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Effect of yoga on VO_2 max and anaerobic power of secondary school boys

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Abstract
Objective: The objective of the present study was to find out the effect of selected yogic practices on aerobic capacity and anaerobic power of sedentary school boys of West Bengal.
Subject: Twenty five (N = 25) sedentary school students were randomly selected as subjects for this study from Ashoknagar Boys Secondary High School, North 24 Parganas. The age ranged from 12-16 years. The study was confined into a single experimental group and no control group was considered.
Methodology: In the present study Aerobic fitness in terms of VO_2 max and Anaerobic Power were the two variables. Aerobic fitness were measured in terms of maximum oxygen consumption during exercise i.e. VO_2 max. VO_2 max was measured by Cureton's 1.0 mile run/walk test (Cureton et al. 1995) which was developed on the population having age ranged from 8-17years. Anaerobic Power were measured respectively by Margaria-Kalamen Anaerobic Power Test. A structured yogic training was intervened for six week.
Statistics: Mean and standard deviation of different variables were calculated. The data of the selected variables were analyzed through standard Statistical procedure. The mean of different variables were compared by using t- test. Statistical significance was tested at 0.05 level of confidence.
Results: The results highlighted that there were significant difference in aerobic capacity between pre and post treatment condition. On the other hand no significant difference was found in anaerobic power between the pre and post treatment condition.

Keywords: VO_2max, Aerobic Capacity, Anaerobic Power, Queens College Step Test and Margaria-Kalamen Anaerobic Power Test.

Introduction
All the orthodox systems of Indian Philosophy have one goal in view, the liberation of the soul through perfection. The method is by Yoga. Swami Vivekananda. Yoga is an ancient discipline designed to bring balance and health to the physical, mental, emotional, and spiritual dimensions of the individual. It is long popular practice in India that has become increasingly more common in Western society. "Hatha yoga‑ pradipika" again differentiates all asana into four basic classes–: sidhyasana, padmasana, sinhasana, anvadrasana. Besides, asana may be of two types–: dhyanasana (a posture keeps spinal cord free and center of gravity shifts to other part like ribs) and shasthyasana (to get healthy body).
Hatha Yoga is probably the best known form of Yoga and includes Asanas (body postures), Pranayama (control of vital energy through breath control), Kriyas (cleansing practices), Meditation, and Deep Relaxation to reduce stress and build self-confidence.
Aerobic (cardiovascular) capacity is one of the most important components of physical fitness. The other components are muscular strength and endurance, and flexibility and low-back function. Cardiovascular fitness is measured as the amount of oxygen transported in the blood and pumped by the heart to the working muscles and as the efficiency of the muscles to use that oxygen. Increasing cardiovascular fitness means increasing the capability of the heart and the rest of the cardiovascular system in their most important task, to supply oxygen and energy to your body.
Having good cardiovascular fitness has many health benefits. For example, it decreases your risk of cardiovascular diseases, stroke, high blood pressure, diabetes and other diseases. Cardiovascular fitness is best improved by activities, which employ large muscle groups working dynamically. Such activities include walking, jogging, running, swimming, skating,

cycling, stair climbing and cross-country skiing.

Anaerobic power is energy that is stored in muscles and that can be accessed without the use of oxygen. There are two systems that utilize this type of power, the phosphogen system and the lactic acid system. Human beings use this form of energy in short bursts that cannot be sustained for longer than about two minutes.

Aerobic capacity and anaerobic power are associated with the risk of emergence of cardiovascular diseases. As these factors as related to health have been the focus of researchers in the field of health and physical education. Over a past four decades, there has been as increase in the prevalence of overweight and physical fitness deterioration in adult across all genders, age and racial/ethnic groups. It can cause many risk factors to health including coronary heart disease, forms of cancer diabetes, hypertension, stoke, osteoarthritis respiratory problems etc. Low levels of physical activity and Aerobic fitness are both associated with higher risk of all causes and disease specific morality (Thune *et al.* (1998) [13].

A sincere attempt is made to know the research work already done in the subject area, the gaps and weakness of the past research, the methodology used and procedure followed from professional literature. Considering the research work in this field it can be concluded that a very little effort has been taken so far to find the effect of yoga practices on aerobic capacity and anaerobic power on sedentary school children. Accordingly the present project is planned to initiate research work related to the effect of selected yogic practices on aerobic capacity and anaerobic power of school boys from West Bengal.

Materials and methods

Subjects: Twenty five (N = 25) sedentary school boys were randomly selected as subjects for this study from Ashoknagar Boys Secondary High School, North 24 Parganas. The age ranged from 12-16 years. The study was confined into a single experimental group and no control group was considered. They were basically the students of class VII, VIII & IX of the institution. The study was approved by Institutional Ethical Committee.

Experimental protocol: A six weeks Yogic training schedule (5 days in a week), started on 25th January up to March 1st week, were intervened on the subjects by the researcher with the help of qualified yoga instructor and other coaching professionals. Yoga classes were offered five days per week, from 8.00–9:00 a.m. for 6 weeks, Saturday-Sunday was considered as a rest days. A certified yoga instructor led all classes. Each yoga session consisted of 15 minutes of warm-up exercises. The warm-up program focused on slow, dynamic muscular movements, which consisted of dynamic lunges, shoulder and arm circles, neck rolls, standing forward bend etc. The daily training program was prolonged for 50 minutes of asanas, (yoga postures), and 10 minutes of relaxation in savasana. The selected names of asanas were scheduled as follows. The pranayamas focused on the quality and ease of breath and isometric muscular contractions.

Training schedule

	Total Time - 50 Minutes (Morning Session, 8:00 A.M. - 8:50 A.M.)							
	Time Divided							
Days	**8 Minutes**	**4 Minutes**	**4 Minutes**	**4 Minutes**	**4 Minutes**	**4 Minutes**	**6 Minutes**	**6 Minutes**
Mon	Suryana Namaskar	Padmasana	Sarvangasana	Padahastasana	Noukasana	Matsyasana	Narisodhana	Bhastrika Pranayama
Tues	Suryana Namaskar	Padmasana	Sarvangasana	Padahastasana	Noukasana	Trikonasana	Narisodhana	Bhastrika Pranayama
Wed	Suryana Namaskar	Padmasana	Sarvangasana	Dhanurasana	Noukasana	Trikonasana	Narisodhana	Bhastrika Pranayama
Thurs	Suryana Namaskar	Padmasana	Sarvangasana	Dhanurasana	Noukasana	Trikonasana	Narisodhana	Bhastrika Pranayama
Fri	Suryana Namaskar	Padmasana	Sarvangasana	Dhanurasana	Noukasana	Trikonasana	Narisodhana	Bhastrika Pranayama

After every Asana 1 minute Savasana was given

Variable Studied: In this project three variables were studied viz.:

1. Aerobic capacity in terms of VO_2 max – Cureton's 1mile run/walk Test
2. Anaerobic power – Margaria Anaerobic Power Test or Margaria-Kalamen Power Test

Measuring Procedure: Height and Weight were measured by Anthropometric rod and Digital Weighing machine (Tanita™, Model: BC-554). To measure aerobic capacity in terms VO_2max Cureton's 1mile run/walk Test was administered on all the selected subjects in pre as well as post treatment condition.

Prediction of VO_2 max: To estimate VO_2 max of 8-17-year-olds children the 1.0-mile (1600m) run/walk test [Cureton, Sloniger, O'Bannon, Black and McCormack 1995] are widely used. The test was conducted on a 400-m track. Subject was instructed to maintain their best possible steady pace to cover the specified distance in the fastest possible time. Walking was allowed, but the objective of the subject was to cover the distance in shortest possible time. Before start subject was allowed to 2- to 3-minute worm-up. Time was taken by stop watch. Following equation was used to predict VO_2max in ml/kg/min, as proposed by Cureton *et al.* 1995.

VO_2 max (ml/kg/min) = 108.94 – 8.41(time in min) + 0.34 (time in min) ^{2} + 0.21 (age x Gender) – 0.84 x BMI

[Where for Gender, the value =1 for boys, and the value =0 for girls, BMI in Kg/m^2, age in years]

Prediction of Anaerobic Power: Stopwatch, timing mats (optional, like this one), tape measure, and flight of 12 steps with a starting line of 6 meters in front of the first step. Each step is approximately 17.5 cm high with the 3rd, 6th and 9th clearly marked. The vertical distance between the 3rd and 9th step must be accurately measured for use in the results formula. The student's weight is determined in kilograms. The student is given a few practice runs up the steps to warm up. The student stands ready at the starting line 6 meters in front of the first step. On the command "Go", the students sprints to and up the flight of steps, taking three (3) steps at a time (stepping on the 3rd, 6th and 9th steps), attempting to go up the steps as fast as possible. The time to get from the 3rd step to the 9th step is recorded(either using a stop watch or using switch mats placed on the 3rd and 9th steps), starting when the foot was in first in contact with the 3rd step, and stopped when the foot contacts the 9th step. Allow three trails of the test, with 2-3 minute, recovery between each trial.

Anaerobic Power (Watts) were calculated from the formula below, where P = Power (Watts), M = Body mass (kg), D = Vertical distance, between steps 3 & 9 (meters), T = Time (seconds). 9.8 is the constant of gravity.

$$\text{Power} = P = \frac{M \times D \times 9.8}{t}$$

The unit of power in S.I system was Jule/Second or Watts.

Instrument and Tools

Following instruments and tools were used for collecting the data: 1) Staircase 12-16 stairs (15-20 cm), 2) Weight Scale, 3) Stepping Bench (16-17"), 4) Metronome and 5) Stopwatch.

Statistical analysis: In the present study for the sake of analysis of data mean and standard deviation of the variables were calculated. To find out significant difference of mean between the pre and post intervention in different variables statistical t-test was used. The significance of means were tested at $p<0.05$ level of confidence. For statistical calculations Excel Spread Sheet of windows version 7 will be used.

Results and discussion

The mean and standard deviation of obtained data belonging to height and weight of the boys have been presented in Table-1.

Table 1: Mean and stander deviation of Height and Weight of the subject

Height (cm)		Weight (kg)	
Pre	Post	Pre	Post
1.47 ± 0.07	1.47 ± 0.06	54.25 ± 8.22	52.12 ± 7.32

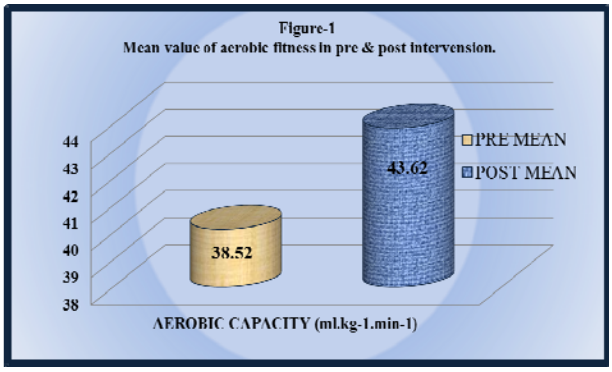
From Table-1 it was found that the mean and standard deviation of pre height of school boys were 1.47 ± 0.07 cm, post height of school boys were 1.47 ± 0.06 cm, and the mean and standard deviation of Pre weight of school boys were 54.25 ± 8.22 kg, Post weight of school boys were 52.12 ± 7.32 kg.

Table 2: Mean, S.D, Mean Difference, Standard Error, and 't'- Value Of Aerobic Fitness & Anaerobic Power Measurement of Sedentary school boys

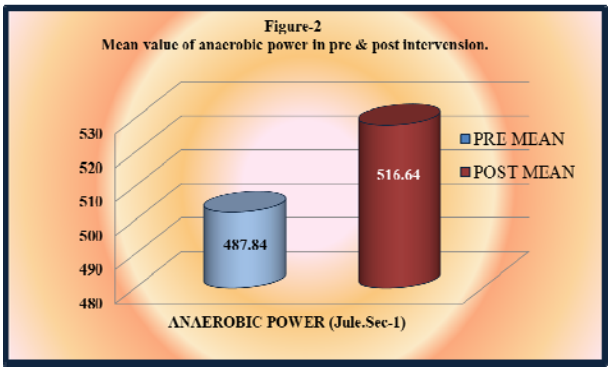
Name of The variables	Mean ± SD		Mean Difference	Standard Error	T-Value
	Pre-Data	Post-Data			
Aerobic Fitness ($ml.kg^{-1}.min^{-1}$)	38.52±8.24	43.62±7.24	5.10	2.19	2.32 *
Anaerobic Power (Jule/Second)	487.84±82.32	516.64±96.66	28.80	25.39	1.13

* Table value of 't' for at 0.05 level of confidence = *2.001

From Table-2 It was found that the mean and standard deviation of aerobic capacity of the sedentary school boys in the pre and post intervention of training were 38.52 ± 8.24 ($ml.kg^{-1}.min^{-1}$) and 43.62 ± 7.24 ($ml.kg^{-1}.min^{-1}$) respectively. Figure – 1 indicates the mean value of aerobic capacity of the sedentary school boys. It was found that in case of aerobic capacity significant difference was observed between the pre and post intervention condition.



From Table-2 it was observed that the mean and standard deviation of obtained data belonging to anaerobic power as measured by Margaria Kalamen Power Test of Sedentary school boys in the pre and post intervention of training were 487.84 ± 82.32 ($Jule.Sec^{-1}$) and 516.64 ± 96.66 ($Jule.Sec^{-1}$) respectively. Figure – 2 indicates the mean value of aerobic capacity of the sedentary school boys. It was found that in case of anaerobic fitness no significant difference was observed between the pre and post intervention condition.



On the basis of analysis of data the following results were obtained for the present project:-

a) In aerobic capacity significant difference was found between the pre and post intervention condition of the sedentary school boys.
b) No significant difference in anaerobic power was obtained between the pre and post intervention condition of the sedentary school boys.

The result of the study may be explained by the fact that the yogic practices particularly pranayama practices effects on the circulorespiratory system and the pulmonary ventilation improved by these exercises. That may cause the improvement of aerobic fitness between pre and post intervention condition.

But the Anaerobic Power basically depends on the energy reserves (ATP) and muscle physiology i.e. on the ability of instant muscle contraction, Fiber quality, No of fast twitch muscle fiber and energy liberation by anaerobic method which was not improved too much by yogic practices that

may be the cause of insignificant difference in Anaerobic Power between the pre and post intervention condition.

Conclusion

Thus On the basis of the Result it can be concluded that the yogic practices are effective for improving the aerobic capacity but not too much effective for improving anaerobic power.

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