



International Journal of Physical Education, Sports and Health

P-ISSN: 2394-1685
E-ISSN: 2394-1693
Impact Factor (RJIF): 5.38
IJPESH 2024; 11(4): 320-322
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www.kheljournal.com
Received: 16-05-2024
Accepted: 21-06-2024

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VO₂ Max of male and female sports person training in polluted and non-polluted environments: A comparative study

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Abstract

The objective of the study was to evaluate the impact of pollution on VO₂ Max of Male and Female Sports Person Training in Polluted and Non-Polluted Environments. For this two places were selected Delhi with high level of pollution and Raxaul, Bihar with low level of pollution.

Participants: For the purpose of this study, ten male and ten female athletes from polluted city i.e., Delhi were selected randomly and similarly from a non-polluted city i.e., Raxaul, East Champaran district of Bihar. Athletes were not sports specified. The subjects selected for the study had been training 4-5 days a week. The age group of the subjects was between 18-25 years. All the athletes had already completed their schooling from Central Board of Secondary Education.

Results: The mean and standard deviation of VO₂ max for males training in Delhi is 42.0697 and 2.97854189. The mean and standard deviation of VO₂ max for males training in Bihar is 44.675 and 3.442240614. The T- ratio of both the males group is 0.043692868. The mean and standard deviation of VO₂ max for females training in Delhi is 32.4179 and 4.2442027. The mean and standard deviation of VO₂ max for females training in Bihar is 34.291 and 4.26374981. The T-Ratio of both the females group is 0.168941185. The statistical analysis of the data revealed that the VO₂ max of the athletes training in Non-Polluted area was slightly better than that of athletes training in Polluted area.

Conclusion: The athletes who performed in non-polluted areas of Bihar had better results of maximal oxygen consumption. As per the tabulated value of 1.734 females have more significant figures as compared to the males of both the regions of Delhi and Bihar.

Keywords: VO₂ max, polluted, non-polluted, environments, secondary education

Introduction

Aerobic capacity, also called maximal oxygen uptake, is characterized by the amount of oxygen the body produces and circulates to all major organs to regulate systemic homeostasis. It is believed that aerobic capacity is directly proportional to cardio respiratory fitness based on heart rate factors often influenced by body size, climate, gender, and physical activity levels. Oxygen is a critical ingredient in the respiratory process that's involved in breathing. As you breathe in oxygen, your lungs absorb and turn it into energy called ATP. VO₂ max plays a crucial role in the performance of athletes and most of the top level athletes in the world have a very high score of VO₂ max. In most of the football clubs all across the world VO₂ max is used as a fundamental score in scouting, team selection and formation of in game tactics based the overall aerobic capacity of the players in the teams. Atmospheric Pollution is a state in which the harmful materials enter the atmosphere and these harmful materials are known as pollutants. The six major pollutants are Carbon Monoxide, PM 2.5, Carbon Dioxide, Nitrogen dioxide, Sulphur dioxide and Ozone (O₃). According to the research done by Indian Metrological Department, India is the fifth most polluted country among 117 countries, regions and territories around the world, assessed. The country's annual average PM_{2.5} levels reached 58.1 micrograms per cubic meter (µg/m³) in 2021, returning to pre-quarantine concentrations measured in 2019 with pollution the overall composition of the atmosphere is affected. As athlete's into the polluted air while training and playing an event they inhale these pollutants inside the lungs with oxygen.

Although pollution is caused by various solid particles and gases but the main the source of pollutant effecting aerobic capacity and overall cardiovascular health of an athlete is Particulate matter.

Various athletes all around the globe prefer to play and train in areas with low levels of pollution as high level of pollution has an impact on their lung capacity and overall performance and training schedule. Most of the governing bodies of the various sports and International Olympic Committee are looking for host countries with low level of pollution because high level of pollution brings down the performance level of the athlete and due to which an athlete cannot perform to best of his ability on the field due to which his overall chances of winning a tournament or an event is affected. Due to this various sports scientist all across the globe have started researching on the impact of pollution on the human body and athlete in particular. This research would help scientist to develop new training patterns for the athlete in the polluted environment to increase his performance level, to come up with new training equipment form protection of athlete from the air pollution and to boost his performance level.

Selection of the subjects

For the purpose of this study, ten male and ten female athletes from polluted city i.e., Delhi were selected randomly and similarly from a non-polluted city i.e., Raxual, East Champaran district of Bihar. Athletes were not sport specified. The subjects selected for the study had been training 4-5 days a week. The age group of the subjects was between 18-25 years. All the athletes had already completed their schooling from Central Board of Secondary Education.

Selection Variables

After going through available literature and also after having a detailed discussion with our supervisors, a list of variables under different categories was prepared. Keeping the feasibility criteria in mind the following variables were selected for the study.

Physical fitness variables-Weight, Height and Age.

Physiological Variable-Maximal Oxygen consumption.

Independent Variable-Walk Time.

Administration of test

1. After a slight warm up athletes were made prepared for the running test.
2. The subjects were asked to stand at the starting point of the field where they were directed to run and on the signal 'GO' were asked to run for one mile along the markings.
3. The same procedure is used for both males and females. In total 40 subjects were taken out of which 20 were from Delhi and 20 were from Raxual, Bihar. The ground differences on which the athletes ran wasn't much. Subjects in Bihar ran on hard caly soil surface and Delhi subjects ran on a soil mixture made up of clay, silt and sand.
4. On completion of one mile the subjects were made to stop running. Their timing was recorded in seconds using a stopwatch.
5. The pulse rate of the subject was recorded using two finger method in which fingers were placed upon the athlete for 1 minute on radial artery and pulse was counted for 30 seconds and the value was multiplied by 2 to obtain pulse rate of the athlete for 1 minute the value was multiplied by 2 to obtain pulse rate of the The values

were substituted in the formula to obtain the value of $VO_2\max$. The following formula were used to calculate $VO_2\max$.

Formula for females: $VO_2 \max = 139.168 - (0.388 \times \text{age}) - (0.077 \times \text{weight in LB}) - (3.265 \times \text{walk time in minutes}) - (0.156 \times \text{heart rate})$.

For males: $VO_2 \max = 139.168 - (0.388 \times \text{age}) - (0.077 \times \text{weight in LB}) - (3.265 \times \text{walk time in minutes}) - (0.156 \times \text{heart rate}) + 6.318$.

The values obtained from the test and personal record is substituted in the formula to obtain the results for both males and females.

Results, Analysis and Discussion of study

After collected data T-Test was applied on the data and mean and standard deviation was calculated.

Analysis of data

Table 1: Mean and standard deviation values of male athletes

Subjects	Mean	Standard deviation	Calculated value
Group 1 Delhi	42.0697	2.97854189	0.043692868
Group 2 Bihar	44.675	3.442240614	

*Significant at 0.05 level of significance

Table 1 shows the mean values of the male group data of Bihar and Delhi. It shows that mean of male Bihar group is greater than Delhi male group. The tabulated value 1.734 is greater than calculated value 0.04369. This concludes that difference between the means of two groups is insignificantly different.

Table 2: Mean and standard deviation of female athletes

Subjects	Mean value	Standard deviation	Calculated value
Group 1 Delhi	32.4179	4.2442027	0.168941185
Group 2 Bihar	34.291	4.26374981	

*Significant at 0.05 level of significance

Table shows the mean values of the female group data of Bihar and Delhi. It shows that mean of female Bihar group is greater than Delhi female group. It clearly shows that tabulated value 1.734 is greater than calculated value 0.16894. This concludes that difference between the means of two groups is insignificantly different.

Discussion on Hypothesis

The hypothesis stated that there should have been a significant decrease in the max levels of both male and female athletes performing in the Delhi region i.e. the polluted one.

The athletes who performed in non-polluted areas of Bihar had better results of maximal oxygen consumption. As per the tabulated value of 1.734 females have more significant figures as compared to the males of both the regions of Delhi and Bihar.

Another study performed by Prof. Kagarfard. This study aimed to assess the effects of exercise on aerobic power, lactate level, and cell blood count in polluted and nonpolluted areas. The participating criteria where one must be an athlete and a non-smoker. Cooper test was done on the participants i.e., to run as far as possible in 12 minutes time. They used the Kolmogorov-Smirnov test to determine the normality of the variables' distribution.

This study revealed that exercise in high-polluted air reduced

athletes' performance slightly at submaximal levels of physical exertion.

Conclusion

The study assessed the impact of pollution on VO₂ Max in male and female athletes training in polluted (Delhi) and non-polluted (Raxaul) environments. The results indicated that athletes in the non-polluted environment of Raxaul had higher VO₂ Max values compared to those in the polluted environment of Delhi. Specifically, male athletes in Raxaul had a mean VO₂ Max of 44.675, while those in Delhi had a mean of 42.0697. Female athletes in Raxaul had a mean VO₂ Max of 34.291, compared to 32.4179 in Delhi. Although the VO₂ Max was higher in the non-polluted environment for both genders, statistical analysis revealed that these differences were not statistically significant, with calculated T-ratios for males and females being lower than the tabulated value. This suggests that while pollution may affect VO₂ Max, the impact on athletic performance in these specific samples was not significantly different.

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