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Comparison of maximal oxygen uptake and perception of fitness in young male swimmers and gym members

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Abstract

Background: In today's fitness conscious society, people seek various modes to gain fitness like swimming, aerobic dance, gymming etc. All such tasks help to improve maximum oxygen uptake.

Aim: To compare VO_{2max} and International Physical Activity Questionnaire IPAQ score between young male swimmers and gym members. Methods: Swimmers and gym members practicing since 6 months to 2 year having age of 17 to 25 years were included in the study. Subjects having cardiopulmonary, orthopedic and neurological impairments were excluded. VO_{2max} was calculated by Rockport method for both the groups and they were asked to fill IPAQ questionnaire.

Results: On comparison, VO_{2max} and IPAQ score were statistically higher in swimmers.

Conclusion: Swimming is a better fitness tool to improve fitness compared to that of gymming as far as its perception & aerobic capacity is concerned.

Keywords: swimming, VO_{2max}, IPAQ questionnaire

Introduction

The sport of swimming has been recorded since prehistoric times; the earliest recording of swimming dates back to Stone Age paintings from around 7000 years ago. It became part of first modern Olympic Games in 1896 in Athens. William Wilson wrote in the 1883 book, "the swimming instructor": the experienced swimmer, when in water may be classed among the happiest of mortals in the happiest of moods and in the most complete enjoyment of happiest of exercises. Swimming is characterized by predominantly simple movements which differ in the form and manner of performance. Swimming can be undertaken using wide range of different styles known as strokes, there are four main strokes used in competition and in recreational swimming which are front crawl, breaststroke, backstroke and butterfly. The arms move in wide arcs, the hips are engaged as the legs scissor through the water and the head and spine twist from side to side, plus with every stroke as swimmer reach forward, lengthening the body which also helps give a good stretch from head to toe.

Swimming provides an all-over body workout as

1. Nearly all of the body parts such as pectorals, biceps, triceps, abdominals, quadriceps, hamstrings, calf muscles and many more.
2. Swimming puts the body through a broad range of motion that helps body to stay loose and flexible.
3. When human body is submerged in water, it automatically becomes lighter and therefore pool provides an ideal peace to work on overweight bodies.

Swimming engages practically all muscles groups of the body. It is therefore not surprising that very high oxygen uptakes have been obtained in swimmers [1]. The maximum oxygen consumption index or VO_{2max} is use for measurement of aerobic power. Maximum oxygen uptake (VO_{2max}) is defined as the highest rate at which oxygen can be taken up and utilized by the body during severe exercise. It is one of the main variables in the field of exercise physiology, and is frequently used to indicate the cardio-respiratory fitness of an individual [2]. Since there is a strong positive correlation between V02 max and physical work

Capacity [3, 4], it is generally considered the best indicator of cardio-respiratory endurance and aerobic fitness. Gymming was popular in ancient Greece. It is a type of physical exercise specializing in the use of resistance to induce muscular contraction which builds the strength, anaerobic endurance and size of skeletal muscles. It involves manipulations of the number of repetitions (reps), sets, tempo, exercises and force to cause desired change. Gymming primarily consist of free weights including dumbbells, barbells and exercise machines. Many types of group exercises classes exits but generally these includes classes based on aerobics, cycling, high intensity training, yoga, Pilates and muscle training.

Aerobic walk tests are the most common field tests of cardio respiratory fitness. The Rockport 1.0 Mile Walk Test predicts aerobic fitness for individuals of all ages [5, 6]. This test incorporates the time to finish the walk, exercise heart rate, body mass, age, and gender into an equation to predict aerobic fitness. The Rockport Fitness Walking Test (RFWT), a maximal-paced 1-mile track walk, appears to satisfy several

considerations deemed important in field tests that estimate maximal oxygen consumption VO_{2max} [7].

Methodology

Approval of the Institutional ethical committee was obtained prior to the commencement of the study.

Study Design: Observational cross sectional study

Sample Size: Two groups were selected group A and group B, where group A is swimmers and group B is Gym members. 30 swimmers and 35 Gym members were selected on the basis of inclusion criteria.

Procedure

The study was conducted among swimmers and Gym members who has practice session of one hour for 6 days/week. Two groups were selected GROUP A and GROUP B where group A is swimmers and group B is Gym members. After taking written consent from the subject of both groups that is group A and group B, they were requested to fill the International physical activity questionnaire(IPAQ) [8, 9] IPAQ is a simple questionnaire which measures the subjective as well as objective data regarding self perception of fitness. Then they were asked undergo Rokport Testing. The Rockport Walking Test is a submaximal field test to estimate VO_{2max}. The 400 m track on level ground was demarcated in the campus of Physiotherapy department at Digdoh hills Hingna, district Nagpur. Subjects were asked to walk for one mile as fast as possible and the time taken by them to complete the walk was measured .The participant's heart rates (HR) were recorded immediately upon the completion of the mile. The VO_{2max} can be calculated by, Estimated VO_{2max} (in ml • kg-1 • min-1) =132.853 – (0.0769 x weight) – (0.3877 x age) + (6.315 x gender) –(3.2649 x time) – (0.1565 x HR)[5,6] Where, Weight is in (lb), age in (yr), and gender (Males = 1, females = 0), time in min, and post exercise heart rate (bpm)

Fig 1: Subject performing Rockport's Testing

Statistical analysis

Table 1: Comparison of VO_{2max} in group A and group B.

Group	Mean VO_2 Max	STD. Deviation	T Value	P Value
A	53.64	5.807	1.4229	<0.0001
B	46.93	4.081		

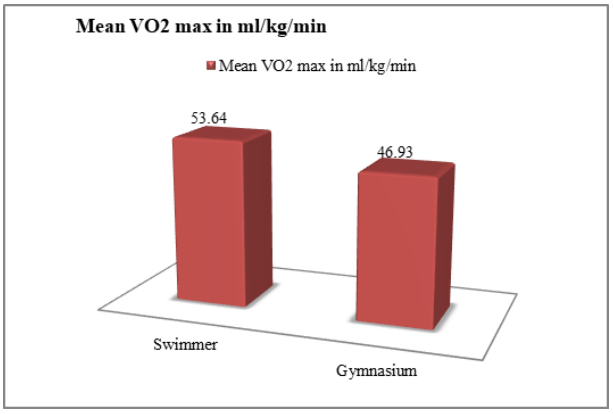

Fig 2: In comparison of VO_{2max} group A showed higher values than Group B which was statistically highly significant

Table 2: comparison of total time consumption during test by Group A and Group B.

Group	Mean Time	STD. Deviation	T Value	P Value
A	14.80	1.105	3.204	0.003
B	16.00	1.257		

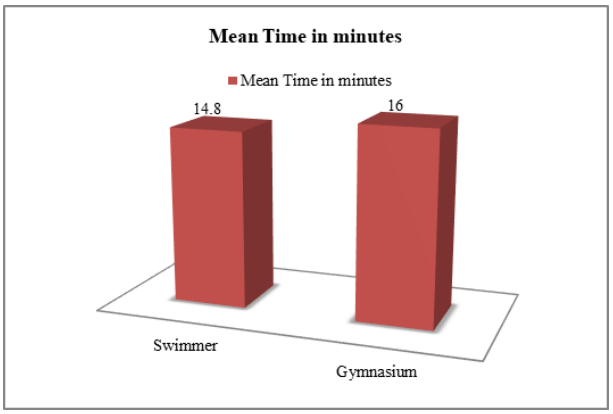

Fig 3: Group B took more time (statistically significant) than group A to complete the test.

Table 3: comparison of IPAQ score in group A and group B

	Group	Mean Scoring of Ipaq	STD. Deviation	P Value
Scoring of IPAQ	A	2652.80	1710.227	0.978
	B	2508.45	970.939	

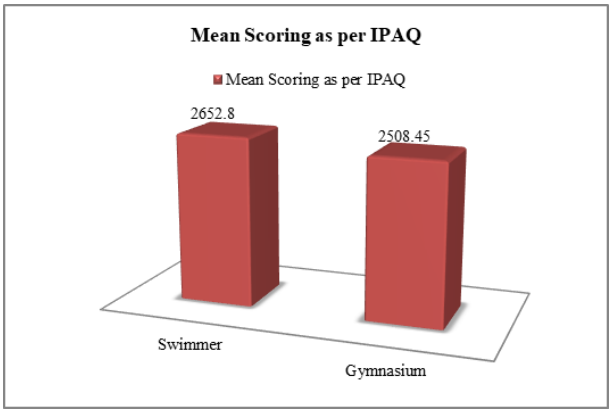

Fig 4: On comparison of IPAQ [8, 9] score group A had statistically significantly more scoring than group B

Results

On comparison of VO_{2max} group A showed higher values than group B which is statistically highly significant. Group B took more time (statistically significant) than group A to complete the test. On comparison of RPE scores group B showed statistically significant higher values than group A.
On comparison of IPAQ score group A had statistically significantly more scoring than group B.

Discussion

The present comparative and cross sectional study shows that

1. Maximal oxygen uptake in swimmers is higher compared to gym members.
2. Time taken by the swimmers to complete the test is less compared to gym members.
3. RPE scores of swimmers is less as compared to gym members.
4. On comparison of IPAQ scores, swimmers scored more than gym member.

In a study done by CORRY and N. POWERS, Five cross-country runners and five competitive swimmers performed a pulling exercise with elastic shock cords and a treadmill run to exhaustion. The runners could reach 41% to 64% of their running V02 max in the pulling exercise; with a mean of 53%. The swimmers reached 72% to 85%, with a mean of 79%. With the heart rate attained by swimmers was 93% to 98% mean 96% and runners attaining 91% to 103% and mean 95%; Oxygen pulse, the volume of oxygen consumed per Heartbeat, is where the most clear-cut difference between the groups is seen. In running, the O_2 pulse max was 23 ml/beat for the runners and 24 for the swimmers, while in pulling the runners dropped to 13 and the swimmers to 20 in a given specific activity [10].
The explanation for the higher maximal oxygen uptake and oxygen pulse in swimmers is that heart rate and blood lactate responses to sub maximal exercise are sensitive indicators of endurance fitness [11, 12] and that blood lactate responses are related to training induced adaptations occurring within skeletal muscle [13, 14].
Good swimmers tend to be above average for lung capacity. Training during adolescence increases vital capacity and total lung capacity due to the development of a broad chest and long trunk and this increased vital capacity helps swimmers maintain their buoyancy [15].
During the first 10-15 sec of underwater breath hold swimming in humans, the cardiovascular response (as indicated by heart rate) is similar to that seen during a similar level of exercise while breathing air. From then on there is a progressively more intense bradycardia which is probably indicative of an oxygen conserving response consisting of reduced perfusion of most of the body except the heart, CNS and active locomotory muscles. The degree and rate of onset of this proposed oxygen conserving response are influenced by the intensity of the exercise [16]. Endurance training causes increase in percentage utilization of maximal oxygen uptake (% VO2 max). It also causes increase in VO_{2max} of fast-contracting muscle fibers and rapid disappearance of lactate from muscle and blood. Endurance training causes increased number of myoglobin and mitochondria in slow-contracting and fast contracting muscle fibers. It also causes increased stroke volume and cardiac output. Therefore, adaptations to endurance training that increases maximal oxygen consumptions can be divided into two groups.
The Adaptations to endurance training that increase maximum oxygen consumption and also increases the amount of oxygen supplied to the muscles includes the increased amount of oxygen transferred from the lungs into the bloodstream, the increased total amount of blood in the body, the increased number of red blood cells; increased cardiac output, the increased number of capillaries around the muscle fibers and improved blood flow to working muscles.
Adaptations to endurance training that increase oxygen utilization by the muscles includes the increased rate of myoglobin in the muscle, the increased size and number of mitochondria, the increased activity of enzymes that regulate aerobic metabolism. Air column resistance also plays a role in case of swimming while diving and getting out of the swimming pool. Hence this can be one of the components of the better VO_{2max} in swimmers. All these adaptations directly or indirectly affect the increase in VO_{2max} among
Swimmers [17]. Being an endurance swimmer, swimmers may have unconsciously remained around the limit of his aerobic power. An alternative explanation for his relatively low blood lactate concentration after the men's 100 metre freestyle event relates to the fact that he had previously swum in the 1500 metre freestyle [18, 19, 20]. According to VO_{2max} values, the work intensity in swimming can be optimized through exercise heart rate and subjective feelings of fatigue and therefore it is very important to measure the maximal oxygen uptake which is the highest level of performance [21] The research (physical fitness and mental health) suggests that physical fitness training leads to improved mood, self concepts and work behavior large body of research has demonstrated a link between exercise and affective states and investigations have frequently reported mood improvements following acute and chronic bouts of exercises in swimming

Conclusion

From this study, it can be concluded that swimming is better fitness tool subjectively and objectively compared to gym activities

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