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## A comparative study on physiological fitness components of male athletes of two different air polluted zones of West Bengal

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### Abstract

Regular exercise is an important way to live a healthy life, while exercise and air pollution can be an unhealthy combination. The study was carried out to observe whether environmental air pollution has any effect on physiological fitness parameters of male athletes of two different polluted zones of west Bengal. Two different zones (Cooch Behar -A B N Seal College, Durgapur -PCBL More) with their respective climate condition of West Bengal, India were selected for the present study. The air quality of these different zones was collected from WBPCB for comparative study of air pollution from January 2017 to February 2017. The total number of 21 male athletes aged 18-25 years undergoing regular training program for a minimum period of 3 years and having participation in national /state/district level sports competitions and residents of that particular area for the past 5 years or more were enrolled as subjects of this study. They were subdivided into two groups according to their residence of particular zone. Selected physical measurement, physiological fitness and air pollutants were measured. Values of PM10 of Durgapur zone was much more than the national ambient air quality standards, while SO<sub>2</sub> and NO<sub>2</sub> of both zones were within the standards. There was no significant difference between athletes of Cooch Behar and Durgapur zone in respect of height, weight and BSA. BMI of the athletes of the Cooch Behar zone was significantly higher than Durgapur zone. Pre exercise heart rate of the Cooch Behar athletes was significantly lower than Durgapur athletes. Blood pressure, PFI and VO<sub>2max</sub> of the Cooch Behar athletes were significantly higher than the Durgapur athletes.

**Keywords:** Air pollution, fitness, athletes

### 1. Introduction

Air pollution is one of the most serious problems in the world which has been motivated by the country's developments. Air pollution may affect an athlete's health and performance (Rundell, 2012; Pierson, 1989) [19, 17]. Kargarfard *et al.* (2011) [11] found a significant decrease in meanVO<sub>2max</sub> for trained athletes and detrained athletes group in the higher-polluted than in the lower-polluted area. Regular physical exercise exceeds the harmful effects of air pollution. To become stay fit and healthy one should focus on the possible way to minimize the exposure of air pollution while exercising (Edward & Laskowski, 2017) [9]. Air pollution may affect an athlete's health and performance (Rundell, 2012) [19]. Air pollution adversely affected the VO<sub>2max</sub> in children, and physical exercise in a polluted environment might not have a beneficial effect on cardiopulmonary fitness (Yu *et al.*, 2004) [22]. Chatterjee *et al.* (2016) [4] revealed that exercising in higher air pollutant zone might harm the physical fitness level. It was also revealed that in the case of sedentary subjects, the boys residing in lower air pollutant zones had a better physical Fitness status. Exposure to air pollution was associated with reduced respiratory function and may lead to a decline in physical efficiency in pre-adolescent children (Zebrowska & Mankowski, 2015) [23]. However, studies on the effects of air pollution on fitness parameters in adults, particularly athletes are scanty. So the researcher was interested to measure physiological fitness of male athletes of two different polluted zones of West Bengal and to identify difference between them if any.

### 1.1 Purpose of the study

The purposes of this study are stated below-

- To observe whether environmental air pollution has any effect on physiological fitness parameters of male athletes of two different polluted zones of west Bengal.

## 2. Materials and Methods

### 2.1 Selection of Place

Two different zones (Cooch Behar -A B N Seal College, Durgapur -PCBL More) with their respective climate condition of West Bengal, India were selected for the present study. The air quality of these different zones was collected from WBPCB for comparative study of air pollution from January 2017 to February 2017. The environmental condition of these zones was more or less same. According to Air Quality Index (AQI) Durgapur was marked polluted zone (poor category), and Cooch Behar was Non-polluted zone (satisfactory category) (Air Quality Index, 2020).

### 2.2 Selection of Subject

The total number of 21 male athletes aged 18-25 years undergoing regular training program for a minimum period of 3 years and having participation in national /state/district level sports competitions and residents of that particular area for the past 5 years or more were enrolled as subjects of this study. They were subdivided into two groups according to their residence of particular zone. The numbers of subjects in two different zones taken for the study have been presented in the table no-1

**Table-1:** Represent numbers of subjects from Cooch Behar and Durgapur zones

Name of zones	Number of subjects in two different zones	
	Available Population	Selected Athletes (n)
Cooch Behar	19	10
Durgapur	22	11
Total	41	21

### 2.3 Criteria Measured

Physical measurement, physiological fitness and air pollutants were the criteria for the present study. Under physical measurement there were four parameters i.e. height, weight, Body Surface Area (BSA) and Body Mass Index (BMI). Physiological fitness was included with five parameters i.e. pre exercise heart rate, systolic blood pressure, diastolic blood pressure, Physical Fitness Index (PFI) and Maximum oxygen uptake ( $VO_{2max}$ ). Air pollutants were included with Particulate matter ( $PM_{10}$ ), Sulfur dioxide ( $SO_2$ ) and Nitrogen dioxide ( $NO_2$ ).

### 2.4 Data collection

The data collected included Physical parameters, physiological parameters and air pollutants.

#### 2.4.1 Physical parameters

Standing height in cm was measured with shoes removed, feet together.

Weight in kg was measured with shoes and Jackets removed.

**Table 4:** Comparison on physiological fitness of male athletes of two different zones (Mean± S.D)

Zone/Parameters	Cooch Behar	Durgapur	't'	Significant
Pre exercise Heart rate (beats/min)	61.80±5.69	70.36±6.92	3.08*	0.01 level
Systolic Blood Pressure (mmHg)	119±7.38	111.82±6.03	2.58*	0.05 level
Diastolic Blood Pressure(mmHg)	82±6.32	77±2.32	2.45 *	0.05 level
PFI	99.50±8.21	89.27±10.62	2.44*	0.05 level
$VO_{2max}$ (ml/kg/min)	51.60±4.89	44.74±7.56	2.44*	0.05 level

\*Significant at 0.05 level, \*\* Significant at 0.01 level, NS =Not Significant, Table value at 0.05 level-2.09, df-19.

BSA was calculated by (DuBois and Du Bois, 1916) BMI was calculated by Meltzer's equation (Meltzer's *et al.*, 1988).

#### 2.4.2 Physiological parameters

Pre Exercise Heart rate (beats/min) by (Åstrand and Rodahl, 1970) <sup>[1]</sup>. Pre Exercise Blood Pressure (mmHg): Sphygmomanometer. Physical Fitness Index (PFI) by Harvart step test (Brouha *et al.*, 1943) <sup>[3]</sup>. Maximum oxygen uptake ( $VO_{2max}$ ) by Queen's college step test (Das and Bhattacharya, 1995) <sup>[6]</sup>.

#### 2.4.3 Air pollutants

Particulate Matter ( $PM_{10}$ ) by (Gravimetric Method) (CPCB, 2013) Sulphur dioxide ( $SO_2$ ) by (Improved West and Gaeke Method) (CPCB, 2013) Nitrogen dioxide ( $NO_2$ ) (Modified Jacob and Hochheiser Method) (CPCB, 2013)

### 2.5 Statistical analysis

The calculated data were analysed using appropriate statistical procedure. Mean was calculated as the measure of central tendency and the standard deviation was calculated as the measure of the variability. Statistical significant of difference, between mean value was analysed by 't'- test -Two Sample Assuming Equal Variance by using MS Excel 2016.

## 3. Results & Discussion

### 3.1 Results

The data for different parameter and their statistical analysis have been presented in following section.

**Table 2:** Personal information of male athletes of two different zones (Mean± S.D)

Zone/Parameters	Cooch Behar	Durgapur
Age(years)	20.60±1.78	19.45±1.37
Training age(Years)	5.6±1.96	5.18±1.88

**Table 3:** Comparison on physical measurement of male athletes of two different zones (Mean± S.D)

Zone/Parameters	Cooch Behar	Durgapur	't'	Significant
Height(cm)	170.72±5.29	169.99±3.56	0.37	NS
Weight(kg)	63.53±10.95	55.66±4.980	1.88	NS
BSA(m <sup>2</sup> )	1.74±0.16	1.66±0.07	1.53	NS
BMI(kg/m <sup>2</sup> )	21.60±2.63	19.55±1.70	2.14**	0.05 level

\*Significant at 0.05 level, \*\* Significant at 0.01 level, NS =Not Significant, Table value at 0.05 level-2.09, df-19.

Mean and S.D of all the physical parameters of male athletes of two zones are shown in Table no 2. Comparing the mean values, it is observed that there were differences in mean values of male athletes of two zones in respect of height, weight, BSA and BMI. To observe the significant difference between the two groups 't' value was calculated. BMI was significantly higher ( $p<0.05$ ) in Cooch Behar athletes than Durgapur athletes whereas no significant differences were obtained in height, weight and BSA, although values were higher in Cooch Behar athletes.

Mean and S.D of all the physiological fitness parameters of male athletes of two zones are shown in Table no 3. Comparing the mean values, it is observed that there were differences in mean values of male athletes of two zones in respect pre exercise heart rate systolic blood pressure, diastolic blood pressure, PFI and  $VO_{2max}$ . To observe the

significant difference between the two groups 't' value was calculated. Pre exercise Heart rate was significantly higher ( $p<0.01$ ) in Durgapur athletes than Cooch Behar athletes. Systolic blood pressure, Diastolic blood pressure, PFI and  $VO_{2max}$  were significantly higher ( $p<0.05$ ) in Cooch Behar athletes than Durgapur athletes.

**Table 5:** Mean  $\pm$  SD of  $PM_{10}$ ,  $SO_2$  and  $NO_2$  of two differently polluted zones

Parameters / Zone	Particulate Matter ( $PM_{10}$ ) $\mu g/m^3$	Sulphur Dioxide ( $SO_2$ ) $\mu g/m^3$	Nitrogen Dioxide ( $NO_2$ ) $\mu g/m^3$
Cooch Behar	80.43 $\pm$ 10.14	2.00 $\pm$ 0	20.01 $\pm$ 1.25
Durgapur	222.25 $\pm$ 8.23	12.57 $\pm$ 0.23	43.80 $\pm$ 2.10

It is seen from Table 4 that the means of particulate matter ( $PM_{10}$ ), sulphur dioxide ( $SO_2$ ), and that of nitrogen dioxide ( $NO_2$ ) were not equal of two zones. According to National Ambient Air Quality Standards (NAAQS) 16<sup>th</sup> Nov 2019, standard value for particulate matter ( $PM_{10}$ ) in industrial, residential, rural and other areas for 24 hours is 100  $\mu g/m^3$  and for sulphur dioxide ( $SO_2$ ) and nitrogen dioxide ( $NO_2$ ) is 80  $\mu g/m^3$  and 80  $\mu g/m^3$  respectively. Values of  $PM_{10}$  of Durgapur zone was much more than the national ambient air quality standards, while  $SO_2$  and  $NO_2$  of both zones were within the standards.

### 3.2 Discussion

Nande *et al.* (2008) [15] indicated in a report that the mean height of standard level athletes from track and field, badminton, and cricket is around 167.64 cm, whereas mean body weight varies between 51 and 61 kg. BMI of such athletes as mentioned by them is between 19-22  $kg/m^2$ . Data of the present study in this three parameters, height weight and BMI are in close proximity to the report of Nande *et al.* (2008) [15]. It simply means that the physical measurement of the male athletes of the present study are almost at par with Indian standard athletes.

In physiological fitness there were five parameters and all these parameters there were significant differences exist between athletes of Cooch Behar and Durgapur zones.

In pre exercise heart rate athletes of Cooch Behar zone were significantly lower than Durgapur zone. Banerjee *et al.* (1970) [2] observed that training lowers the resting pulse rate. This is done by increasing the stroke volume and heart volume with training. However, how does training causes resting bradycardia. Pope *et al.* (1999) [18] indicated that an increase in pulse rate in association with ambient particulate matter of less than 10 $\mu$  in diameter.

It is well known that regular exercise lowers the blood pressure in the general population however when compared to athletes to non-athletes control some researchers reported higher blood pressure among the athletes whereas some researchers found lower blood pressure among the athletes. Further some researchers reported about significant inter group differences between dynamic type athletes (speed, endurance sports and ball games) and static type athletes (power, combat athletes) (Shahraki *et al.*, 2012; Varga-Pintér *et al.*, 2011) [20, 21].

Environmental factor is an important determinant of physical fitness in terms of PFI score. Similar observations were obtained by different investigators in different terms like treadmill performance, aerobic performance (Demeersman *et al.*, 1984; Klissouras, 1975) [7, 13] and physical work capacity (Engstrom & Fischbein, 1977) [10].

Katralli *et al.* (2015) [12] reported that physical fitness has a direct relation with the duration of the training period which is used to separate perfectly higher and lower level judo players.

Oliveira *et al.* (2006) [10] opined that even a brief acute exposure to moderate level of air pollution may create significant physiological abnormalities, including oxygen uptake in the healthy young adult.

Yu *et al.* (2004) [22] reported that children who are the resident of high polluted district had less  $VO_{2max}$  than those who are the resident of low polluted district. General habitual physical exercise had a significant positive relation with a higher  $VO_{2max}$  in the low-pollution district but not in the high-pollution district.

Kargarfard *et al.* (2011) [11] found a significant decrease in mean  $VO_{2max}$  for trained athletes and detrained athletes group in the higher polluted than in the lower-polluted area.

In this present study the PFI and  $VO_{2max}$  of the Cooch Behar athletes were significantly higher than the Durgapur athletes and notable the  $PM_{10}$  of the Durgapur zone was much more than the national ambient air quality standards.

### 4. Conclusions

On the basis of the discussion the following conclusions has been made.

#### 4.1 On Physical Measurements

1. There was no significant difference between athletes of Cooch Behar and Durgapur zone in respect of height, weight and BSA.
2. BMI of the athletes of the Cooch Behar zone was significantly higher than Durgapur zone.

#### 4.2 On Physiological Fitness

1. Pre exercise heart rate of the Cooch Behar athletes was significantly lower than Durgapur athletes.
2. Blood pressure, PFI and  $VO_{2max}$  of the Cooch Behar athletes were significantly higher than the Durgapur athletes.

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