test applying Lewis nomogram, 50 yard dash test, and hand grip dynamometry.

Effect of training:- high standard of physical health is that the person can stand heavy muscular work for long period. Aerobic capacity increases the capacity to accumulate the great oxygen debt. The maximum blood lactic acid level is higher in trained person. Restitution after work is more rapid after training. The high value of aerobic activity is found in skier to be as high as 88ml/kg/min. Such increase is due to changes in both central & peripheral components of aerobic system.

Aerobic exercise increases oxygen utilization in several ways- (1) Strengthen the muscles of respiration (2) Improves the pumping efficiency of the heart (3) Tones up the muscles throughout the body (4) It causes increase in the total amount of circulating blood, rbc and Hb making the blood more efficient oxygen carrier.

Das Gupta & De (4) assessed cardiopulmonary efficiency in 18 Indian medical students and 19 state level athletes and found Vo2-max 2.7 ±0.27 lit/min. in non-athletes, and 2.98 ±0.34 lit/min in athletes.

Vitamins and muscular performance:- Vitamins are organic compounds needed in small amounts which act as catalysts for metabolic functions. It act as body regulators by helping other nutrients perform their functions. An adequate amount of vitamins can be obtained through a proper and well balanced diet.

Thiamine (B1) and muscular performance:- B1 plays important role in energy metabolism & in nervous system. Increased physical activity increases B1 requirements, because of the greater energy involved, but when expressed per 1000 k cal the requirement remained constant and does not vary. The level required to saturate the tissues is 0.3 t 0.35mg/1000kcal, and any excess will be excreted . B1 supplementation was not favorable. (7) (2)

Ascorbic acid (Vit C) & muscular performance:- Vit C is known to be involved in the synthesis of collagen, adrenaline & glucocorticoids and in metabolic reaction of tyrosine. Various studies have shown that supplementation of vit c is of no significance. (6)

Training and hemoglobin:-Many athelets are found to be anemic due to iron deficiency. It has been termed as “sports anemia” 70. It has been known since long that trained endurance athelets have low hematocrit value than non-athelets. The majority of the cases of anemia found in athelets are simple hypochromic iron deficiency anemia. The total amount of circulating Hb is well correlated with maximal O2 uptake (VO2-max). Anemic athelets may present with fatigue, lack of energy, listlessness. Iron deficiency anemia is easily corrected with tablets ferrous sulphate BP 200mg three times daily .

Material and Methods:-
The study was conducted in Indira Gandhi Government Medical College, Nagpur. 57 untrained subjects (medical students) (28 males & 29 females) and 71 trained subjects(42 males & 29 females) of Physical Education College Nagpur, who were doing regular exercise of about 2 hours since 1½ to 2 years. The age of all the subjects ranges from17 to 26 yrs.

The test carried out between 10am to 1pm after light breakfast. Height weight & chest circumference at the level of nipple during maximum inspiration & expiration.

Hb was estimated by cyn-methaemoglobin method.(Potassium ferricyanide oxidizes hemoglobin into methaemoglobin which is converted into cyn-methaemoglobin by potassium cyanide. The color produce by cyn-methaemoglobin is directly proportional to the

hemoglobin conc., and is measured by photometer). This method has excellent accuracy and reproducibility, and the color produced is stable for 24 hrs at room temperature.

VO2-max by Astrand-Astrand Nomogram :- Bench stepping test was conducted at the rate of 30 steps per minute for 5 minutes. The height of step being 33cm for females and 40 cm for males. One minute pulse rate was immediately recorded after exercise. Pulse rate and body weight data was applied to the nomogram and predicted VO2-max read from the middle scale (lit/min.) PHOTO. Anaerobic power by Lewis Nomogram:- Subjects power output was determined by knowing the score on the jump & reach and the body weight. The difference was measured between a person's standing reach and the height to which he or she can jump and touch. Body weight in kg and height in meter were applied to the lewis nomogram, and the aerobic power is directly read from nomgram in kg-meters/sec.

Among trained subjects:- 26 with low Hb of 11mg% or less were supplemented with iron (Tab. Ferrous sulphate 200mg) three times a day for 6 weeks, after which VO2-max & anaerobic power were estimated. Data was statistically analyzed by applying t-test and finding out correlation co-efficient.

Observations:-

In this study VO2-max & anaerobic power were estimated in 128 subjects 57 untrained and 71 trained subjects. 26 subjects had hemoglobin 11gms or less, were supplemented with iron and the effects of iron supplementation was seen in VO2-max & anaerobic power. 19 untrained subjects were supplemented with Thiamine and Ascorbic acid. The effects were seen on VO2 max & anaerobic power.

Table 1:- showing VO2-max (lit/min) & anaerobic power (kg/meter/sec) in trained & untrained subjects-

VO2-max	Trained	Untrained	Anaerobic	Trained	Untrained
No. of subjects	71	57	No. of subjects	71	57
Mean	2.51	2.13	Mean	67.80	64.38
SD	0.60	0.59	SD	10.39	15.38
Minimum	1.40	1.10	Minimum	34	36
Maximum	4.00	4.15	Maximum	106	101
Mean increase t-value p Significance	0.38 (17.84%) 3.54 <.0005 Highly significant		Mean increase t-value p significance	3.42 (5.31%) 1.21 > 0.05 Not significant	

Table 2:-Effects 0f VO2-max and Anaerobic power in trained subjects before & after iron supplementation

VO2-max	Before iron suppliment	After iron suppliment	Anaerobic	Before iron suppliment	After iron suppliment
No of subjects	26	26	No of subjects	26	26
Mean	2.50	2.70	Mean	64.53	65.84
SD	0.64	0.54	SD	18.19	17.58
t-value P Significance	1.20 >0.05 (0.23) Not Significant		t-value P Significance	0.263 >0.05 (0.793) Not Significan	

Table 3: - showing VO2-max (lit/min) And Anaerobic power (kg/meter/sec) before and after vit. B1 (Thiamine) & vit. C (Ascorbic acid) in untrained subjects

VO2-Max (lit/min)	Before Vit.B1	After Vit.B1	Before Vit.C	After Vit.C	Anaerobic kg/metr/sec	Before Vit.B1	After Vit.B1	Before Vit.C	After Vit.C
No. of Subject	19	19	19	19	No. of Subject	19	19	19	19
Mean	2.23	2.47	2.16	2.33	Mean	64.42	64.42	64.84	66.31
SD	0.80	0.60	0.48	0.65	SD	18.20	17.46	15.25	17.67
t-value P Significance	1.02 >0.05 (0.31) Not significant		0.91 >0.05 (0.36) Not Significant		t-value P Significance	0 >0.05(0.72) Not Significant		0.27 > 0.05 (0.78) Not Significant	

Discussion

Aerobic capacity (VO2-max) is one of the important criterion to assess the oxygen transport system or cardio-pulmonary efficiency. It is significant in prolonged activities like swimming, cycling, boxing, wrestling and track running (400mtrs to Marathon). Anaerobic capacity is important in exercise of short duration. It is significant in jumping, throwing, weight lifting, and shooting.

VO2-max and Anaerobic power of **untrained** subjects:- VO2-max of the present study carried out in Indian subjects were similar to those reported by Gupta et al.65,Das Gupta & De A K . & Bhawani et al (4). But less than those reported by Dua et al 42, & jain et al 87. Walter and Nancy and Astrand I (1).The present untrained subjects were medical students who had very little physical activity that can be the cause of lower values in our study.(See Table 1)

VO2-max and Anaerobic power of **trained** subjects:- (See Table 2) Training causes change in maximal oxygen uptake. Our values in trained subjects are 17.8% higher than untrained subjects which is comparable with the studies of Ekblom et al 50 & William et al. Trained subjects shows significantly higher VO2-max than untrained subjects, which enable them to sustained higher work load. Training increases the oxygen utilizing capacity by- 1) Strengthen the respiratory muscles 2) Improves the pumping efficiency of the heart. 3) Tones up the muscles throughout the body. 4) Increase in the total amounts of circulating blood in the body.

Anaerobic power in our study was 67.80 ± 16.39 kg.meter/sec.in 7 trained subjects as compared to 64.38 ± 15.45 kg.meter/sec in 57 untrained subjects which is not significant. This could be because, these trained subjects were involved in aerobic training & anaerobic power requires instant energy and quick vigorous efforts of short duration.

Effect of iron supplementation on hemoglobin, VO2-max and anaerobic power (See Table 3):- Many sports person were found to be iron deficient under heavy training stress. It may be due to marked increase in the plasma volume to red cell mass because of physical exercise. (6) Intravascular hemolysis due to increased mechanical destruction of rbc during exercise. 100. Possibly may be due to 1) reduced dietary intake of iron. 2) Iron loss through sweating. 3) Myoglobin iron loss by rahado myolysis. 4) Hematuria and gastrointestinal bleeding.. In our study out of 71 subjects trained subjects, 26 trained subjects before iron supplementation showed Hb 10.16 ± 0,99 gm%. After iron supplementation mean Hb level was 11.31 ± 0.99 gm%, an increase of 11.32%, which is significantly higher ($p < 0.001$). VO2-max after iron supplementation was increased by 8% ($p > 0.05$), which is non-significant. Anaerobic power after iron supplementation was also non-significant ($p > 0.05$). Our findings are comparable to Rudolf & Telford.

Effect of Thiamine supplementation on VO2-max and anaerobic power (See table 3):- Thiamine plays an important role in energy metabolism (fat and carbohydrate) & in the central nervous system. In our study VO@-max is slightly increased after thiamine supplementation (non-significant $p > 0.05$). Our finding is comparable with other researchers like Keys & Henschel 89 Karporich & Millan 90 . Increased physical activity increases the thiamine require,ent because of greater energy involved, but when expressed per 1000 kcal, the requirement remains constant and the extra amount is excreted(6) . If the subject is fed with well-balanced diet there is no need of thiamine supplementation.

Effect of Ascorbic acid supplementation on VO2-max and anaerobic power (See Table 3):- Ascorbic acid has influence on muscle metabolism due to muscle glycogen reduction. Our study showed no significant differences of ascorbic acid supplementation. This is comparable with Grey G O & Bailey et al (2). If the subject is fed with good balanced diet, there will be no need of Vit C supplementation.

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