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Original Research Article

A Study to Evaluate Cardiorespiratory Fitness and Prediction of Future Risk of Coronary Artery Disease in Public Transport Bus Drivers of Mumbai and Navi Mumbai

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ABSTRACT

Driving bus in an urban area is a demanding job and requires tremendous amount of physical and mental stability to perform the task with minimal hazards. Bus drivers are under continuous stress during the working hours and are prone for many diseases related to the changes induced by stress, especially cardiovascular disorders.

Study Objective: To evaluate cardio-respiratory fitness using three min step test and prediction of future risk of CAD using IPAQ, ACSM risk factor stratification scoring in public transport bus drivers of Mumbai and Navi Mumbai.

Methodology: 100 public transport bus drivers were included according to inclusion and exclusion criteria between the age group of 25-55 years. Bus drivers were interviewed for IPAQ questionnaire, ACSM risk factor stratification scoring and perceived stress scale. Cardio-respiratory fitness was evaluated and the recovery heart rate was recorded. Spearman's correlation test was carried out using SPSS (version16).

Result: Our study revealed strong positive correlation between three (3) minute step test recovery heart rate and ACSM risk factor stratification scoring (r=0.803, p=0.00), derived Vo2max and IPAQ (r=0.588,p=0.00)and strong negative relation between 3 min step test recovery heart rate and IPAQ (r=-0.589,p=0.00), derived Vo2max and ACSM risk factor stratification scoring (r=-0.788,p=0.00), ACSM risk factor stratification scoring and IPAQ (r=-0.719,p=0.00).

Conclusion: Our study demonstrated a moderately high prevalence (93%) of CAD risk factors amongst bus drivers of Mumbai and Navi Mumbai. Sedentary life style was found to be the commonest risk factor amongst the entire study population followed by stress, smoking and dyslipidemia.

Key Words: 3 min step test recovery heart rate, ACSM, IPAQ, VO2MAX, correlation, bus drivers.

INTRODUCTION

Bus drivers in urban areas are under constant high stress not only for time factor but also for the safety of the passengers to avoid accidents. Bus driving has become challenging in urban areas due to increase in number of vehicles, improper roads, improper city design, lack of traffic sense and also improper following of traffic rules. [1] Bus drivers are more likely to develop CAD due to stressors like violence from the passengers, rotating shifts, traffic congestion

and pollution. [2]

Cardiorespiratory fitness is the overall capacity of cardiovascular and cardio-respiratory system to carry out prolonged strenuous activity. [3] Coronary artery disease (CAD) is one of the most common causes of mortality and morbidity in both developed and in developing countries. It is the leading cause of death in India, and its contribution to mortality is rising: the number of deaths due to CAD in 2014 is expected to be doubled by 2030. [4] CAD is a compensable work related disease and is caused by following risk factors: Smoking, Alcohol, Hypertension, Diabetes, Obesity, Hyperlipidemia, Diet.

There is a strong correlation of CAD with occupational factors. [1] Public transport bus drivers are exposed to occupational risk factors such as long working hours, loud noise, exposure to carbon monoxide and pollutants. [5] All these factors increase the probability of developing CAD. In addition to this, bus drivers are more likely to be obese as they burn fewer calories due to their sedentary life style, poor and irregular diet, and work in sitting position for a long period of time. There are many causes of substance abuse including alcohol, cigarette, tobacco as it is cheap and easily available. [5] They are more likely to have psychological problems like depression, anxiety and sleeping problems. [6]

These occupational factors may lead to high blood pressure, diabetes mellitus, abdominal obesity resulting in high risk of CAD among professional bus drivers. [1]

MATERIALS AND METHODS

STUDY DESIGN:

This was a cross sectional study following a purposive sampling involving a population of 100 public transport bus drivers of Mumbai and Navi Mumbai. The inclusion criteria adopted was male public transport bus drivers of BEST and NMMT in the age group 25-55 years, excluding the drivers with less than one year experience of driving, known case of CAD and drivers with respiratory disorders and recent musculoskeletal injuries.

METHODOLOGY:

Informed consent was taken from all the subjects. Physical examination of all subjects consists of measuring of height in meters, weight in kilograms and Body mass index was derived by Quetelet's index - weight (kg)/ height (m^2). [7] The subjects were then interviewed with the already validated questionnaire (*ACSM RISK FACTOR STRATIFICATION SCORING*). The questionnaire was filled based on the answers given by the respondent and their investigation reports of serum cholesterol and fasting plasma glucose level were noted. The subjects were then interviewed for *IPAQ* (short-form) and perceived stress scale. 3-Minute Step Test was performed to assess cardiovascular fitness and recovery heart rate post 1 min was noted through which Vo2max was calculated.

ASSESSMENT OF AEROBIC FITNESS (HR AND VO2MAX):

3-Minute Step Test

- Purpose: To assess aerobic fitness.
- Objective: To step up and down to a set cadence for 3 min and take the resulting heart rate.
- Equipment: 12 inch. (30.5 cm) high bench, Metronome set at 96beats/min, pulse-oximeter and speakers.
- Instructions: The subject listens to the metronome to become familiar with the cadence and begins when ready and the time starts. The subject steps up, down to the 96 beats/min cadence, which allows 24steps/min. This continues for 3 min. After the final step down, the subjects were made to sit down in a relaxed position and heart rate was recorded for 1 minute.
- Scoring: The 1 minute. recovery heart rate is the score for the test.
- Following formula was used for determining VO2max.

Males: VO2max = 111.33 – (0.42 X PR)

Fig. A: 3 min step test on 12 inch stepper.

STATISTICAL ANALYSIS

Collected data was recorded in Excel spreadsheet and was analyzed using Statistical package for the Social Science software (SPSS version 16).The Shapiro-Wilk normality test was used to determine normality of quantitative data which revealed that the data was not normally distributed. Spearman's test was used for the data analysis in software.

RESULT

Table 1: Descriptive statistics of Bus drivers

VARIABLES	MEAN	STANDARD DEVIATION
AGE	35.39	±7.87
BMI	35.39	±3.37
3 MIN STEP TEST RECOVERY HR	105.37	±11.23
VO2 MAX	67.01	±4.77
ACSM RISK FACTOR SCORING	2.752	±0.99
IPAQ	367.10	±125.81
PERCEIVED STRESS SCALE SCORING	22.30	±4.05

The mean value and standard deviation for Age were 35.39,±7.87, BMI:24.48kg/m^2, ±3.37, 3 min recovery heart rate:105.37 bpm,±11.236,ACSM risk stratification scoring: 2.752,±0.99, Perceived stress scale: 22.30,±4.05, VO2max: 67.01, ±4.77 and IPAQ:367.10, ±125.81.

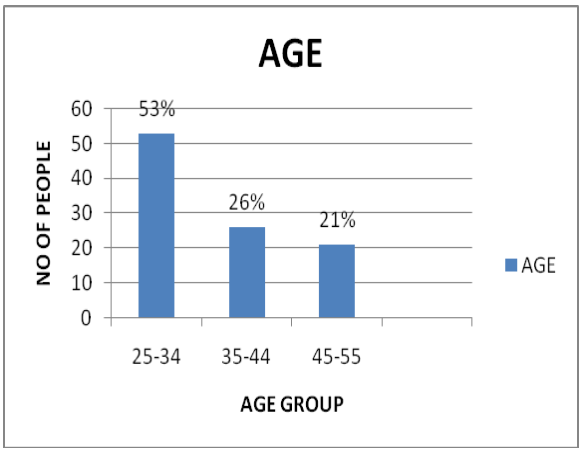


Figure 1: Age group distribution

100 bus drivers were included in this study with mean age of 27 ±7.8.

Majority (53%) of study population were between 25-34years, 26% in 35-44 years and 21% in 45-55 years.

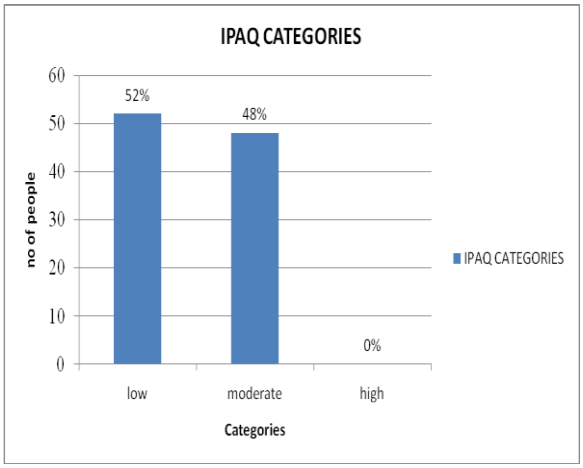


Figure 2: IPAQ categories

As per IPAQ category, 52 bus drivers (52%) were minimally active, 48 bus drivers (48%) were moderately active, 0(0%) were highly active. This indicates most of bus drivers were minimally active because of their sedentary lifestyle, prolonged sitting.

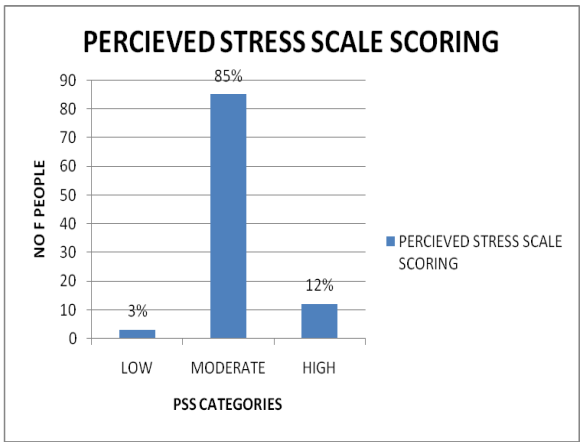


Figure 3: Perceived stress scale scoring

As per perceived stress scale scoring 3(3%) bus drivers were low stressed, 85(85%) bus drivers were moderately stressed, 12 (12%) bus drivers were highly stressed.

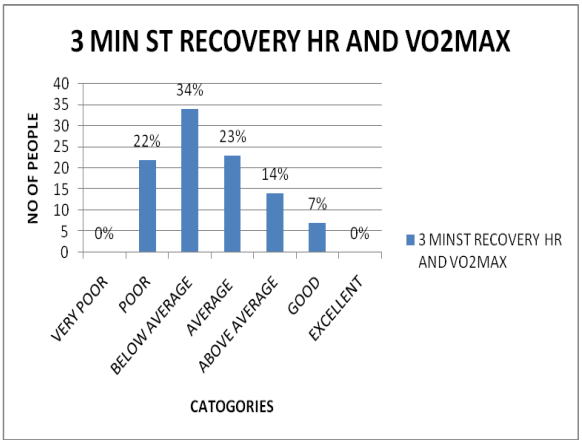


Figure 4: level of Endurance (3min step test recovery heart rate)

On performing 3min step test the recovery heart rate post 1 min and vo2 max was very poor in 1(1%) bus drivers, poor in 22 (22%) bus drivers, below average in 34(34%) bus drivers, were average in 23(23%) bus drivers, above average in 14(14%) bus drivers, good in 7(7%) bus drivers, excellent in 0(0%) bus drivers.

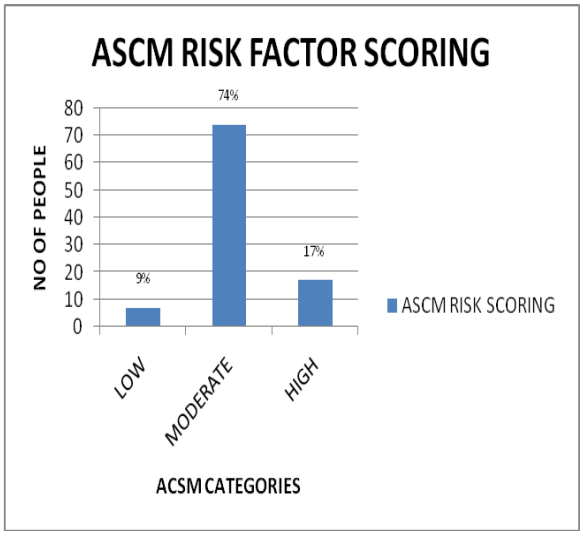


Figure 5: ACSM risk factor stratification scoring categories

On evaluation of results as per ACSM stratification we noted that 9bus drivers (9%) had low risk, 74bus drivers (74%) had moderate risk and 17 bus drivers (17%) had high risk of developing CAD.

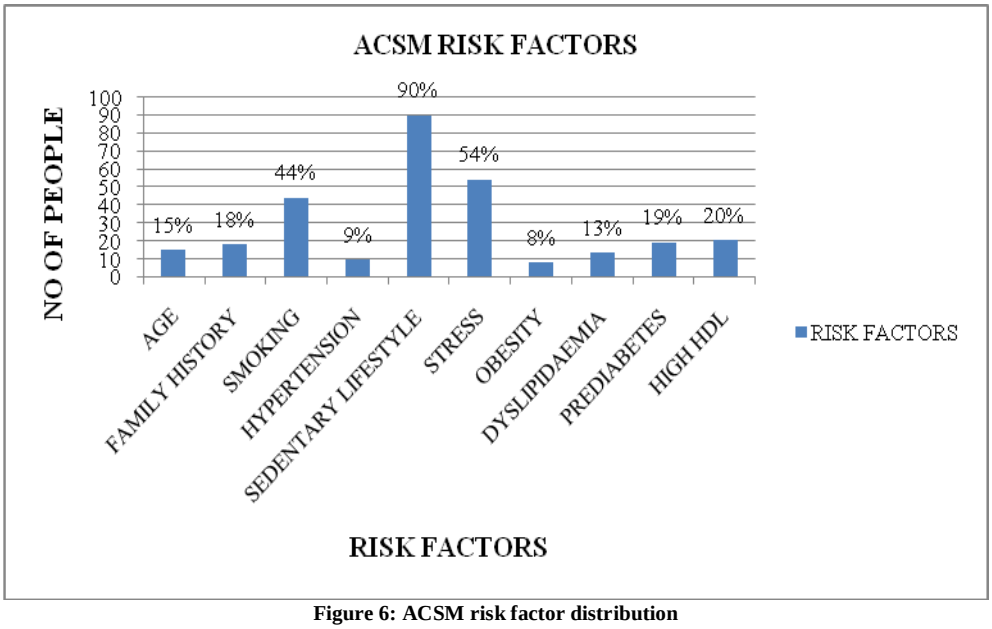
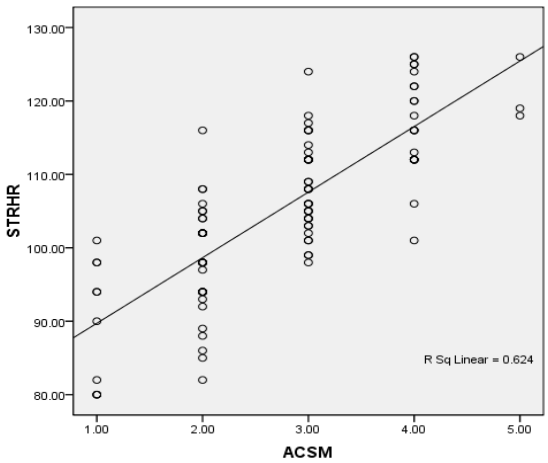


Figure 6: ACSM risk factor distribution

As per ACSM risk stratification scoring (90%) had sedentary life style, (54%) stress, (44%) smoking, (20%) high HDL (19%), (18%) family history, (13%) dyslipidaemia

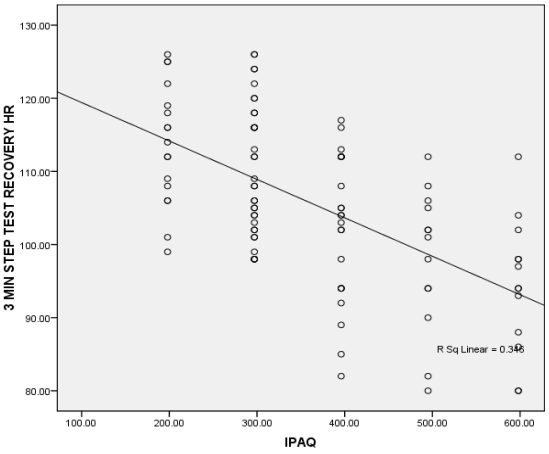


Graph 1: Shows strong positive correlation between 3 min step test recovery heart rate and ACSM categories(r=0.589, p=0.00).

Table 2: As per spearman's correlation there is strong positive correlation between 3 min step test and ACSM categories. (r=0.803, p=0.01).

Correlation coefficient	0.589″
Sig(2- tailed)	0.00

**Correlation is significant at the 0.01 level (2-tailed)

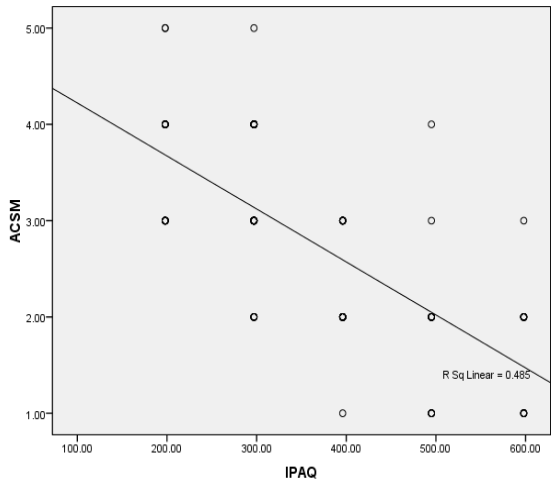


Graph 2: Shows strong negative relation between 3 min step test recovery heart rate and IPAQ(r=-0.719, p=0.00).

Table 3: A per spearman's correlation there is strong negative correlation between 3 min step test recovery heart rates and IPAQ. (r=-0.803, p=0.01).

Correlation coefficient	-0.803″
Sig(2-tailed)	0.00

**Correlation is significant at the 0.01 level (2-tailed)

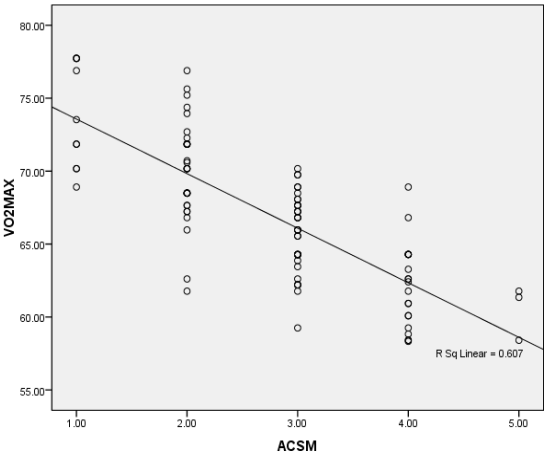


Graph 3: Shows strong negative relation between IPAQ and ACSM (r=-0.719,p=0.00).

Table 4: As per spearman's correlation there is strong negative correlation between ACSM risk factor stratification scoring and IPAQ. (r=-0.719, p=0.01).

Correlation coefficient	-0.719″
Sig (2 -tailed)	0.00

**Correlation is significant at the 0.01 level (2-tailed).

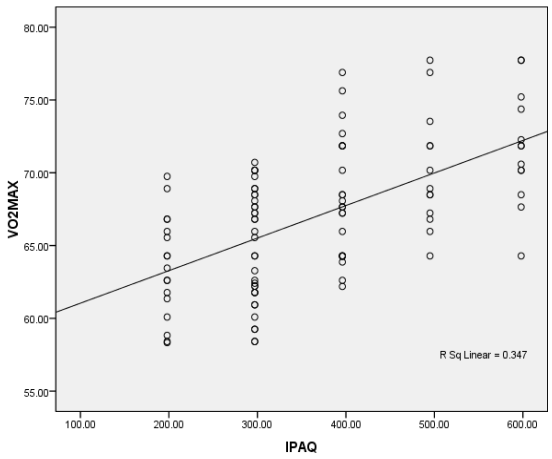


Graph 4: Shows strong negative correlation between derived Vo2max and ACSM(r=-0.-788, p=0.00).

Table 5: As per spearman's correlation there is strong negative correlation between derived vo2max And ACSM Categories r =-0.788p=0.01.

Correlation coefficient	-0.788″
Sigma(2-tailed)	0.00

**Correlation is significant at the 0.01 level (2-tailed)



Graph 5: Shows strong positive relation between derived Vo2max (3 min step test) and IPAQ(r=0.588, p=0.00).

Table 6: As per spearman's correlation there is strong positive relation between derived Vo2max (3min step test) and IPAQ r=0.588, p=0.01.

Correlation coefficient	0.588″
Sigma(2-tailed)	0.00

**Correlation is significant at the 0.01 level (2-tailed)

DISCUSSION

The present study consisted of 100 public transport bus drivers. This study investigated prediction of future risk of Coronary Artery Disease (CAD) amongst public transport bus drivers of Mumbai and Navi Mumbai. As per the study done by Mohd. Rasheeduddin Imran and B. Syamala devi(2013) it was observed that high work stress has repeatedly been associated with increased risk for cardiovascular disease. [1]

In this study ACSM risk stratification scoring was used to evaluate future risk of CAD in public transport bus drivers. According to ACSM risk stratification scoring sedentary lifestyle (90%) of the total study population had sedentary lifestyle as a risk factor. Working hours were mostly spent sedentary by the drivers by sitting for prolonged period of time. Lack of exercise leads to reduced insulin sensitivity, reduces glucose tolerance, reduces HDL cholesterol level, increases triglyceride and LDL cholesterol level. It even impairs fibrinolysis, endothelial cell function and elevates homocysteine level thereby damaging arterial endothelium and inhibiting anticoagulant cascade.

Stress: 54% of the total study population had stress as a risk factor. It causes an increase in the production and circulating levels of catecholamines (β-adrenergic stimulators) thereby increasing blood pressure and myocardial oxygen demand and may cause damage to endothelial cells of arterial blood vessels and platelet agglutination.

Smoking: 44% of the total study population had smoking as a risk factor. Carbon mono-oxide binds with haemoglobin in blood that produces carboxyl-haemoglobin which damages the endothelial cells of the arteries which increases the permeability of the arteries to the invasion of lipids. Nicotine is a potent vasoconstrictor. Smoking also results in elevated fibrinogen level thereby leading to platelet aggregation and thrombus formation. Certain earlier studies suggested that some conventional risk factors, such as smoking and hypercholesterolemia were more prevalent among professional drivers and accounted for their increased risk for CAD. [1]

Prediabetes: 19% of the total study population had prediabetes as a risk factor mainly due to family history, genetic predisposition, physical inactivity and stress. Family History: 18% of the total study population had family history as a risk factor. Familial predisposition to CAD was related to other risk factors like diabetes, hypertension and hypolipoproteinaemia. Obesity: 18% of the total study population had obesity as a risk factor due to prolonged sitting physical inactivity. Obesity is strongly related to hypertension, diabetes, dyslipidaemia and physical inactivity. Age**:** 15% of the total study population had age as risk factor. *Dyslipidaemia:* 13% of the total study population had dyslipidaemia as a risk factor due to low physical activity level, prolonged sitting, excessive alcohol consumption. High HDL: 20% of the total study population had high HDL level. A study conducted by in Korea (2013) stated that bus drivers are at higher risk in

developing CAD. [5] As per study done by RaquelPastr´elloHirata, Luciana Maria Malosa Sampaio (2012) intersate bus drivers revealed high cardiovascular risk factors as obesity, hypertension, hyperlipidemia, hyperglycemia, as well as other contributing factors, such as a low intensity activity, sedentary lifestyle and long duration sitting position. [2]

Stress level was evaluated by using perceived stress scale. In this study as per perceived stress scale scoring, 85(85%) bus drivers were moderately stressed, 12 (12%) bus drivers were highly stressed and 3(3%) bus drivers were low stressed. A study conducted by Geeta V. Bathija, Dattateraya D Bant, S. R. Itagimath in Hubli (2014) also stated that bus drivers are more prone to high level of stress. [6]

Physical activity was assessed using IPAQ questionnaire. As per IPAQ, 52 bus drivers (52%) were minimally active, 48 bus drivers (48%) were moderately active, 0(0%) were highly active. This indicates most of bus drivers were minimally active because of their sedentary lifestyle, prolonged sitting and long working hours. Cardiorespiratory fitness was assessed by using 3 min step test. This test makes it possible to estimate the exercise capacity of drivers and to monitor changes in cardiovascular system to sub maximal exercise. On performing 3 min step test the recovery Heart rate and derived Vo2 max was below average in 34% bus drivers, average in 23(23%) bus drivers, poor in 22 (22%)bus drivers, above average in14 (14%) bus drivers, good in 7(7%) bus drivers and very poor in 1(1%)bus drivers which indicates cardiorespiratory fitness of bus drivers was affected in majority of study population due to their sedentary lifestyle, long working hours, exposure to pollutants and high stress level.

This study also showed strong positive correlation between 3 min step test recovery heart rate and ACSM categories which indicates drivers with higher ACSM risk factors showed higher 3 min step test recovery heart rate because sedentary lifestyle, smoking, high level of stress, dyslipidaemia will cause greater changes in cardiorespiratory system therefore causing poor response to sub maximal exercise. There was a strong negative correlation between 3 min step test recovery heart rate and IPAQ which indicates bus drivers with low physical activity showed higher heart rate post 3 min step test because drivers have low physical activity due to long working hours and sedentary lifestyle which reduces the overall capacity of cardiorespiratory system against sub maximal exercise. Study also showed strong negative correlation between ACSM categories and IPAQ which indicates lower the physical activity, higher the ACSM risk factor. physical activity helps to prevent the development of diabetes, helps maintain weight loss, and reduce hypertension, which are all independent risk factor for CAD therefore low physical activity leads to de-conditioning effect on the cardiorespiratory system resulting in higher ACSM risk factors. Based on our findings, we recommend that drivers' health be better monitored for risk factors of cardiovascular disease.

CONCLUSION

The present study showed moderately high prevalence (93%) of CAD risk factors amongst public transport bus drivers of Mumbai and Navi Mumbai. It was observed that bus drivers were exposed to volley of problems in all three domains of health viz. physical, mental & social, owing to their unique job profile. Sedentary life style was found to be the commonest risk factor amongst the study population followed by stress smoking and dyslipidemia. This study suggests that the excess risk of CAD in public transport bus drivers may well be prevented by manipulation of parameters viz., working hours, shift duty, physical activity, smoking habits of the bus drivers and to work with cleaner vehicles and improved city planning.

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