

## ROLE OF REGULAR EXERCISE ON VO<sub>2</sub> MAX AND PHYSIOLOGICAL PARAMETERS AMONG RESIDENTIAL AND NONRESIDENTIAL SCHOOL CHILDREN OF BIJAPUR

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### Abstract

**Background and Objective:** Maximal oxygen consumption (VO<sub>2</sub> max in ml/kg/min) reflects the physical fitness of an individual. Physical fitness acquired in school children provides healthy impact on cardio respiratory system. So, our study aimed to find out the role of regular exercise and nutrition on VO<sub>2</sub>max and physiological parameters among Residential and Non-Residential school children of Bijapur.

**Methods and Material:** A cross sectional study involving 200 healthy school children aged 12 to 16 years. The study group was divided into two i.e Group I (n=100, Residential school children) and Group II (n=100, Nonresidential school children). VO<sub>2</sub> max was determined by Harvard Step Test and physiological parameters like pulse rate (PR), respiratory rate (RR), systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial pressure (MAP) were recorded by using the standard techniques. Statistical analysis done by using SPSS version 9.0.

**Results:** We found statistically significant higher values of VO<sub>2</sub> max in Group I compared to Group II. The physiological parameters have been compared between Groups I and II. Excepting for PR and RR, all other physiological parameters such as SBP, DBP and MAP have been significantly increased in Group I compared to Group II.

**Conclusion:** Possibly, regular physical exercise in residential school children responsible for increase in the VO<sub>2</sub> max, decrease in the PR and RR and increase in SBP, DBP, MAP.

**Keywords:** VO<sub>2</sub> max, Physiological parameters, Residential school children, Non Residential School Children

### 1. Introduction:

Physical fitness is maintained by a healthy life style, including habitual physical activity<sup>1</sup>.

Physical fitness acquired in growing children provides healthy impact on cardiorespiratory system. Several factors like heredity, environment, diet, socioeconomic status and training are known to contribute to physical fitness of an individual. Physical fitness level of an individual depends on the amount of oxygen which can be transported by the body to the working muscles, and the efficiency of the muscles to use that oxygen<sup>2</sup>.

VO<sub>2</sub> max (maximal oxygen consumption) is the maximum capacity of an individual's body to transport and use oxygen during incremental exercise, which reflects the physical fitness of the individual. "Maximal oxygen uptake (VO<sub>2</sub>max) is widely accepted as the single best

measure of cardiovascular fitness and maximal aerobic power.

Several studies have established that physical fitness and health can assist in the prevention of chronic degenerative diseases, thus providing better health and quality of life. Thus, emphasis has been laid on acquiring physical fitness and health for individuals of both sexes in different age groups. Maximum aerobic capacity is obtained at the time of childhood and adolescence, since these phases of the life are associated with changes related to physique and body composition<sup>3</sup>.

The present attractive education system has helped to improve the education standards. But, the non active sedentary stressful life has made the youth physically unfit. Now, the time has come to consider about the physical fitness and exercise in the adolescent age group. Realizing

this fact, educationalists have recommended minimal physical exercise in the curriculum<sup>4</sup>.

In our country, residential schools like Sainik School, Navodaya School and many others have implemented regular exercise training by qualified trained persons for their students. Nutritious food is also provided under the guidance of qualified dieticians and doctors in such schools. In non-residential schools, education is being provided but regular exercises are not monitored regularly and no dieticians are there to guide for the nutrition for the students<sup>5,6</sup>.

Hence the present study is undertaken to compare the VO<sub>2</sub> max and physiological parameters between Residential and Non residential school children.

## 2. Material &Methods:

A cross-sectional study was conducted during January 2009 –March 2010 after the approval from the human research ethical committee of the institute. Our study included 200 boys in the age range of 12 to 16 years by Simple Random Sampling technique from residential (Sainik) and non-residential (Banjara) schools of Bijapur city, North Karnataka.

We divided the students into two groups.

**Group I:** It consisted of 100 boys from residential (Sainik) school of Bijapur city, North Karnataka, who were undergoing regular Physical training/NCC, games of  $\approx$  2 hours/day for 6 days in a week.

**Group II:** It consisted of 100 boys from non-residential (Banjara) school of Bijapur city, North Karnataka, who were not undergoing regular Physical exercise.

Written consent was taken from Parents and Principals of both the schools as students were minor.

The procedures were explained to children. Through thorough history and detailed clinical examination, students were selected.

Subjects were taken into confidence and data was collected at the school campus during working hours between 12 noon to 2pm during resting period.

### Inclusion criteria:

- 1) Apparently healthy
- 2) Age: 12-16 yrs

### Exclusion criteria:

- 1) Suffering from cardiopulmonary disorders
- 2) Any chronic diseases
- 3) Any endocrine disorders
- 4) Presence of obesity or anaemia.

**Physical fitness can be assessed by VO<sub>2</sub> max. Maximal aerobic power VO<sub>2</sub> Max (ml/kg/min) by Margaria's equation<sup>7</sup>:**

By using Modified Harvard Step Test (HST): The test was done on Modified Harvard Steps of 33 cms height.

Procedure: The Subject is advised to step up on the modified Harvard steps of 33 cms height once every two seconds (30 per minute) for 5 minutes. A total of 150 steps in total. One minute after completing the test, pulse rate is recorded as

- (a) PR1 (Pulse Rate 1) – 1 min after exercise
- (b) PR2 (Pulse Rate 2) – 3 min after exercise.
- (c) PR3 (Pulse Rate 3) – 5 min after exercise.

Pmax – is the highest value of the pulse rate among PR1, PR2, PR3.

VO<sub>2</sub> max was calculated by using following formula.

$$\text{VO}_2 \text{ Max} = 111.33 - (0.42 \times \text{Pmax})^7$$

**2.1 Recording of Physiological Parameters<sup>8,9,10,11</sup>:** In each subject following physiological parameters were recorded.

- a) **Respiratory rate (cycles/minute):** Without the knowledge of the subject, the upward and downward excursions of anterior chest wall and anterior abdomen wall were confirmed by palpation for one minute.
- b) **Pulse rate (Beats/minute):** Right radial artery pulsation recorded.
- c) **Systolic and Diastolic blood pressure (mm of Hg)** by using mercury sphygmomanometer (Diamond). SBP and DBP are recorded in the lying down position by both Palpatory and Auscultatory methods.
- d) **Mean Arterial Pressure (MAP in mmHg):** It is calculated by formula:  $\text{DBP} + \frac{1}{3} \text{Pulse Pressure (PP)}$

**2.2 Statistical Methods:** Statistical analysis done by using SPSS version 9.0. All values are presented as Mean  $\pm$  Standard Deviation and SE. Comparison of mean values of parameters between group I and group II is done by 'Z' test<sup>12</sup>. p Value  $<0.05$  is considered as significant.

### 3. Results:

**Table 1: Characteristics of subjects of Group I and Group II.**

Parameters	Group I(n=100)			Group II(n=100)			Z Values	P Values
	Mean	+ SD	SE	Mean	+ SD	SE		
Height (cms)	160.31	7.64	0.764	150.36	6.84	0.684	9.70	0.0002***
Weight (cms)	44.35	6.78	0.678	39.31	8.08	0.808	4.77	0.0002***
BSA (sq mt)	1.43	0.13	0.013	1.28	0.14	0.014	7.89	0.0002***
BMI (kg/mt <sup>2</sup> )	18.26	1.80	0.180	17.52	3.46	0.346	1.90	0.056*

\*p: <0.05, \*\* p: <0.01, \*\*\* p: <0.001. BMI: body mass index. BSA: Body Surface Area

#### 3.1. Comparison of VO<sub>2</sub>max among Residential and Non-Residential school children:

**Table 2: Comparison of VO<sub>2</sub>max between Group I (Residential School) and Group II (Non-Residential School)**

Parameters	Group I(n=100)			Group II(n=100)			Z Values	P Values
	Mean	+ SD	SE	Mean	+ SD	SE		
VO <sub>2</sub> Max (ml/kg/min)	66.03	7.06	0.706	55.23	7.53	0.753	10.44	0.00001***

\*p: <0.05, \*\* p: <0.01, \*\*\* p: <0.001. VO<sub>2</sub> max: Maximal Oxygen Consumption in ml/kg/min.

VO<sub>2</sub> max is significantly (p=0.000) higher in Group I compared to Group II (Table 2).

#### 3.2. Comparison of Physiological parameters among Residential and Non-Residential school children.

**Table 3: Comparison of Physiological Parameters between Group I (Residential School) and Group II (Non-Residential School).**

Parameters	Group I(n=100)			Group II(n=100)			Z Values	P Values
	Mean	+ SD	SE	Mean	+ SD	SE		
PR (bpm)	79.4	8.72	0.872	82.5	7.42	0.742	2.70	0.0142**
RR (cycle/mi)	18.56	2.92	0.292	19.48	2.34	0.234	2.45	0.0142**
SBP (mm Hg)	112.74	10.81	1.081	109.76	8.54	0.854	2.16	0.0308*
DBP (mm Hg)	72.18	8.17	0.817	69.28	7.45	0.745	2.62	0.0142**
MAP (mm Hg)	87.70	7.87	0.787	82.73	7.63	0.763	1.79	0.0734

\*p: <0.05, \*\* p: <0.01, \*\*\* p: <0.001. pulse rate (PR), respiratory rate (RR), systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial pressure (MAP).

SBP, DBP and MAP are significantly higher in Group I compared to Group II. Significantly lower PR and RR in Group I compared to Group II (Table 3).

### 4. Discussion:

The results of our study showed the beneficial effects of regular exercise and nutrition on VO<sub>2</sub> max and physiological parameters among growing children.

#### 4.1. Effect of regular exercise on VO<sub>2</sub> max:

We found statistically significant higher VO<sub>2</sub> max in residential compared to non residential school children.

In a study by Pakkala and coworkers significantly higher values in athletes were observed as compared to non-athletes<sup>13</sup>. Ara et al observed that physically active children had significantly higher values of VO<sub>2</sub> max than that of non-physically active children<sup>14</sup>.

The possible underlying mechanisms for higher VO<sub>2</sub> max in residential school children may be due to regular physical exercise which

increases Cardiac Output secondary to high Stroke Volume and an increase in Arterio-Venous (AV) Oxygen difference. It appears that physical training increases VO<sub>2</sub> max by about 50% due to an increase in cardiac output and rest 50% due to increased extraction of Oxygen by working muscles which is reflected by increased AV difference<sup>15</sup>.

**4.2. Effect of regular exercise on physiological parameters:** We found statistically significant higher values of SBP (p=0.03), DBP (p=0.01) and statistically insignificant higher value of MAP (p=0.07) in residential school children compared to non-residential school children.

SBP, DBP and MAP are increased in residential school children due to increase in the cardiovascular endurance. This is because

of regular exercise which brings changes on myocardium, cardiac output, coronary circulation, increased efficiency of blood flow and bradycardia<sup>16, 17, 18, 19</sup>.

Also we observed significant lower values of PR ( $p=0.01$ ) and RR ( $p=0.01$ ) in residential school children compared to non-residential school children.

Decrease in PR in residential school children may be attributed to increased parasympathetic discharge to heart. This is in turn due to regular exercise<sup>20</sup>. Similar findings also observed by Dipayan Choudhuri *et al*<sup>21</sup>.

Decrease in RR in residential school children is probably due to increased compliance of respiratory muscles due to training<sup>22</sup>.

### Conclusion:

Our study showed beneficial effects of regular exercise on VO<sub>2</sub> max and physiological parameters in growing children. Therefore, regular physical exercise can be included as a part of curriculum for school going children.

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