

A Comparative study of Exercise Capacity in Smokers and Non-Smokers

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Abstract

Purpose: Medical studies have proven that smoking tobacco is amongst the leading causes of various diseases such as lung cancer, myocardial infarctions, COPD and erectile dysfunction. Neoplastic, vascular and respiratory changes are also seen. Smoking decreases the Oxygen carrying capacity of the blood in the body effectively decreasing oxygen delivered for various bodily functions, resulting in reduced physical capacity & performance.

Objectives: To compare the exercise capacity in smokers & age-matched non smokers.

Method: Written consent was taken from 60 subjects [30 smokers (smoking index >10) + 30 non-smokers], after screening them with PAR-Q and you questionnaire; mean age of smokers was 28.36±2.88 years and of non-smokers was 27.5±2.99 years. BMI was calculated. Incremental Shuttle Run Test was performed by the subjects. Pre test & post test, vitals and RPE using the Borg's CR-10 rating scale of exertion was taken. VO₂max was calculated using the formula.

Result: Mean distance covered by smokers is 337.33 ± 69.42 meters and by non-smokers is 610.66 ± 165.40meters.

Mean speed of smokers is 8.71±0.28 km/hr and that of non-smokers is 9.6±0.49 km/hr

Mean of VO₂max in smokers is 31.60±1.66 ml/kg/min and non-smokers 36.76 ± 2.91 ml/kg/min (p value 0.00)

Conclusion: We safely conclude that the distance covered, speed & the exercise capacity of non-smokers was significantly better than that of the smokers, safely attributing it to their smoking status.

Key words: Smoking, VO₂max, Incremental shuttle run test, Smoking index, Exercise performance.

Introduction

Today medical studies have proven that smoking tobacco is amongst the leading causes of various diseases such as lung cancer, myocardial infarctions, COPD, erectile dysfunction. It is also known to cause birth defects. The other hazards of smoking include neoplastic, vascular and respiratory changes. Smokers tend to lose at least one decade of life expectancy as compared to those who have never smoked. It is seen that smoking cessation before the age of 40 years reduces the risk of death associated with continued smoking by about 90% [1]. Smoking decreases the oxygen carrying capacity of the blood in the body. For peak performance at rest & during activity, the heart and lungs need oxygen rich blood. Smoking causes introduction of carbon

monoxide in the body which is just one of the 4000 chemicals that is present in smoke.

When this carbon monoxide combines with the haemoglobin in the red blood cells more easily than does oxygen, the ability & amount of oxygen transported is reduced. So the amount of oxygen delivered to the body for various bodily functions is effectively less & results in reduced physical capacity & performance [2].

The energy requirements of physical activity are calculated by measuring the oxygen requirements of the amount of exercise or physical activity being performed and it's known as the oxygen consumption (Vo₂). VO₂ provides useful information for exercise professionals, such as the criterion measure of cardio-respiratory fitness (Vo₂max) [3]. VO₂ max is the maximum rate of oxygen

consumption which reflects the aerobic physical fitness of the individual and it is an important determinant of their endurance capacity during prolonged exercise. Accurately measuring VO₂ max involves a physical effort sufficient in duration and intensity to fully tax the aerobic energy system.

Incremental shuttle run test is one of the graded exercise test in which the exercise intensity progressively increases and it's a maximal exercise (run) test. VO₂ max is reached when oxygen consumption remains at steady state despite an increase in workload. As is known smoking affects pulmonary & vascular functions which influence exercise performance on smokers. Therefore the exercise capacity in smokers was thought to be studied & compared to their age matched non smokers.

Methodology

The study was approved by the Ethical committee and written consent was taken from 60 subjects (30 smokers

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Table 1: Initial examination and reassessment data

| Results | Smokers | Non-smoker | p value |
|--------------------|----------------|-----------------|---------|
| Distance (meters) | 337.33 ± 69.42 | 610.66 ± 165.40 | 0 |
| Speed (km/hr) | 8.71 ± 0.28 | 9.6 ± 0.49 | 0 |
| VO2max (ml/kg/min) | 31.60 ± 1.66 | 36.76 ± 2.91 | 0 |

[smoking atleast for 3 years] + 30 non-smokers) after screening them by PAR-Q and you questionnaire. Mean age of smokers was 28.36 ± 2.88 years and the mean age of non-smokers was 27.5 ± 2.99 years. Their weight, height was measured & BMI was calculated. Incremental shuttle run test (ISRT) was performed by the subjects prior to which their blood pressure, respiratory rate, heart rate, and rate of perceived exertion using the Borg's CR-10 rating scale of exertion. The subjects were given trial runs of the ISRT. After completion of the test, all the pre test parameters were reassessed. VO2max was calculated using the formula [4].

The data collected was statistically analysed using Microsoft windows .

Statistical analysis: Unpaired t test was used to find out the comparison between the distance, speed and the VO2 max between the smokers and the non-smokers.

Result

Table 1

The table shows that the distance covered by the smokers was less by almost 50% as compared to that by the non smokers (p value 0.00), therefore the speed of the smokers was less as that of the non smokers (p value 0.00). The exercise performance reflected by the VO2max was also significantly less (p value 0.00) in the smokers.

Discussion

Cigarette smoking is the most important and the most prevalent risk factor for the development of cardiovascular & pulmonary disease. Cigarette smoking contains numerous vaporized chemicals (92%) and particulates (8%) suspended in a gaseous medium. Greater the exposure of tobacco, greater is the risk of developing pulmonary diseases. Prolonged cigarette smoking impairs ciliary movements, produces hypertrophy and hyperplasia of mucus secreting glands [5]. The subject population in the present study was homogenous in nature with respect to their ages where mean age of smokers was

28.36 ± 2.88 years and the mean age of non-smokers were 27.5 ± 2.99 years, the mean BMI of smokers were found to be 25.27 ± 3.8 kg/m² and that of non-smokers was found to be 24.01 ± 3.51 kg/m², and the subjects chosen were employees from Information Technology companies having job of 12-14 hours, of which 80% of work time was spent working on the computer and no recreational activity during the remaining 20% of worktime or even during rest of the day. None of participants of the study went to the gym or played any form of sports. Thus, essentially all were sedentary in nature making the groups mutually homogenous.

The shuttle run test performed by the participants gave a very varied picture probably due to their smoking status. The comparison of distance covered by the smokers and non-smokers was found to be very significant (p = 0.00) i.e., the mean distance covered by the non smokers (610.66 ± 165.40 meters) was significantly more as compared to that covered by the smokers (337.33 ± 69 meters). The calculated mean speed [4] with the help of the stage completed in the ISRT was also significantly better in the non smokers (9.6 ± 0.49 kms/hour) as compared to the speed of the smokers (8.71 ± 0.28 kms /hour).

The researchers also noted that the reason for early test termination in the smokers was usually leg cramps, breathlessness and early fatigue as compared to the non smokers who completed more stages & complained predominantly only of breathlessness. In smokers, the carbon monoxide prevents the oxygen to bind with the haemoglobin causing less supply of oxygen to the body which leads to early fatigue and cramping in muscles. The lung compliance is also affected in the smokers leading to an overall deterioration in exercise performance. Justifying the lesser distance covered, lesser speed achieved & poorer performance by smokers as compared to the non smokers. The smoking index [6] calculated for these people was found to be 22.3+ 12.41, this

index has been designed specifically for our Indian population in order to comment on the cumulative effect of smoking. This adds on the already sedentary lifestyle of the subjects leading to pulmonary, cardiac & vascular system dysfunction. Cardiovascular system dysfunction was reflected by the complaints of leg cramps & early fatigability.

The fact is smoking has ill effects on the blood pressure and the endothelial function [7-12]. It is known to impair cardiac performance. A study has shown that smoking compromises cardiac function and leads to cardiac remodeling [13]. Greater left ventricular mass was seen in chronic smokers independent of any changes in their BP and left ventricular fractional shortening [14].

Comparison of exercise capacity in smokers and non-smokers showed that the maximal oxygen uptake i.e., VO2max in non-smokers (36.76 ± 2.91 ml/kg/min) was significantly higher (p value 0.00) as compared to that of the smokers (31.60 ± 1.66 ml/kg/min) [15]. Smoking destroys alveolar linings making them less elastic & the lung less compliant. This reduces the oxygen absorption. Smokers lung have a lesser surface area and smaller blood vessels. So the lungs receive less blood and oxygen than that needed for functioning normally. Each puff of the smoke inhaled causes the airways to constrict and over a time period narrowing of airways occurs and permanent damage is caused to the lung. This highly preventable danger is faced not only by the active smokers but also by the passive smokers around them putting the community at large at risk of altered exercise performance & eventually decreased functional performance.

Conclusion

From the present study we can safely conclude that the distance covered, speed reached & therefore the exercise capacity depicting the exercise performance of non-smokers was significantly better than that of the smokers safely attributing this lowered performance to their smoking status.

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