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AEROBIC CAPACITY IN YOUNG TOBACCO SMOKING LABOURER

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ABSTRACT

Aims: Even though it is known that smoking adversely affects pulmonary function, disease development, measured VO2max and exercise tolerance, the effect of smoking on VO2max not been evaluated. The aim of the study is to evaluate the cumulative impact of smoking on measured VO2max level of young smokers.

Study design: Community based observational study

Methodology: 116 participants (63 smokers and 53 non-smokers) meeting inclusion-exclusion criteria and willing to participate were included in these study. Queen's college step test was performed on all participants and VO2max was determined according to the formula.

Results: This study shows that there is a negative co-relation between BMI & VO2max (ml/kg/min) of smokers (-0.316) and of non-smokers (-0.392) which means that BMI is adversely proportional to VO2max. Our study evaluated the aerobic capacity of current smokers which showed the mean difference between non-smokers and smokers was -4.474 and the P value of 0.193 which says that the VO2max of young smokers was more than that of smokers.

Conclusion: BMI is inversely proportional to VO2max and smokers have a higher level of VO2 max than of non-smokers.

Keywords: Tobacco smoking, Aerobic capacity, Queen's college step test, VO2max

INTRODUCTION

Tobacco smoking is a critical topic in public health and use tobacco has been increasing in many developing countries around the world including India **[1]**. As per the WHO report of global tobacco epidemic, 24.3% Males and 2.9% females of more than 15 years of age smokes tobacco **[2]**. In India, cigarettes and bidis have caused 100 Million premature deaths of which 77 million were caused by bidi's only **[3]**.

Cigarette smoke that is drawn through the tobacco into an active smoker's mouth is known as mainstream smoke. Mainstream cigarette smoke comprises 8% of tar and 92% of gaseous components **[4]**. Tobacco contains over 44 harmful chemical compounds such as nicotine, tar and carbon mono-oxide (CO), known or suspected human carcinogens such as: benzene, 4-aminobiphenyl, nickel, 2-naphthylamine, and a variety of polycyclic aromatic hydrocarbons (PAH) and N-Nitrosomes **[4]**. Among all compounds, nicotine in is probably the most studied component **[1]**.

Nicotine plays a major role in smoking-related increases in blood pressure, cardiac output, heart rate and its role in cigarette smoke-related athero-thrombotic disease remains controversial. Excessive inhalation CO which is a by-product of incomplete carbon combustion leads to increases concentrations in the airways and blood. All these risk factors make smokers increased risk of developing various forms of arteriosclerosis. Increased levels of CO in the bloodstream also adversely affects skeletal muscle performance **[1, 5, 6]**.

There are many authors who have studied and verified the adverse effects of tobacco smoking on the human being. Smoking has a detrimental effect on respiratory system like airway inflammation, narrowing and lung hyperinflation **[7, 8]**. Individuals who have recently smoked experiences various cardiovascular changes that adversely affect oxygen availability at the tissue level due to failure in the normal vasodilatation response in exercising muscles. Sometimes healthy smokers may not experience limitations in exercise mainly because they do not exercise at sufficient intensities to experience exercise limitations. However, there will be subtle difference during submaximal exercise compared to non-smokers. Differences during submaximal exercise may show underlying limitations due to smoking that may be worsened if smoking continues.

Although it is known that smoking adversely affects cardiac and pulmonary function, effect of smoking on VO2max not been evaluated in young smokers **[10]**. Some of the studies have found that cigarette smokers have significantly lower VO2max, anaerobic threshold and a significantly higher heart rate, respiratory rate and pulse-pressure product.

VO2max is the primary indicator of aerobic fitness, cardio-vascular fitness and endurance performance. The direct measure of VO2max is the ideal way of measuring aerobic capacity where the participant undergoes a maximal or submaximal exercise test either on a treadmill or bicycle ergo-meter and oxygen consumption is measured directly. This is the gold standard but the availability and cost of the equipment makes it impractical in non-laboratory and field situation and also performance of these tests requires a high level of technical expertise and supervision **[11]**.

Because of this limitations, many other tests have been developed for estimation of aerobic capacity. One such commonly used field test is Queen's college step test in which a person steps up and down on a 16.25-inch stool for 3 minutes **[11]**. This test is found to be reliable in measuring VO2max. Therefore, the purpose of this study is to evaluate the cumulative impact of smoking on aerobic capacity i.e. VO2max.

MATERIAL AND METHODS

This is a community based, observational study done over a period of 6 months in village population of Vadodara district of Gujarat. The objective of the study was to find out the aerobic capacity (VO2max) in smokers by using queen's college step test and compare it with the normal age/sex matched non-smokers.

Inclusion criteria:

- Current smokers and age matched non-smokers.
- Age between 20-40 years.
- Those who answers no to all questions of PAR Q & YOU (Physical Readiness Questionnaire and YOU)
- The Individuals who smoke cigarettes or bidis only.

Exclusion criteria:

- Individuals having any known cardiac, respiratory or metabolic disease.
- Individuals with musculoskeletal problems which interferes with the performance of the test.
- Subjects having problems with balance and co-ordination.

After getting the ethical approval from Institutional Ethical Committee, through proper channel, head of the village

(sarpanch) were approached and explained about the study that is aimed to be done on tobacco smoking labourer who have smoked more than 100 cigarettes or bidis in their lifetime and are currently smoking at least once monthly and also requested them to identify such subjects and make announcements in village to encourage voluntary participation. Similarly, age matched non-smoker were also recruited for the comparison of VO2max. Brief assessment of the subjects including demographic data, medical history, type and duration of work, smoking history and current smoking status was taken.

Written consent was taken from the participants who were willingly participated in the study. They were also screened for inclusion criteria and exclusion criteria. Demographic data, medical history, Body mass index (BMI), current smoking status and smoking history was collected from each consenting subject. All the participants answered a PAR-Q and YOU Questionnaire **[17]** which was administered one to one basis. Queen's college step test was explained to each subject in detail. Before performing the queen's college step test, the following steps were taken: First resting vitals were taken. Then each participant was given a practice session for 1-2 Minutes at a lower height step (about 8.1 inches) and rate set by metronome (22 per minute for females and 24 per minute for males) which also served as a warm up. After the practice session, the subjects were allowed to rest till the vitals return resting level and then queen's college step test was conducted **[15]**.

During the test, subjects were asked to step up and down on a step which was of 16.25 inches in height and at the rate of 22/min for females and 24/min for males (with metronome) for 3 minutes. Vitals were taken immediately post-test and especially pulse rate was taken continuously with the help of pulse-oximeter. Then VO2max was calculated by using the following formula:

For Males: VO2max:111.33-[0.42×HR/BPM] **[14]**

For Females: VO2max:65.81-[0.1847×HR/BPM]

Material used during the data collection were 16.25 Inch height stool (for queen's college step test), metronome software with speakers, weighing machine, measuring tape, sphygmomanometer, stethoscope and pulse oximeter.

RESULTS AND DISCUSSION

During the recruitment total 143 subjects who granted consent. Out of these 143 subjects, 27 subjects could not complete the test and hence excluded from the study. In remaining sample of 116 subjects, 63 were smokers and 53 were non-smokers **(Table 1)**.

This study shows that there is a negative co relation between BMI & VO2max (ml/kg/min) of smokers [-0.316] and non-smokers [-0.392] which means that BMI is inversely proportional to VO2 max. As the BMI of the subject's increases, VO2max decreases.

Similar study was done by Snezana Radovanovic *et al* to see the impact of body weight on aerobic capacity who also concluded a significant negative correlation between BMI and VO2max (ml/kg/min) **[19]**. Another similar study done by Laxmi CC in 2014 to see the effect of body mass index on cardiorespiratory fitness in young healthy males and concluded that excessive amount of body fat exerts an unfavourable burden on cardiac function and oxygen uptake by working muscles **[20]**. Smoking activates Na^+-K^+-ATPase enzymes in the heart, which reduces the contraction force of the vessels. This subsequently affects the blood oxygen carrying capacity, increases carboxyhemoglobin concentrations in the blood, and reduces the rate of oxygen dissolution. In addition, this can potentially limit the oxygen-carrying capacity of myoglobin during maximum exercise, which ultimately decreases efficiency of working skeletal muscles leading to a reduced VO2max. Low cardiorespiratory fitness in young adults with increased body fat could be a factor for developing cardiovascular comorbidities later in middle age **(Table 2, 3)**.

Table 1: Socio-demography of the study population

Characteristics	Smokers	Non smokers
N	63	53
Gender (Male)	100 %	100 %
Mean Age	28.07 (±3.12)	24.52 (±2.79)
Mean BMI	23.35 (±4.02)	24.71 (±4.39)
No. of bidi/cigarette per week	7 (±5.63)	00

Table 2: Co-relation between VO2max and BMI between smoker and non-smoker

CO relation between VO2 max & BMI	Smokers	Non smokers
CO-relation co efficient	-0.316	-0.392
P Value	0.0251	0.052

Table 3: Difference in VO2 MAX level between non-smoker and smoker

	Group	N	Mean VO2 Max	Std. Deviation	Mean Difference	t-value	P-value
VO2max	Non Smoker	53	44.624	9.085	-4.474	-1.324	.193
	Smoker	63	49.098	12.200			

Our study evaluated the aerobic capacity of a current smoker which showed the mean difference between non-smokers and smokers was -4.474 with the P value of 0.193 which says that the VO2 max of smokers was more than that of non-smoker. A study done by Chia-Lun lee in 2013 to find out the effects of cigarette smoking on

aerobic and anaerobic capacity and heart rate variability among female university students and concluded that smoking may increase smokers' exercise fatigue and decrease their average performance during an Intermittent sprint test, while reducing their maximal aerobic capacity **[1]**. The dissimilarity in result is probably due to a high VO2max between some subjects who had high levels of physical activity due to their occupation (physical labourer) and relatively very low levels of cigarette smoking.

Most of the smokers in this study were labourer and doing hard physical activity on a daily basis. This may lead to increase in their maximum oxygen uptake during queen's college step test. Whereas most of the non-smokers in this study were students having sedentary life style. This may partly explain the reasons of high VO2max among smokers that non-smokers. Further a study on maximum oxygen uptake capacity of smokers of different age groups was done by Chatterjee S *et al* and concluded that VO2max of smokers was significantly lower than that of non-smokers only in the young age group of 20-29 years, which means smoking impairs VO2max only in the young ages.

In the present study, the mean age of smokers was 28.07 and mean age of non-smokers was 24.52, which also partly explains why smokers of this study were having high VO2max.

CONCLUSION

Our study concluded BMI has a negative correlation with VO2max and young smokers have a higher level of V02max than non-smokers.

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