“Effect Of Yogic Exercise Module On Aerobic Capacity In Young Adult Males -A Study In Central India”

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Abstract:
Introduction – Yoga is a science that’s being practiced in India over thousands of years which facilitates homeostasis, an ancient way of life intended to improve the quality of life, general health and fitness of an individual. Practice of yogic exercise have proposed to alter the aerobic capacity of individual. Physical fitness depends upon cardiorespiratory endurance of an individual which can be determined by VO2 max.

Aim and objectives - To assess the effect of yogic exercise module on aerobic capacity (VO2 max).

Methodology – Total forty, first year MBBS male students, age 18-20 years with normal body mass index were included in the study. They performed yogic exercise in the form of module which included a set of physical postures (asana), breathing techniques (pranayama), and meditation (dhyana) for 35mins, 5times /week for 6 months. VO2 max was assessed using (AD-Instrument) pre and post interventional.

Results - Mann Whitney U test was used to compare pre and post interventional results. VO2 max was found to be increased after 6 month’s practice of yogic exercise. P < 0.05 was considered statistically significant.

Conclusion: Aerobic capacity of young adult participants was found to be enhanced after 6 month’s practiceyogic exercise module.

Keywords – Yogic exercise, Aerobic capacity, VO2 max.

INTRODUCTION-
In Sanskrit word yoga means yoke or union. Yoga unites individual self with the cosmic consciousness. Yoga is a science being practiced in India over thousands of years. It facilitates homeostasis, an ancient way of life intended to improve the quality of life, general health and fitness of an individual[1]. It produces consistent physiological changes and have sound scientific basis. Yoga is psychophysical in character due to the continuous focus on the body, breathing and mind. It is also a spiritual tool with enhanced health and well-being as one of its positive effects.

The origin of yoga has occurred in India thousands of years ago. It is a method of learning that aims to attain the unity of mind, body and spirit through three main yoga structures: exercise,
breathing and meditation. Yoga is a great form of exercise and a mind–body practice that can have physical, mental and emotional benefits (2). Yoga uses psychophysical energy movements including specific body postures (asana), breathing exercises (pranayama) and concentration exercises (dharaana) for the mind which are very commonly applied for health benefits and are found to be beneficial for better maintenance of body functions even in normal healthy subjects (3). It has been observed that asana in yoga resembles more of a physical exercise, which may lead to the perception that yoga is another kind of physical exercise. The Oxford English dictionary defines exercise as’Activity requiring physical effort, carried out to sustain or improve health and fitness’ (4). Practice of physical postures (asana) improves the muscle strength, flexibility, mind-body coordination and balance. At cellular level there occurs improvement in the blood flow, tissue perfusion and oxygenation.

Focusing on one’s own breathing (pranayama) while practicing yoga body movements, and vice versa can function as a tool to increase awareness of tension/relaxation states (5). Technique of breathing pranayama helps us to control our emotions & also influences our vital energy sheath. Slow, deep and rhythmic breathing is ideal for controlling stress and overcoming emotional hang-ups. The practice of pranayama helps us to regulate our emotions and stabilize the mind. We can observe that our breathing becomes rapid when we are angry and it is slower when we are cool and relaxed. Thus, slow, rhythmic and controlled breathing in pranayama leads to the emotional control seen in many yoga sadhakas.

Meditation (dhyana) helps us to focus our mind and dwell in it to channelize our energy in a holistic manner towards the right type of evolutionary activities. Also makes us to understand our self-better to become better humans in this social world (6). It acts by calming down the mind, improves the concentration thus helps in enhancing work output. By maintaining tranquillity of mind, it can promote clear thinking, better judgment and effective decision making. (7). It is a state which eliminates unnecessary thought, effortless attention on the present moment. In order to experience the real essence of yoga - the full integration of body, mind and soul, the ability to calm mental turbulence is essential (4, 8).

Fitness level of an individual depends on oxygen which can be transported by the body to working muscles to use that oxygen, hence maximum oxygen uptake capacity is widely considered to be reliable indicator of fitness. It is a measure of aerobic capacity has been determined as the international standard of physical activity (9). VO₂max refers to the intensity of aerobic process and actually denotes the maximum capacity to transport and utilize oxygen during exercise done at increasing intensity. It is the highest rate of oxygen consumption attainable during maximal exercise. The basic unit of measuring the maximal oxygen uptake is its absolute value expressed in liters or milliliters per minutes. However, the absolute value is highly affected by body weight so it is often expressed as ml/kg/minutes (10).

Accurate ways to assess VO₂ max are through maximal graded exercise test, performed to violation exhaustion on motorized treadmill or cycle ergometer while expired air is analyzed continuously by gas analyzer. At present costly equipment and staff training limits direct measurement of VO₂ max also very few studies demonstrating effect of yogic module on aerobic fitness of healthy young males are available hence forth this study was undertaken.

MATERIAL AND METHODS

Study setting: Study was conducted in Exercise Physiology Laboratory in Department of Physiology and gymnasium of Jawaharlal Nehru Medical College, Sawangi (Meghe), Wardha.

Study design: Prospective interventional study

Study duration: One year

Sample size: Considering drop out, sample size kept was 10% more than expected. Forty-two first year MBBS male students were recruited as participants in each group of age 18-20 years with normal body mass index from Jawaharlal Nehru Medical College, Sawangi (M), and Wardha.

Sample size calculation for testing a hypothesis in interventional studies (11)

Sample size= 2SD²(Z α/2+ Zβ)²

d²

SD = Standard Deviation from previous studies
or pilot study \(^{(12)}\)  
\[ = 5.2 \]
\[ Z \alpha/2 = Z 0.025 = 1.96 \text{ (from Z-table as Type I error)} \]
\[ Z \beta = Z 0.050 = 0.842 \text{ (from Z-table) at 80% power} \]
\[ d = \text{effect size} \]
\[ = \text{difference between mean values} \]
\[ = 69.8 - 66.5 \]
\[ = 3.3 \]
\[ \text{Sample size} = 2 \times 5.2^2 (1.96 + 0.84)^2 \]
\[ = 37.98 \text{ approx in each group.} \]

**Criteria for selection**

**Inclusion criteria:**
1. First year MBBS male students from Jawaharlal Nehru Medical College, Sawangi (M), Wardha.
2. All participants with age, BMI and sex matched.
3. Participants who had volunteered and given written consent.

**Exclusion criteria:**
1. Previous experience of yoga exercises.
2. Participants addicted to smoking and drinking.
3. Suffering from or diagnosed with any chronic diseases.
4. Participants with Chronic Obstructive Pulmonary Disease, cardiovascular disorder, hypertension or diabetes.
5. Participants suffering from any psychiatric illness.
6. Recent surgical procedures during the previous 6 months.

**Study Protocol**

Detailed plan of work, aim of present research project were explained to participants and briefed regarding study protocol. Written informed consent was obtained from them.

**Measurement of parameters:**

Prior to the day of recording of parameters all the participants were familiarized with the laboratory environment and were instructed regarding experimental procedures. On the day of recording they were advised to abstain from tea, coffee and any medication 24hr prior to recording of parameters. Recordings were done in morning after a light breakfast. All the parameters were recorded prior to the study and after six months completion of study.

1. **BMI** - Height without shoes was measured to the nearest 0.1cm using a standard meter. Body weight was measured using standard calibrated clinical weight scale in light indoor clothes to the nearest 0.1kg. Body Mass Index (BMI) = Weight in Kilograms (kg)/ (Height in meter)\(^2\)

2. **VO\(_2\) max** - Participants were asked to perform the maximal GXT on a treadmill (Precor 9.1/9.2, Ambala). In treadmill GXT, protocol participants were required to walk at a brisk pace at level grade for 3 min, followed by jogging at a self-selected speed at level grade (4.3-7.5 mph) for an additional 3 minute. Participants used hand signals to inform the test administrator when a comfortable jogging pace was achieved. Thereafter, the treadmill grade was increased 2.5% every min (treadmill speed remaining constant), until participants achieved volitional fatigue, and were unable to continue despite verbal encouragement. Heart rate-max (HR) was recorded at the highest observed HR during the final stages of the GXT. Metabolic analyzer was used to measure oxygen consumption (AD instrument). The highest full-minute oxygen uptake value observed during the final stages of the GXT was recorded as VO\(_2\)max. VO\(_2\) values were considered maximal when at least two of the following three criteria were satisfied \(^{(8)}\) Respiratory expiration ratio \(\geq 1.1\) Maximal HR of <15 bpm below age-predicted HR max (220-age) and Leveling off of VO\(_2\) despite an increase inwork.
**Intervention**

Participants were given moderate intensity yogic exercise for 35 minute’s duration in the form of module. It included asana, pranayam and meditation. Sequence of asana were Suryanamaskar (sun salutations), Trikonasana, Tadasan and Sukhasan. According to some author’s sun salutations postures had metabolic values higher than treadmill walking at 3.2 km/hour and they were not significantly different than ACSM recommended minimum values for moderate levels of exercise intensity (3.0 METs) \(^{(14)}\). Some studies found sun salutations to be strenuous form of yoga practice involving continuous movement and were comparable to walking 4.8km/hour on a treadmill which might provide enough intensity to improve cardiorespiratory fitness in sedentary individuals \(^{(15)}\). Sequence of pranayama were Anulom-Vilom, Kapalbhati which was followed by meditation. They were taught asana, pranayama by certified yoga trainer. They were trained for a period of week during which they were shown pictures, diagrams and audio cassettes related to yogic exercise for 45 minutes. Out of which last 20 minutes were devoted to a guided commentary \(^{(16)}\).

**Data Analysis:**

All data obtained were presented as mean and standard error of mean. Statistical Package for the Social Sciences software (version 20) was used for data analysis.

**Table -1. Age wise distribution of participants**

<table>
<thead>
<tr>
<th>Sr no</th>
<th>Age group (years)</th>
<th>Number of Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>18</td>
<td>12(30%)</td>
</tr>
<tr>
<td>2</td>
<td>19</td>
<td>17(42.5%)</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>11(27.5%)</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>40(100%)</td>
</tr>
</tbody>
</table>

**Mean ±SD** 18.87±0.85

**Interpretation** - 42.5% of the participants were of 19 years, 30% participants were of 18 years & 27.5% were of 20 years.

**Table-2.BMI wise distribution of participants**

<table>
<thead>
<tr>
<th>Sr no</th>
<th>BMI (kg/m²)</th>
<th>Number of Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Underweight(&lt; 18.5)</td>
<td>0%</td>
</tr>
<tr>
<td>2.</td>
<td>Normal Weight(18.5-24.9)</td>
<td>40(100%)</td>
</tr>
<tr>
<td>3.</td>
<td>Overweight(25-29.9)</td>
<td>0%</td>
</tr>
<tr>
<td>4.</td>
<td>Obese(≥30)</td>
<td>0%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>40(100%)</td>
</tr>
</tbody>
</table>

Mean ± SD 23.26±6.02

**Interpretation** - All (100%) of the participants were having normal BMI (18.5-24.9).

**Table-3. Effect of Yogic Exercise on VO2 Max**

<table>
<thead>
<tr>
<th>Sr no</th>
<th>Mea n</th>
<th>N</th>
<th>Std. Deviat ion</th>
<th>Std. Error Mean</th>
<th>Mean Difference</th>
<th>Z-valu e</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseli ne</td>
<td>20.6</td>
<td>4</td>
<td>1.65</td>
<td>0.25</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2 month</td>
<td>21.0</td>
<td>4</td>
<td>1.67</td>
<td>0.26</td>
<td>0±0</td>
<td>0.00</td>
<td>1.00, N</td>
</tr>
</tbody>
</table>

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**Interpretation**

Mean VO$_2$ max at baseline was 20.62±1.65, at 2 months it was 21.07±1.67, at 4 months it was 31.89±3.58 and at 6 months it was 40.59±3.16. By using Wilcoxon Signed Rank Test statistically no significant improvement was found at 2 months (z=0.00, p-value=1.00) and significant improvement was found at 4 months (z=5.32, p<0.05) and at 6 months (z=5.31, p<0.05).

**Discussion**

Physical fitness of an individual depends on it’s cardio respiratory endurance. VO$_2$max (maximal oxygen uptake/maximal aerobic power/aerobic capacity) is widely accepted as the best measure of cardio respiratory endurance. Analysis of VO$_2$ max was done by using Wilcoxon Signed Rank Test at the beginning of the study after two, four and six months of intervention. In present study 42.5% of the participants were of 19 years, 30% participants were of 18 years & 27.5% were of 20 years as shown in Table-1. All (100%) of the participants were having normal BMI (18.5-24.9) as shown in Table-2. On analysis of VO$_2$ max mean baseline value was 20.62±1.65, at 2 months it was 21.07±1.67, 4 months it was 31.89±3.58 and at 6 months it was 40.59±3.16. By using Wilcoxon signed rank test statistically no significant improvement was found at 2 months (z=0.00, p>0.05) but statistically significant improvement was observed at 4 months (z=5.32, p<0.05) and at 6 months (z=5.31, p<0.05) as shown in Table-3, Graph-3.

In present study no changes were observed after two months of yogic exercise in VO$_2$Max. Similar results were also observed in studies done by Hovsepian et al., 2013$^{(17)}$ who studied three months effect of yoga on physical fitness parameters in 60 healthy participants & Kodgire 2014$^{(18)}$ who studied two months effect of yoga on selected physiological variables of healthy individuals. In both the studies no improvement was observed in VO$_2$max after yogat raining. They conclude that short term yogat raining program was not able to...
facilitate the uptake of oxygen in tissues and hence there was no increase in VO₂max in the participants.

Significant improvement in VO₂max after four and six months of yogic exercise intervention in our study are consistent with those of previous research who showed similar improvement in VO₂max as seen in study done by Ray et al. 2001, Raju et al. 1997 and Amutha, 2010. Effect of hatha yoga exercise on aerobic capacity for six months duration was done by Ray et al. 2001 who found that absolute value of VO₂ max increased significantly in the yogagroup after 6 months of training. Raju et al. 1997 had found a significant increase in oxygen consumption per unit work after yoga training. They explained these changes on the basis that during meditation body achieves an altered state of consciousness in a brief period where relaxation response is produced causing metabolism of body to slow down also heart rate, blood pressure and breathing decreases which facilitates uptake of oxygen. Evaluation of the effect of yoga on anxiety levels and VO₂ max were also observed by Amutha, 2010 and Jayachandran, K, 2014. They observed decrease in anxiety levels with increase in VO₂ max of the study participants and concluded yoga being driven by its characteristic prolonged breathing helps to dampen the causes of anxiety within one’s mind which contributes in reduction of sympathetic activity and increase in maximal oxygen uptake. Similar results were seen in a prospective interventional study done by Doijad V, Kamble P, Surdi A 2013 where increase in VO₂ max after 12 weeks of yoga therapy was found. They suggested yogic exercise training brings generalized decrease in vascular tone due to stimulation of parasympathetic activity which helps in better utilization of oxygen at cellular level and contributing to increase aerobic capacity of participants. Also, Lau C et al. 2015 examined the effects of a 12-week Hatha yoga on 173 adults and found that the yoga group achieved significant improvements in VO₂ max (P<0.01) as compared to control group. Increased VO₂ max in the yogic exercise group after four months duration was also observed by Meshram K et al. 2017. Increase in muscular endurance caused by various yogic exercise postures results in better control of intercostal muscles that helps to improve lung functions could be the reason that would probably improve VO₂ max (24,25,26,27,28). Thus, overall increase in VO₂ max after yoga exercise intervention in our study ensures good aerobic capacity in participants.

CONCLUSION-

VO₂ max indicates physical fitness of an individual. Present study showed no increase in VO₂ max after two months of yogic exercise training from which it could be concluded that shorter term training program was not able to facilitate the uptake of oxygen in tissues and hence there was no increase in VO₂ max while increased VO₂ max after four and six months ensures good aerobic capacity in young participants of present study.

Limitation - Smaller sample size and only male participants were included in the study.

Future directions - Implementation of yogic exercise module in low cardio respiratory reserves participants, especially in patients in whom heavy exercises are contraindicated.

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Conflict of interest - None declared

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