

Research Article

Comparison of Aerobic and Anaerobic Capacities among Smoker and Non-smoker Male Collegiate Population

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DOI: <https://doi.org/10.24321/0019.5138.202120>

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How to cite this article:

Zutshi K, Qaiser M, Khan N. Comparison of Aerobic and Anaerobic Capacities among Smoker and Non-smoker Male Collegiate Population. J Commun Dis. 2021; 53(2): 14-17.

Date of Submission: 2021-01-22

Date of Acceptance: 2021-06-23

A B S T R A C T

Background: Cigarette smoking is common among the male collegiate population. It causes various negative effects on their body, particularly it affects the lungs. Hence, the aim of this study is to compare the aerobic and anaerobic capacities among the smoker and non-smoker male collegiate population.

Methods: 68 healthy male college students participated in this study. Aerobic capacity was assessed by 3-minute step test. Anaerobic capacity was assessed by 30-meter sprint fatigue test. T-test was used to compare the data between groups.

Result: Present study reported that smokers had a higher heart rate after performing 3-minute step test. The fatigue index was higher in smokers as compared to non-smokers.

Conclusion: From the present study it can be concluded that cigarette smoking reduces the aerobic and anaerobic capacities of an individual.

Keywords: Smoking, Aerobic capacity, Anaerobic Capacity

Introduction

Physical ability including aerobic and anaerobic capacities is necessary to perform daily living activities. Aerobic energy system helps in performing long duration activities. Anaerobic energy system provides a burst of energy to sustain short duration high-intensity tasks.

Smoking is defined as the inhalation of the smoke of burning tobacco that may occur occasionally or habitually as a consequence of physical addiction to some chemicals, primarily nicotine.¹ Smoking prevalence in men and women averages 42% and 24% respectively, for developed countries,

and 48% and 7% respectively, for less developed countries.² There are 26.7 crores tobacco users belonging to the age group of 15 years or more years. 3500 people die daily in India due to tobacco.³ Cigarette smoking is a common lifestyle habit among the collegiate population. Previous researches have focused on the prevalence of smoking among secondary school students, graduate students, and adults. Once this population starts smoking, it becomes difficult for them to quit.^{4,5}

Cigarette contains harmful substances that affect health. It reduces cardio-respiratory fitness by affecting aerobic and anaerobic capacities.^{6,7,8} As per an Indian Council of

Medical Research (ICMR) survey conducted in 2017, for the prevention of non-communicable diseases, one should not consume tobacco.⁹ Various pieces of research have been done which check the aerobic capacity of the Indian population in different regions.^{10,11} Shenoy et al. found the relationship between risk factors of cardiovascular disease and aerobic capacity in a study conducted on north Indians.¹⁰ Research has been done which checks anaerobic capacity in elite power sports players,¹² but no such study was conducted in India on male collegiate smokers and non-smokers to compare their aerobic and anaerobic capacities. The present study hypothesised that aerobic capacity and anaerobic capacity are reduced in smokers as compared to non-smokers.

Methods and Materials

Present study was conducted at Rehabilitation Centre, Jamia Hamdard in New Delhi, India between December to march.

Ethical approval/Informed consent: The study was a cross-sectional non-experimental type for which prior consent of participants had been taken after explaining the testing equipment, tests, and study protocol.

A total of 70 subjects were invited to participate in the study. Out of those, 68 subjects had participated. 18 to 25 years male collegiate smokers and non-smokers, with the smokers having a history of smoking of minimum of two years were included in the study. Subjects with any cardiovascular, respiratory, musculoskeletal, neurological, psychological disorders were excluded from the study.

Subjects were divided into two groups based on their smoking history. Chronic chain smokers were labelled as group A and non-smoker subjects were labelled as group B.

Everyone was instructed to avoid caffeine, alcohol, and heavy meal on the day of testing. A practice test was performed three days before the formal test to familiarise the subjects with the mode and method of testing. It was identical to the formal test.⁷

Warm-up was done before testing to avoid any injury. It included 5 minutes of jogging. YMCA 3-minute step test was performed by using a wooden box of 12 inches. Metronome was set at 96 beats per minute. Subjects were instructed to follow each beat of the metronome. They had followed the cadence of up, up and down, down and continued it for 3-minutes. After three minutes, they sat on a wooden box and their heart rate recovery was measured for one minute by using a pulse oximeter. Pulse oximeter is an appropriate, non-invasive way to measure heart rate either at rest or during and after exercise.⁸ Age-adjusted heart rate standards were given by YMCA. Based on that, we ranked the subjects as excellent, very good, good, poor,

and very poor. A rest period of 48 hours was given between 3-minute step test and sprint fatigue test.

Four marking cones were used. Out of which, two were placed at a 30-meter distance which indicated the sprint distance. Two cones were placed on each end at a 10-m distance. Subjects sprinted for 30 m. One stopwatch was used to measure lap and the other recorded the total time. The subjects were allowed to slow down in the 10-meter distance. They performed 10 sprints and the total time was recorded. The fatigue index was then calculated by calculating the average speed of the first three trials and dividing it by the average speed of the last three trials and a value approximately between 75% and 95% was obtained. A fatigue index of more than 89% indicates excellent anaerobic capacity. 80%-89% indicates good anaerobic capacity. 80%-84% indicates average, and below 80% indicates poor anaerobic capacity. After one week, a formal test was performed.

Analysis was done by using SPSS (Statistical Package for Social Sciences for Windows) software, version 16. T-test was used to find the differences in pre-heart rate (PHR), heart rate recovery (HRR), and fatigue index between smokers and non-smokers.

Results

A total of 68 subjects went through the testing protocol. All of them were healthy age-matched collegiate. The mean and standard deviation of age and BMI of group A were 22.147 ± 2.13 and 20.62 ± 3.48 , and that of group B were 21.41 ± 2.07 and 21.37 ± 2.74 .

The mean and SD of PHR and heart rate recovery (HRR) were 86.04 ± 12.89 and 114.84 ± 19.98 respectively. T-test for the difference between mean pre-heart rate and post-heart rate revealed that the difference between mean PHR and HRR was statistically significant and the mean levels of heart rate had increased after the test.

T-test for the difference between mean pre-heart rate of smokers and non-smokers revealed that there is a significant difference between the mean PHR of smokers and that of non-smokers. Mean levels of PHR is higher for smokers than that of non-smokers. T-test for the difference between mean heart rate recovery of smokers and non-smokers revealed that there is a significant difference between the mean HRR of smokers and that of non-smokers ($p < 0.05$). Mean level of HRR is higher for smokers than that of non-smokers (Table 1 and Figure 1).

The mean and SD of fatigue index of smokers and non-smokers are 95.29 ± 28.87 and 90.50 ± 9.76 respectively. T-test showed that fatigue index is higher in smokers with a p-value of 0.36 (Table 1 and Figure 2).

Table I. Mean, Standard Deviation, T-value and P-value of the Values

	Group A (Smokers)	Group B (Non-smokers)	t-value	p-value
PHR (beats/min)	93.76 ± 12.37	78.53 ± 8.25	5.89	0.00
HRR (beats/min)	128.74 ± 17.53	100.94 ± 10.28	7.97	0.00
Fatigue index	95.29 ± 28.87	90.50 ± 9.76	0.91	0.36

PHR: Pre-heart rate, HRR: Heart rate recovery.

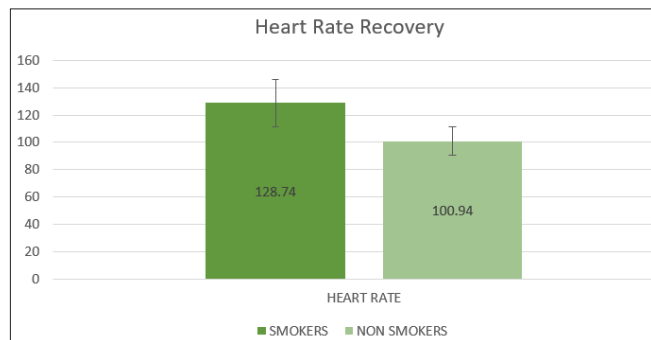


Figure 1. Comparison of Heart Rate Recovery between Smokers & Non-smokers

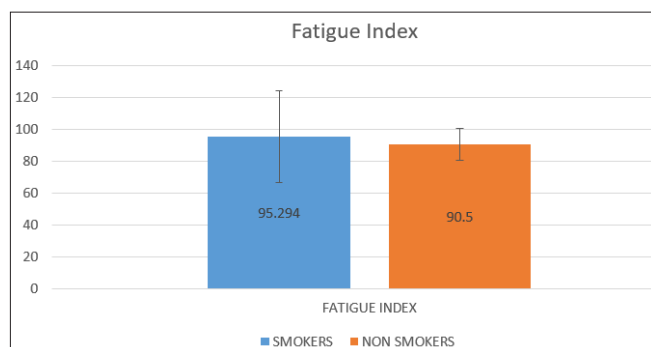


Figure 2. Comparison of Fatigue Index between Smokers and Non-smokers

Discussion

Aerobic capacity can be assessed by assessing heart rate recovery. Group A (smokers) had higher heart rate recovery and resting heart rate. This is due to smoking which contains tar and nicotine like substances. Many people had started smoking to ease the feeling of stress that comes with depression or anxiety. Smoking reduces the oxygen-binding capacity of haemoglobin in their bodies as a small amount of carbon monoxide binds with haemoglobin.^{13,14,15,16,17} This can reduce the oxygen diffusion capacity in the lungs. These findings are consistent with the findings of Lee et al.,¹³ A higher heart rate can also be due to anxiety, depression, thyrotoxicosis, higher blood pressure, and excessive alcohol consumption.

Fatigue index means the rate at which power declines. Another finding of our research was that we found a higher fatigue index of smokers which shows that they get tired easily while performing anaerobic activities. Sprint exercise

uses ATP and PCr as a source of energy but smokers rely upon glycolytic metabolism which ultimately reducing their anaerobic capacity. This is supported by a study conducted by McDonough et al. which states that smoking increases the reliance upon glycolytic metabolism during exercise which contributes to earlier fatigue in smokers as compared to non-smokers who exercise.¹⁶ Study by Huie et al. concluded that smokers have higher blood lactate concentration and it did not affect the glycolytic metabolic pathway therefore, if the duration of sprints increases while performing the IST, it didn't. However, the effects of smoking on blood lactate concentrations and heart rate during anaerobic exercises are still unclear and require further examination.¹⁸

It was seen that physical activity helps to maintain normal physiological functioning of the body; therefore, a study can be done in future to compare the effect of smoking between those who are smokers and are actively involved in any sports with those who are not actively involved in sports.

Conclusion

Our study concluded that smoking reduces aerobic capacity by causing delayed and reduced heart rate recovery among male university smokers. Although, statistically no significant reduction was found in the fatigue index which measures anaerobic capacity. Smoking manifests as an extra-pulmonary manifestation such as increased resting heart rate, decreased aerobic capacity, increased post-exercise heart rate etc. and awareness programmes should be conducted to educate the population especially the young adults about the same.

Abbreviations

BMI: Body Mass Index, PHR: Pre-heart Rate, HRR: Heart Rate Recovery, PCr: Phosphocreatine, IST: Intermittent Sprint Test

Source of Funding: None

Conflict of Interest: None

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