Int J Clin Exp Physiol. 2022;9(1):41-44
www.ijcep.org

Original Article

Effects of Tobacco Consumption on Aerobic Fitness in Indian Adult Men

Hasmukh Shah*, Tejas Prajapati

ABSTRACT

Background and Aim: Smokeless tobacco products like khaini, guthakha, betel quid, zarda are very commonly consumed by men and women of all age group followed by smoking of bidi, cigarette and hookah. Tobacco consumption is associated with poor cardiorespiratory, gastrointestinal and overall health. Compromised physical fitness is seen in tobacco consumers and severity depends on type of product and duration of use. Aerobic or cardiorespiratory fitness is compromised in tobacco consumers. This study was planned to check the effect of tobacco consumption on aerobic fitness of Indian adult men of 18 to 60 years of age group. **Materials and Methods:** Participants for this study were recruited from Pramukhswami Medical College and its affiliated institutes after obtaining permission from the Institutional Ethics Committee (IEC). A total 74 adult men of 18-60 years' age groups were enrolled for the present study after their voluntary consent. A total 24 participants who consume tobacco were placed in study group and a total 50 participants who were not consuming tobacco products were placed control group. All participants were apparently healthy at the time of Treadmill exercise stress test following Bruce protocol. Predicted VO_2 max (PVO_2 max) was calculated on the basis of total exercise time in minutes and seconds on Treadmill machine as per Bruce's formula of calculating indirect maximal oxygen consumption. **Results:** PVO_2 max values obtained by Treadmill exercise test following Bruce protocol in study group was 29.16 ± 8.88 ml/kg/min while control group was 36.47 ± 9.7. A statistically significant reduction in aerobic fitness was seen in study group as compared to control group. **Conclusion:** Aerobic fitness was significantly less in tobacco consumer Indian adult men of 18-60 years' age group as compared to who do not consume tobacco.

Key words: Aerobic fitness, Cardiorespiratory fitness, PVO_2 max, Maximum oxygen utilization, Treadmill test, Tobacco consumer.

Hasmukh Shah*, Tejas Prajapati

Department of Physiology, Pramukhswami Medical College, Bhaikaka University, Karamsad, Gujarat, INDIA.

***Correspondence**

Dr. Hasmukh Dahyabhai Shah
MBBS, MD, Professor and Head, Department of Physiology, Pramukhswami Medical College, Bhaikaka University, Karamsad-388 325, Gujarat, INDIA.

Email: drhasmukhshah0505@gmail.com

History

- Submission Date: 09-01-2022;
- Review completed: 23-02-2022;
- Accepted Date: 17-03-2022.

DOI : 10.5530/ijcep.2022.9.1.8

Article Available online
http://www.ijcep.org/v9/i1

INTRODUCTION

Tobacco consumption is one of the main base of morbidity and mortality in India.[1-2] Tobacco usage is main risk factors for respiratory and cardiovascular diseases. Cancer of mouth and lungs are very common in tobacco users due to easy availability and affordability. India is the second largest producer and consumer of tobacco products.[3-4] Variety of tobacco products is available at very low price in India. Global Adult Tobacco Survey India (2016-17) documented 267 million adults above 15 years of age consume tobacco every year and 1.35 million adults die every year.[5] Consumption of smokeless tobacco products like khaini, guthakha, betel quid and zarda are very common in all age groups of both genders while smoking of bidi, cigarette and hookah are more common in adult men. Consumption of cigarette smoking is increased in adolescents and even in children also due to commercialization and positive social image.[4-5] Tobacco consumption is one the biggest public health issue in all class of population in India and world.[1-2]

Sleep problems like sleep apnoea, short breathing, short sleep duration and poor sleep quality are seen cigarette smokers as compared to non-smokers.[6] Disturbed memory and poor cognition are seen in smokers as compared to non-smokers.[6-7] Motor functions are disturbed and varied in chronic smokers.[8] Mortality due to cardiovascular diseases is one to two time more in smokers as compared to non-smokers. Increased blood pressure and heart rate are seen immediately after smoking and consumption of smokeless tobacco.[9] Tobacco consumption is associated with reduced sensitivity to baroreceptors and significant decreased in heart rate variability.[10-11] Increased arterial stiffness after acute smoking as well as in chronic users are very common.[9-10] Compromised vascular system poses tobacco consumers to have increased blood pressure and heart rate.[8-10] Overall fitness of tobacco consumers compromised and severity depends on types of product use and total duration of usage.[12]

Assessment of cardiorespiratory fitness is one of the best marker of overall fitness and health.[13] Cardiorespiratory fitness can be assessed during resting state of heart and during exercise by various stress test. Oxygen utilization during exercise

Cite this article: Shah H, Prajapati T. Effects of Tobacco Consumption on Aerobic Fitness in Indian Adult Men. Int J Clin Exp Physiol. 2022;9(1):41-4.

stress test is used for the assessment of aerobic fitness.[13-15] Maximum oxygen utilization or VO_2 Max is different in individual with different body mass, fat mass, visceral fatness, physical activity, blood pressure.[10] Consumption of tobacco, alcohol, nicotine and other stimulants also affects oxygen utilization during exercise stress testing.[16] Scant literature is available on consumption of tobacco and maximum oxygen utilization. Therefore, the main objective of this study was to check maximum oxygen utilization during exercise stress testing in tobacco consumers and non-tobacco consumers' Indian adult men.

MATERIALS AND METHODS

Participants for the present cross-sectional study were recruited after approval of Institutional Ethics Committee, Pramukhswami Medical College, Karamsad, Gujarat. Participants were informed about the study protocol and risks associated with exercise stress testing and they were recruited after written informed consent. Healthy participants without any diseases were enrolled for the current study. Participants with history of cardiorespiratory diseases, joint problem and arthritis, any other chronic illness, history of current alcohol consumption were excluded from the study. Participants who are doing yoga, meditation and athletes were excluded from the study. Indian adult men of 18 to 60 years of age with history of tobacco consumption with duration of more than 5 years were recruited for the study as study group. After following exclusion criteria, Indian adult men of 18 to 60 years of age without history of tobacco consumption were recruited as control group for the study.

All participants were informed to report to Research Laboratory, Department of Physiology during morning hours (10.00 am to 12.00) without intake of tea, coffee, food, drugs and other stimulants with keeping at least 3 hr' period of nil by mouth except water. Height of participants were recorded using standard stadiometer. Omron body fat analyser (Omron HBF-302) was used to record body weight, body fat mass, visceral fat mass by using bioelectrical impedance technique.[17] Assessment of total sleep duration spent during last few weeks were noted by participants' self-rated health.

Assessment of maximum oxygen utilization (VO_2 max) was done motorized treadmill machine by Bruce's protocol after following all standard protocols. Exercise stress testing by Bruce is continuous, incremental exercise on treadmill with total 7 stages of 3 min of each stage.[18] Grade and speed of exercise is changed and increased after each stage of 3 min. Heart rate and blood pressure were recorded beofre the exercise, during each stage of exercise and during recovery period by sphygomanometer after following all standard precautions. Exercise ends point was considered mainly on the basis of concept of maximum heart rate for their respective age and self-reported exhaustion as per Borg scale. At the end of exercise stress test (EST), total time was recorded in minutes and seconds and VO_2 max in men was calculated using following formula: VO_2 max (ml/kg/min) = 14.76 - (1.379 × T) + (0.451 × T2) - (0.012 × T3). [T= total time duration in minutes and seconds].[19]

Statistical Analysis of Data

Standard descriptive data (mean ± standard deviations) were computed to describe the sample and data were analysed using SPSS Trial version 19. Quantitative data of two groups were compared by independent sample *t*-test and P value < 0.05 was considered significant.

RESULTS

Present study comprised total 74 participants of 18-60 years of age group. A total 24 participants who consumed tobacco were included in study group and total 50 participants who did not consume tobacco were included in control group. As per Table 1, the mean age of study group was (43.75 ± 9.9) higher than control group (35.26 ± 11.8) and it was statistically significant also. Body mass index was more in study group and fat free mass was reduced in study group but both were not significant. Fat mass was more in study group as compared to control group.

Table 1: Anthropometric profile of the participants.

	Control Group (*n* =50)	Study Group (n =24)
Age (in years)	35.26 ± 11.8	43.75 ± 9.9**
Height (cm)	169.15 ± 5.15	169.37 ± 4.92
Weight (kg)	70.55 ± 10.5	73.08 ± 13.85
Body mass Index (BMI)	24.62 ± 3.31	25.46 ± 4.78
Total body fat % (TBF)	25.32 ± 6.42	29.90 ± 4.86**
Fat mass (FM)	18.18 ± 6.31	22.19 ± 6.34*
Fat free mass (FFM)	52.36 ± 6.70	50.88
Visceral fat (VF)	9.6 ± 3.8	11.54 ± 5.72

Data are expressed as mean±SD. *indicate P < 0.05, ** indicate P < 0.01

Table 2: Cardiovascular profile and aerobic fitness of the participants.

	Control Group (*n* =50)	Study Group (n =24)
SBP (mmHg)	122.88 ± 12.39	126.08 ± 14.77
DBP (mmHg)	81.02 ± 10.70	82.87 ± 9.26
HR (per min)	80 ± 11.13	86.12 ± 10.85*
RPP	98.59 ± 18.68	109.4 ± 22.97*
PA-R	2.66 ± 1.34	1.91 ± 0.77*
Total Sleep duration	7.1 ± 0.67	7.2 ± 0.58
Total exercise duration	10.44 ± 2.56	8.73 ± 2.35**
Predicted VO_2 Max by Treadmill Test	36.47 ± 9.7	29.16 8.88**

Data are expressed as mean±SD. *indicate P < 0.05, ** indicate P < 0.01

Systolic blood pressure and diastolic blood pressure were more in tobacco consumer as compared to non-consumer but it was statistically not significant. Heart rate and rate pressure product (RPP) were more in tobacco consumer as compared to non-consumer and it was statistically significant also. Physical activity score by NASA-Johnson was less in tobacco consumer as compared to non-consumer and it was statistically significant. Predicted VO_2 max by exercise duration-based Bruce protocol was 36.47 ± 9.7 ml/kg/min in non-tobacco consumers and it was 29.16 8.88 ml/kg/min in tobacco consumer. Statistically significant reduction in predicted VO_2 max was seen in tobacco consumers as compared to non-consumers (Table 2).

DISCUSSION

The purpose of this study was to check difference between maximum oxygen utilization during exercise stress testing in tobacco consumers and non-tobacco consumers' Indian adult men. Maximum oxygen utilization by equation-based exercise stress test was measured as per Bruce protocol in tobacco consumers and non-tobacco consumers. Tobacco consumers ran for lesser duration as compared to non-consumer during exercise stress testing. Healthy participants who do not consume tobacco crossed more stages as compared to tobacco consumers. Statistically significant reduction in predicted VO_2 max was seen in tobacco consumer as compared to non-consumers and our finding were supported by Tzani *et al.*[20] and Kumar Neeraj.[21]

Consumption of tobacco either by oral or nasal route augments cytokine production and exaggerates cardiovascular changes during exercise.[22] Augmented blood pressure and heart rate responses during exercise stress testing limits further exercise. Resting heart rate and systolic blood pressure are components of RPP and useful indicators of myocardial workload and myocardial oxygen consumption (MVO_2). Increased heart rate and systolic blood pressure during rest and during different stages of exercise make heart to work against more load and significant reduction in MVO_2 is observed in tobacco consumers.[23] Gidding *et al.* reported high resting heart rate in smokers and Mahmud and Feely, Kim *et al.* reported increased systolic blood pressure in smokers were similar to our findings.[24] RPP in tobacco consumers was increased as compared to non-consumer in our study and it was supported by Bolinder and Faire,[25] and Minami *et al.*[11] and Benowitz *et al.*[26] Reduced myocardial oxygen consumption due to increased myocardial workload in tobacco consumers may be used as prognostic tool to prevent cardiovascular and all-cause mortality.[23]

Andreas D. Flouris reported reduction of maximum oxygen utilization and increased perceived exertion on exposure to second hand smoke (SHS) also.[22] Reduced maximum oxygen utilization in smokers of all age group was reported by Chatterjee S and this effect was augmented with aging.[13] Smoking during rest and maximum exercise on cycle ergometer in young male showed significant reduction in endurance time and VO_2 max.[27]

Maximal exercise test duration difference between tobacco consumer and non-consumer was 1.71 min in our study and it was supported by study of Papathanasiou G, *et al.*[23] Peak exercise capacity of non-consumer of tobacco was approximately 2 MET higher than tobacco consumer during exercise stress testing following Bruce protocol.

Limitation and Future Perspective of the Study

Limitation of this study includes, first the cross-sectional nature of the study and cause-effect relationship was not established. Second major limitation of the study was relatively small sample size. Third, possible limitation was calculation of maximum oxygen utilization by usage of indirect method of Bruce exercise stress testing protocol not the direct measurement of VO_2 max.

Consumption of tobacco either by smoking or smokeless products are associated with higher heart rate and blood pressure and reduced exercise capacity and tolerance. Tobacco consumption is well-known risk factor for the cardiovascular diseases and it can be modifiable, but early detection and prevention is the best approach. Consumption of tobacco products on the basis of types and duration will be studied further with larger sample in all age group.

CONCLUSION

Consumption of tobacco showed reduced aerobic fitness in Indian adult men of 18-60 years' age group. Cardiovascular variables like, heart rate, blood pressure and RPP were higher in tobacco consumers with reduced exercise tolerance compared to non-consumers. Tobacco has a negative effect on fitness and overall health. Though social awareness program is run by government, a strong policy is required to stop production, availability and usage of tobacco.

ACKNOWLEDGEMENT

The authors are thankful to our parent organization Charutar Arogya Mandal, Karamsad, for providing a platform for the study. The authors are thankful to Dr. Ashok R. Nair for their continuous support and guidance. The authors are obliged to our participants; without them this study was not possible.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

Financial Support

Our study was supported by Charutar Arogya Mandal and Bhaikaka University, Karamsad, Gujarat, India.

ABBREVIATIONS

PVO_2 max: Predicted Maximum Oxygen Utilization; **MVO_2:** Myocardial Oxygen Consumption; **MET:** Metabolic Equivalent; **SBP:** Systolic Blood Pressure; **DBP:** Diastolic Blood Pressure; **HR:** Heart Rate; **RPP:** Rate Pressure Product; **PA-R:** Physical Activity Rating.

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Cite this article: Shah H, Prajapati T. Effects of Tobacco Consumption on Aerobic Fitness in Indian Adult Men. Int J Clin Exp Physiol. 2022;9(1):41-4.