DOI: 10.7860/JCDR/2021/49089.14921

Original Article

Public Health Section

Occupational Stress and Metabolic Syndrome among Bus Drivers: Risk Factors for Cardiovascular Diseases

SANJEEV SRINIVAS WALVEKAR[1], JEEVAN G AMBEKAR[2], BASAVARAJ B DEVARANAVADAGI[3], DEEPA S SAJJANNAR[4]

ABSTRACT

Introduction: Bus drivers are more vulnerable to health complications due to the nature of their occupation. There is limited information available on the role of occupational stress and metabolic syndrome as the risk factors for Cardiovascular Diseases (CVD) among them. Metabolic syndrome is described by clustering of hypertension, hyperglycaemia, obesity, and dyslipidemia.

Aim: To investigate the relationship between occupational stress and metabolic syndrome and assess its role among bus drivers as a predictive risk factor for CVD.

Materials and Methods: A case-control study was conducted from June 2014 to March 2015, at the Department of Biochemistry, BLDE (DU) Shri BM Patil medical college, Vijayapura, Karnataka, India with randomly selected bus drivers (n=90) and age, sex-matched healthy participants (n=110) serving as controls. The National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) was used to describe metabolic syndrome. Data on socio-demographic features, anthropometric indexes, blood pressure, and biochemical parameters, including serum cortisol, were obtained. The questionnaire related to working patterns and Perceived Stress Scale (PSS) was used to assess the psycho-social hazards, and the Framingham Risk Score (FRS) model was used to predict the subsequent 10-year possible risk of developing CVD in bus drivers. Data was analysed using Statistical Package for Social Sciences (SPSS) software version 16.0.

Results: The mean age of bus drivers was 44.60±6.74 years. According to the PSS, with 28 as the cut-off value, 36 (40%) bus drivers were under stress. As per FRS, 51 (56.7%) of bus drivers were at low CVD risk, 27 (30%) were at intermediate risk, and 12 (13.3%) were at a higher CVD risk. Statistically significant values for parameters such as Fasting Blood Sugar (FBS), glycosylated haemoglobin (HbA1c), serum triglyceride, serum cortisol, and PSS were seen among bus drivers with metabolic syndrome ($p<0.001$). A positive correlation between Waist Circumference (WC) and Triglycerides (TG) ($r=0.215$, $p<0.001$), WC and diastolic blood pressure ($r=0.329$, $p<0.001$), WC and HbA1c ($r=0.409$, $p<0.001$) was observed.

Conclusion: The stress at work in the bus driver's occupation is a crucial factor associated with metabolic syndrome, a significant risk factor for CVD. The awareness program in health camps and regular physical activity will prompt lifestyle modification that reduces diseases and moderate future cardiovascular events.

Keywords: Framingham risk score, Glycosylated haemoglobin, Health complications, Heart diseases, Perceived stress scale

INTRODUCTION

The nature of occupation and the workplace has become a health concern. Bus drivers indulge themselves in driving for an extended period of time during their working hours. They are subjected to a daunting challenge and come across the ergonomic factors of the profession. This profession's precise nature involves physiological and psychological stressors that include prolonged working hours, shift work, night shift, job dissatisfaction, sedentary working style, inappropriate sleep, dietary habits, and occupational stress. Occupational stress is the leading cause of many disorders among workers. It is characterised as a perceived disparity between work demands and the individual's ability to work. Few studies revealed that occupational stress is a psycho-social risk factor that plays a significant role in developing metabolic syndrome. Metabolic syndrome is a combination of various disorders such as obesity, high blood pressure, impaired glucose tolerance, and dyslipidemia [1].

In addition to these risk factors, familial history, smoking, physical inactivity, and alcohol consumption are known as risk factors for CVD. Each of these has an independent impact, but they became synergistic when clustered together, rendering the risk of developing CVD [2]. In a Japanese study, the prevalence rate of metabolic syndrome was higher among transport employees (25.7%) compared to construction employees (21.0%) and mining employees (20.5%) [3]. In a community- based study conducted in Kolkata, India, the prevalence rate of metabolic syndrome was 44.6% [4]. Approximately, 30% of deaths are caused by cardiovascular disease worldwide, and in India also, it is a significant contributor in this direction [5].

Despite advances in the medical field, CVD prevention is still a major public health issue globally. Very few studies [6,7] have been done on bus drivers to find the role of psychosocial factors in developing metabolic syndrome and CVD even though there is a vital link between them. Because of the potential risk associated with proficient driving and the paucity of data on bus drivers' cardiovascular risk profile, it was essential to investigate the prevalence of risk factors for metabolic syndrome and CVD in this region. Simultaneously, in this study, the authors evaluated the PSS and serum cortisol levels to establish their relationship with metabolic syndrome and to verify whether the individual personality variables contribute to the onset of risk factors for CVD. The present study also assessed the FRS for each driver. The FRS is a valuable tool and indicates alarm well ahead of time about preventing and managing cardiovascular risk factors [8]. With the existing occupational potential risks and their impact on bus driver's health status being unclear and accompanied with few such related studies, the present study was undertaken to characterise the awareness of their risk burden and eventually help frame policies to address the development of metabolic syndrome, leading to a high CVD risk.

MATERIALS AND METHODS

A case-control study was conducted at the Department of Biochemistry, BLDE (DU) Shri BM Patil Medical College, Vijayapura, Karnataka, from June 2014 to March 2015 after obtaining the Institutional Ethical Committee approval for the protocol as per the revised Helsinki declaration. All the participants were pre-intimated about the purpose of the study and their consent was taken.

Inclusion criteria: This study comprised 90 professional, male bus drivers aged 27-60 years, who expressed job-related complaints, as the study group.

Age-matched 110 male subjects from the general population who visited our hospital Outpatient Department for various other purposes were included as the control group.

Exclusion criteria: The bus drivers with existing ailments like rheumatoid arthritis, tuberculosis, and other infective conditions were excluded from the study.

Sample size calculation: It was was done by using the formula:

$$n=Z^2\frac{P(1-P)}{d^2}$$

Where, n=sample size. The 'Z' value is 1.96. In this study, the results are presented with 95% confidence intervals (CI), P=35%; Prevalence rate, metabolic syndrome [9]; d=Precision, 0.1, Keeping all the values, n came to be 87.4 (Rounded to 90).

Procedure

Blood samples were collected from the subjects with overnight fasting for estimation of biochemical parameters. Detailed information about their physical activity [10] and habits such as smoking and alcohol consumption and their previous medical history was recorded. Physiological measurements were recorded, including the subjects' height, weight, WC, and hip circumference. Systolic and diastolic blood pressures were measured in the supine position after the participant was settled for at least 10 minutes.

Perceived Stress Scale (PSS) criteria: The self-perception of stress was measured in the bus drivers with the PSS-14. It has a set of 14 items (questions). PSS is a psychological instrument used to measure the extent to which situations were perceived as stressful in one's life. The fourteen questions cover both negative and positive elements. Each question was scored on a five-point scale from 0='Never' to 4='Very often,' covering the past month. The PSS ratings were obtained by reversing the responses (e.g., 0=4, 1=3, 2=2, 3=1 and 4=0) to the four positively stated items (items 4, 5, 7, and 8) and then computing across all the scale items. The scores ranged from 0 to 56. The set of questions translated within the local language was provided to the participants. The score 28, was set as the upper bound's operational cut-off value and identified as the 'stressed' and 'non stressed' those who scored less than 28 [11].

Framingham risk score: (Assessment of cardiovascular risk.) American College of Cardiology suggests utilising the Framingham model in predicting the 10-year possible risk of developing CVD in subjects with metabolic syndrome [12]. The coronary risk factors, including age, sex, total, and High Density Lipoprotein (HDL). Cholesterol, triglyceride, systolic blood pressure, smoking habit, and the subjects being diabetics were considered for the FRS calculation. Points determined a Ten-year chance of CVD risk in rate. (point 1=1.9%), (point 2=2.3%), (5=3.9%), (10=9.4%), (15=21.6%), (point 17=29.4%), (point 18=≥30%) and so on. The CVD risk percentage over ten years was classified as low risk (<10%), intermediate-risk (10-20%), and high risk (>20%) [13].

Metabolic syndrome: The subjects from control group and bus drivers were classified as per modified NCEP ATP III Guidelines. Accordingly, the presence of any three of the subsequent five factors is required for a diagnosis of Metabolic Syndrome: (1) abdominal obesity (WC ≥90 cm for Asian men or ≥80 cm for Asian women); (2) TG ≥150 mg/dL; (3) HDL cholesterol ≤40 mg/dL for men or ≤50 mg/dL for women; (4) systolic/diastolic blood pressure ≥130/85 mmHg or receiving drug treatment; and (5) fasting plasma glucose ≥100 mg/dL [14].

STATISTICAL ANALYSIS

All characteristics were summarised descriptively. The data for the continuous variables were presented as mean±SD. An independent t-test was used to find the significance between the two groups. Statistical significance was established at p<0.05. Bivariate correlation analysis was applied using Pearson's correlation coefficient (r) to test the strength and direction of relationships between the interval levels of variables. For categorical data, numbers and percentages was used in the data summaries. Statistical analysis was done by using Statistical Package for the Social Sciences (SPSS) version 16.

RESULTS

In total, 200 subjects were involved in this present study. As there was no substantial difference in age between the two groups, it implied an equal distribution of participants. More participants belonged to the 41-50 years age group (58.9%), followed by the 51-60 years age group (18.9%). The bus drivers had a higher mean BMI, waist to hip ratio, and both systolic and diastolic blood pressure compared to control subjects. (p<0.001). Except for FBS, total cholesterol, and LDL cholesterol rest of all parameters were significantly raised amongst bus drivers (p<0.001) [Table/Fig-1].

Characteristics	Controls (n=110) (mean±SD)	Bus drivers (n=90) (mean±SD)	p-value
Age (years)	46.52±7.66	44.60±6.74	0.064
Body mass index (kg/m²)	22.99±3.33	24.79±3.68	**0.0001**
Waist (cm)	74.83±7.25	91.19±10.79	**0.0001**
W/H ratio	0.84±0.06	0.95±0.08	**0.0001**
Blood pressure (Systolic) mm/Hg	120.52±8.22	124.56±10.08	**0.002**
Blood pressure (Diastolic) mm/Hg	78.17±6.53	80.91±8.13	**0.009**
Fasting blood glucose (mg/dL)	97.96±11.28	107.36±50.94	0.060
Glycosylated HbA1c (%)	4.89±0.68	5.74±1.10	**0.0001**
Triglyceride (mg/dL)	117.94±28.14	148.43±83.56	**0.001**
Total cholesterol (mg/dL)	178.40±27.47	180.38±31.31	0.635
HDL cholesterol (mg/dL)	47.38±6.26	42.22±9.93	**0.0001**
LDL cholesterol (mg/dL)	107.43±28.09	108.47±34.67	0.815
VLDL cholesterol (mg/dL)	23.59±5.63	29.69±16.71	**0.001**
Serum cortisol (µg/dL)	9.75±0.47	20.80±1.09	**0.0001**
PSS (perceived stress scale)	18.82±0.62	26.70±0.75	**0.0001**

[Table/Fig-1]: General characteristics and biochemical parameters of participants in study and control groups. Values are expressed as mean±SD. The student t-test was performed for analysis. (p-value <0.05 significant, p-value <0.001 statistically highly significant.)
W/H: Waist/Hip; HDL: High density lipoprotein; LDL: Low density lipoprotein; VLDL: Very low density lipoprotein

[Table/Fig-2] shows the percentage distribution of smoking, tobacco chewing, alcohol consumption, and the categorised physical activity as a low, average, regular activity in both control and bus drivers.

A significant difference in the values for WC, FBS, and HbA1c, triglyceride, and VLDL Cholesterol, serum Cortisol, and PSS have been recorded (p<0.05) [Table/Fig-3].

About 40% of bus drivers with a score of more than 28 were categorised as stressed. A significant increase in cortisol and PSS score levels was observed in bus drivers classified as 'stressed' (p<0.001) [Table/Fig-4].

The WC was found to correlate significantly with diastolic blood pressure (r=0.329, p<0.001), triglyceride (r=0.215, p<0.05), Gly. HbA1c (r=0.409, p<0.001). Such observations were not found in both the BMI and waist to hip ratio [Table/Fig-5].

Participants	Total no. of individual group	Smoking	Alcohol consumption	Tobacco chewing	Physical activity		
					Low	Average	Regular
Control group	110	15 (13.6%)	29 (26.4%)	19 (17.3%)	40 (36.4%)	46 (41.8%)	24 (21.8%)
Bus drivers	90	21 (23.3%)	43 (47.7%)	29 (32.2%)	47 (52.2%)	32 (35.6%)	11 (12.2%)

[Table/Fig-2]: Habits and physical activity of bus drivers and control subjects. The values are expressed in the terms of percentage.

	Metabolic syndrome in bus drivers (n=33)		Non-metabolic syndrome in bus drivers (n=57)		
Variables	Mean	SD	Mean	SD	p-value
Age (years)	45.21	7.70	44.25	6.17	0.515
Body mass index (kg/m²)	25.42	1.78	24.43	4.39	0.217
Waist circumference (cm)	99.09	9.16	85.91	13.80	**0.0001**
W/H ratio	0.97	0.05	0.93	0.01	0.049
Systolic blood pressure (mmHg)	125.70	9.58	123.89	10.39	0.417
Diastolic blood pressure (mmHg)	83.21	8.99	79.58	7.34	0.040
Fasting blood glucose (mg/dL)	141.55	69.86	87.56	15.75	**0.0001**
HbA1c (%)	6.58	1.32	5.26	0.54	**0.0001**
Triglyceride (mg/dL)	204.03	111.26	116.25	33.88	**0.0001**
Total cholesterol (mg/dL)	178.27	31.14	181.60	31.64	0.630
HDL cholesterol (mg/dL)	38.79	8.80	44.21	10.08	**0.012**
LDL cholesterol (mg/dL)	98.68	36.77	114.14	33.02	0.041
VLDL cholesterol (mg/dL)	40.81	22.25	23.25	6.78	**0.0001**
Cortisol (µg/dL)	24.09	10.99	18.90	9.61	**0.022**
PSS	29.85	7.86	24.88	6.00	**0.001**

[Table/Fig-3]: Distribution and comparison of mean characteristics in bus drivers as Metabolic and Non-metabolic syndrome. Values are expressed as mean±SD. Student's t-test was done. p-value <0.05 considered significant.
Gly. HbA1c: Glycosylated haemoglobin A1c; PSS: Perceived stress scale

	Stressed PSS (score 29-56) (n=36)		Non-stressed PSS (score 0-28) (n=54)		
Variables	Mean	SD	Mean	SD	p-value
Age (Years)	44.80	7.30	44.41	6.41	0.742
BMI (kg/m²)	24.32	3.44	25.11	3.82	0.319
Waist (cm)	93.72	13.60	89.50	15.42	0.186
W/H ratio	0.96	0.07	0.94	0.09	0.431
Systolic blood pressure (mm of Hg)	124.17	9.90	124.81	10.29	0.767
Diastolic blood pressure (mm of Hg)	79.86	7.89	81.81	8.23	0.198
Fasting blood glucose (mg/dL)	121.25	66.66	98.09	34.71	0.034
Glycosylated HbA1c (%)	6.01	1.28	5.57	0.94	0.060
Triglyceride (mg/dL)	164.58	85.35	137.67	81.36	0.135
Total cholesterol (mg/dL)	183.31	37.01	178.43	27.08	0.472
HDL cholesterol (mg/dL)	42.97	11.65	41.72	8.68	0.562
LDL cholesterol (mg/dL)	107.42	39.23	109.17	31.65	0.816
VLDL cholesterol (mg/dL)	32.92	17.07	27.03	16.27	0.135
Cortisol (µg/dL)	29.38	10.00	15.09	5.66	**0.0001**
PSS (perceived stress scale)	33.42	5.31	22.22	3.92	**0.0001**

[Table/Fig-4]: Demographic and biomedical parameters in "Stressed and Non-stressed bus drivers. Values are expressed as mean±SD. Student's t-test was used.

As seen in [Table/Fig-6], we tabulated the values in a two-set of variances, expressed in (%) distribution, regarding CVD risk indicators in control subjects, bus drivers with and without metabolic syndrome. To define the metabolic syndrome, the values for the first set indicate ranges set as the cut off value. The second set of observations was clinically demonstrative of abnormalities and suggestive of components of CVD threat.

In the bus drivers with metabolic syndrome, we observed that 39.4% of the subjects had FBS greater than 125 mg/dL. Furthermore, 66.7% had HDL cholesterol of 31-40 mg/dL, and 36.4% had blood

Between	BMI	Waist. Cm	W/H ratio
Body mass index			
Waist (cm)	0.221*		
W/H ratio	-0.154	0.416	
Systolic blood pressure (mmHg)	0.009	0.175	0.072
Diastolic blood pressure (mmHg)	0.152	0.329**	0.183
Fasting blood glucose (mg/dL)	0.062	0.188	-0.05
HbA1c (%)	0.104	0.409**	0.06
Triglyceride (mg/dL)	0.04	0.215*	0.097
Total cholesterol (mg/dL)	-0.164	0.036	0.017
HDL cholesterol (mg/dL)	0.025	-0.155	- 0.051
LDL cholesterol (mg/dL)	-0.175	-0.027	0.017
VLDL cholesterol (mg/dL)	0.04	0.215*	0.097
Cortisol (µg/dL)	-0.05	0.068	0.07
PSS	-0.061	0.075	0.035

[Table/Fig-5]: Pearson's correlation coefficient (r) between different characteristics and BMI, Waist Circumference, waist to hip ratio among the bus drivers.
*p-value <0.05 considered significant

CVD risk factors			Controls subjects		Bus drivers		
Variable	Range	Units	Control (n=110) (n)	%	Metabolic syndrome (n=33) (n) %	Non-metabolic syndrome (n=57) (n)	%
Fasting blood glucose	100-125	mg/dL	(35)	31.8	(8) 24.2	(12)	21.1
	>125	mg/dL	(9)	8.2	(13) 39.4	(3)	5.3
Triglyceride	150-200	mg/dL	(14)	12.7	(8) 24.3	(4)	7.0
	>200	mg/dL	0		(10) 30.3	(5)	8.7
Total cholesterol	200-239	mg/dL	(24)	21.8	(4) 12.1	(10)	17.5
	>240	mg/dL	(3)	2.7	(5) 15.2	(3)	5.3
HDL cholesterol	31-40	mg/dL	(17)	15.5	(22) 66.7	(15)	26.3
	≤30	mg/dL	0		(5) 15.2	(5)	8.7
LDL cholesterol	131-159	mg/dL	(21)	19.1	(2) 6.1	(11)	19.3
	≥160	mg/dL	(2)	1.8	(2) 6.1	(7)	12.3
Lipoprotein (a)	>25	mg/dL	0		(6) 18.2	(11)	19.3
Homocysteine	>14	µmol/L	(4)	3.6	(16) 48.5	(12)	21.1
BMI	25-29.9	kg/m²	(30)	27.3	(14) 42.4	(17)	29.8
	>30	kg/m²	(5)	4.5	(6) 18.2	(6)	10.5
Blood pressure	>130/85	mmHg	(27)	24.5	(12) 36.4	(8)	14.0
	>140/90	mmHg	(13)	11.8	(12) 36.4	(4)	7.0
Waist circumference	90-102	cm	(7)	6.4	(22) 66.7	(16)	28.1
	>102	cm	(3)	2.7	(8) 24.2	(5)	8.8

[Table/Fig-6]: CVD risk factors in the group of metabolic and non-metabolic syndrome of the bus drivers and control subjects. The values are expressed in terms of percentage % and n is written in bracket.

pressure higher than 140/90 mm/Hg. The values for age, systolic and diastolic blood pressure, triglyceride, and FBS differed significantly. (p<0.001). WC, total cholesterol, and serum cortisol values were also significantly differed (p<0.05) from each other [Table/Fig-7]. The [Table/Fig-8] shows, the prevalence of metabolic syndrome in both bus drivers and control subjects by age group. Bus drivers over the age of 50 were found to have a higher rate. Metabolic syndrome was evaluated among the control subjects using the same modified

NCEP ATP III guidelines. A total of 13 (11.8 %) of the 110 control subjects were found to have metabolic syndrome. However, none of the studied parameters showed any substantial difference with non-metabolic syndrome subjects.

Risk factors	FRS <10% Low risk		FRS 10-20% Intermediate risk		FRS >20%; High risk		p-value
Numbers	51 (56.7%)		27 (30%)		12 (13.3%)		
	Mean	SD	Mean	SD	Mean	SD	
Age, (years)	42.25	6.81	45.96	4.43	51.50	5.37	**0.001**
Waist circumference, (cm)	88.02	14.92	91.59	11.90	100.42	10.13	**0.019**
Systolic blood pressure, (mmHg)	120.14	7.77	129.53	10.20	131.83	9.04	**0.001**
Diastolic blood pressure, (mmHg)	78.53	7.29	82.63	7.90	87.17	8.29	**0.001**
Triglyceride (mg/dL)	133.2	54.53	136.41	54.36	233.25	160.7	**0.001**
Total cholesterol (mg/dL)	174.37	28.62	194.96	34.02	170.50	37.54	**0.015**
HDL cholesterol (mg/dL)	43.01	10.90	43.04	8.35	39.08	8.63	0.439
Fasting blood sugar (mg/dL)	87.39	22.31	119.07	46.36	143.17	57.89	**0.001**
Serum cortisol (μg/dL)	20.51	10.32	18.70	9.02	28.01	9.86	**0.026**
PSS (perceived stress scale)	25.80	7.09	26.40	5.71	31.08	8.92	0.065
Smoking rate (n%)	9 (17.6)		17 (63.0)		7 (58.3)		
Alcohol drinking rate (n%)	30 (58.8)		15 (55.6)		8 (66.7)		
Low physical activity (n%)	44 (86.3)		15 (55.6)		8 (66.7)		
Family history of DM (n%)	7 (13.7)		9 (33.3)		6 (50.0)		
Family history of hypertension (n%)	13 (25.5)		8 (29.6)		7 (58.3)		

[Table/Fig-7]: Baseline characteristics and biochemical parameters of the participants for the FRS among Bus drivers. One-way ANOVA was used to find p-value. Values are expressed as mean±SD and in percentage. p-value <0.05 considered significant.
HDL: High density lipoprotein; DM: Diabetes mellitus

S. No.	Age group (Years)	Bus drivers (n=33)	Control subjects (n=13)
1	27-30	04 (12.1%)	00
2	31-40	07 (21.2%)	03 (23.0%)
3	41-50	09 (27.3%)	04 (30.8%)
4	Above 50	13 (39.4%)	06 (46.2%)

[Table/Fig-8]: Metabolic syndrome rate by age groups among bus drivers and control subjects.

DISCUSSION

This study's outcome implies the strategy for the bus driver's health condition and its existing association with the risk factors involved in their occupation. There was a higher prevalence of risk factors for them than for the general population (controls), and many of them were unaware of their risk status. During the interaction, the bus drivers expressed concern over prevailing working conditions, low social support, and occupational stress. Only a few studies have adopted the validated questionnaires to assess stress at work [15]. In the present study, the PSS-14 questionnaire was implemented to evaluate the self-perception of stress. Cortisol level in the blood has been identified as a stress index. It secretes more when the body is subjected to chronic stress. According to the studies, there is a correlation between serum cortisol and CVD [6], and serum cortisol and the PSS-14 score show the potential role of the occupation's stress factor [16]. It was observed that the 'stressed group' levels for serum cortisol and PSS differed significantly from the' non-stressed group. (p<0.001). Earlier studies have linked metabolic syndrome with occupational stress as a clinical tool to find the risk of CVD [17,12].

The prolonged exposure to stress at work will lead to metabolic syndrome and induce more cortisol production [18]. In line with this study's observations, Park SB et al., reported the rise in risk for the metabolic syndrome associated with increased cortisol levels after adjusting for age and BMI [19]. The authors in this study found that subjects with metabolic syndrome had higher serum cortisol and PSS score levels than non-metabolic syndrome (p-value <0.0001). These findings of serum cortisol and PSS indicate the current role played by the stress among the bus drivers. Additionally, other selected variables such as lipid profile, blood glucose, HbA1c, and other anthropometric parameters varied significantly from each other in participants with the metabolic and non-metabolic syndrome (p-value <0.001). A statistically substantial disparity in cortisol levels was also seen in the three FRS classification classes (p<0.05).

FRS classification demonstrated that the high-risk group subjects had an age of mean of 51.50±5.37 years. These reports suggest that the bus driver's job, which involves occupational stress, posed a risk of cardiovascular disease only in their late middle years.

During their duty hours, many bus drivers remain in a sitting position for a long and extended period and are more prone to becoming obese. Obesity adds further to the development of metabolic syndrome and plays a significant role in developing health-related complications like CVD [20]. A meta-analysis report found that for those who exhibited work stress, the association between work stress and elevated cardiovascular risks was attributable to physical inactivity rather than smoking [21]. One of the significant predictors of obesity is WC, which is identified as the primary risk factor for metabolic syndrome.

Likewise, hyperglycaemia is considered a key risk factor for the development of CVD [22]. It was observed that 23.3% of bus drivers with a WC >90.0 cm had a blood glucose level of more than 126.0 mg/dL. Thus, both the WC and elevated blood glucose components of metabolic syndrome demonstrated a significant inter-relationship among them (p<0.001) and exhibited a higher risk for CVD. In the FRS classification, the subjects with high-risk groups were shown to have higher WC (p<0.05).

WC played a major role in identifying other existing risk factors, and a positive correlation of WC was found with triglyceride (r=0.215, p-value <0.05), diastolic blood pressure (r=0.329, p<0.01), and gly. HbA1c (r=0.409, p<0.01). However, no such kind of association could be found between BMI and any other variables studied. Similarly, in one Vietnam study, it was noted that CVD was linked with WC and was more explanatory than BMI [23]. Studies have investigated the current association between high mortality risk and physical inactivity with higher WC [24]. For either case, the American Heart Association (AHA) recommends 150 minutes of moderate-intensity aerobic exercise or, if nothing else, 75 minutes of aerobic activity per week to have good cardiovascular health [10]. The present study showed that 52.2% of bus drivers had low physical activity, and daily physical activity was only 12.2%. Another important finding in this study was that 42.4% of bus drivers had their BMI with a metabolic syndrome between 25-29.9 kg/m^2 and 18.2% with a BMI above 30.0 kg/m^2. These results indicate the presence of pre-obesity or obesity in bus drivers. Besides, as an individual component, BMI signifies its role as one of the risk factors for CVD.

In addition to obesity, hypertension is a significant risk factor for CVD [25]. It is a silent disease that remains undetected for a long time. Because of persistent stress exposure over time, individuals are at a higher risk of developing hypertension [26]. Continuous driving and prolonged sitting can cause stress, and this type of repeated exposure can increase blood pressure [7]. The bus drivers revealed that they are used to being on the road for 11-12 hours a day, almost every day and that a large portion of the street condition is below average and not smooth-riding.

Along with obesity, bus drivers' irregular eating habits and lack of physical activity can serve as a combination of factors to raise blood pressure, demonstrating a deep connection between hypertension and obesity. In the current study, the prevalence of hypertension (blood pressure higher than 140/90 mm Hg) was 36.4% in bus drivers with metabolic syndrome. This observation was analogous to the studies carried out at other places. In a study on bus drivers from North Kerala, India, the prevalence of hypertension was 41.3% [27] and 33.5% in Sokoto, Nigeria [28]. The lack of awareness, the asymptomatic nature of hypertension, and ignorance were a few reasons that contributed to the rise in the number of hypertensive subjects in the present study.

Bus drivers have revealed that they have developed tendencies towards unhealthy habits such as smoking and consuming alcohol. They attribute it to the nature of occupation and an endeavor to get relieved from the perceived stress they experience. High rates of smoking and alcohol intake each have their impact on mortality risk. When combined, however, they have a stimulating effect [29], and some studies have confirmed their strong link with CVD [30]. In this study, the prevalence of smoking among the bus drivers was 23.3%, the habit of regularly chewing tobacco was 32.2%, and the rate of alcohol consumption was 47.7%. With the FRS classification, the smoking habit was around 58 % among the high-risk group bus drivers. These characteristic observations provided precise data on potential risk factors contributing to CVD development in them. Similarly, alcohol consumption was prevalent in a Nigerian study conducted on long-distance bus drivers, and the prevalence rate was 71.1%, and the smoking rate was 19.5% [31].

Dyslipidemia is considered a significant metabolic syndrome component and is predicted to be a risk factor for CVD [32]. The studies have identified lipid disorders with job stress in bus drivers and found the impact of stress on dyslipidemia [33]. In the present study, predominantly, the HDL-C between the ranges of 31-40 mg/dL was 66.7% and below 30.0 mg/dL was 15.2%, followed by triglyceride level more than 200 mg/dL was 30.3% in the subjects identified with metabolic syndrome. The authors found many bus drivers had low HDL-C levels, which pose a potential risk for CVD. Kajani S et al., have reported that low HDL-C is a risk factor for CVD development [34]. One of the instruments used to describe metabolic syndrome is impaired blood glucose. Hyperglycaemia initiates a complex chain of events that damages blood vessels and will cause CVD [35]. The stress at work was found to play an influential role in raising the number of hyperglycaemia incidences among bus drivers. It was found that 24.2% of study subjects had their blood glucose between 100-125.0 mg/dL, and 39.4% of participants had their blood glucose level of more than 125.0 mg/dL, who were identified with metabolic syndrome. Similar findings were observed in the study done in Brazil on truck drivers [36]. The prevalence rate of metabolic syndrome of bus drivers was 33 (36.7%) and 13 (11.8%) in control subjects.

It is relevant to note from this study that the prevalence of metabolic syndrome, co-existing of CVD risk factors among the bus drivers, emphasises the impact of work stress on their health. The risk factors of metabolic syndrome represent the major threat of CVD among them. Each component of metabolic syndrome, in its capacity, has a contribution to the advancement towards the risk of CVD, which can be observed from FRS classification. It was also noted that the bus drivers who were classified as high-risk groups as per FRS classification were found to have a higher percentage of family history of diabetes mellitus and hypertension. The stress being the underlying cause at work, it has been tended very precisely with PSS and serum cortisol in this study.

Limitation(s)

The study subjects were bus drivers and males by gender. Even though the useful questionnaires was incorporated to collect the work-related psychosocial hazards, few could have remained unnoticed and may significantly impact CVD outcomes.

CONCLUSION(S)

The bus drivers are at higher risk for CVD. The prevalence of risk factors for metabolic syndrome and CVD among them was evaluated and found that the rate of hypertension, diabetes, obesity, and stress was significantly higher. It is necessary to make them understand the benefits of regular physical activity, reducing the pace of smoking, and consumption of alcohol. Besides, steps such as reducing long driving hours and routine health check-ups are ultimately required. Moreover, it is proposed that more longitudinal studies should be carried out to improve the validity of the results of this report.

REFERENCES

[1] Payab M, Hasani-Ranjbar S, Merati Y, Esteghamati A, Qorbani M, Hematabadi M. The prevalence of metabolic syndrome and different obesity phenotype in Iranian male military personnel. Am J Men's Health. 2017;11(2):404-13.

[2] Lecca LI, Campagna M, Portoghese I, Galletta M, Mucci N, Meloni M, et al. Work-related stress, well-being and cardiovascular risk among flight logistic workers: An observational study. Int J Environ Res Public Health. 2018;15(9):1952. Doi: 10. 3390/ijerph15091952.

[3] Hidaka T, Hayakawa T, Kakamu T, Kumagai T, Hiruta Y, Hata J. et al. Prevalence of metabolic syndrome and its components among Japanese workers by clustered business category. PLoS ONE. 2016;11(4):e0153368. Doi: 10.1371/journal. pone.0153368.

[4] Banerjee R, Dasgupta A, Naskar NN, Kundu PK, Pan T, Burman J. A study on the prevalence of metabolic syndrome and its components among adults aged 18–49 years in an urban area of West Bengal. Indian Journal of Community Medicine. 2019;44(3):261-64.

[5] Prabhakaran D, Jeemon P, Roy A. Cardiovascular diseases in India current epidemiology and future directions. Circulation. 2016;133:1605-20. Doi: 10.1161/CIRCULATIONAHA.114.008729.

[6] Jahangiry L, Farhangi MA, Rezaei F. Framingham risk score for estimation of 10-years of cardiovascular diseases risk in patients with metabolic syndrome. Journal of Health, Population and Nutrition. 2017;36:36. Doi: 10.1186/s41043-017-0114-0.

[7] Moy FM, Bulgiba A. The modified NCEP ATP III criteria may be better than the IDF criteria in diagnosing Metabolic Syndrome among Malays in Kuala Lumpur. BMC Public Health. 2010;10:678. http://www. biomedcentral.com/1471-2458/10/678.

[8] Cohen S, Kamarck T, Mermelstein R. A global measure of Perceived stress. Journal of Health and Social Behavior. 1983;24(4):385-96.

[9] Bener A, Mohammad AG, Ismail AN, Zirie M, Abdullatef WK, Al-Hamaq. Gender and age-related differences in patients with the metabolic syndrome in a highly endogamous population. Bosn J Basic Med Sci. 2010;10(3):210-17.

[10] Lloyd-Jones DM, Hong Y, Labarthe D, Mozaffarian D, Appel LJ, Van Horn L, et al. Defining and setting national goals for cardiovascular health promotion and disease reduction: The American Heart Association's strategic impact goal through 2020 and beyond. Circulation. 2010;121:586-613.

[11] Genest J, McPherson R, Frohlich J, Anderson T, Carpentier NCA. 2009 Canadian Cardiovascular Society/Canadian guidelines for the diagnosis and treatment of dyslipidemia and prevention of cardiovascular disease in the adult- 2009 recommendations. Can J Cardiol. 2009;25(10):567-79.

[12] Biglari H, Ebrahimi MH, Salehi M, Poursadeghiyan M, Ahmadnezhad I, Abbasi M. et al. Relationship between occupational stress and cardiovascular diseases risk factors in drivers. International Journal of Occupational Medicine and Environmental Health. 2016;29(6):895-901.

[13] Steptoe A, Kivimäki M. Stress and cardiovascular disease: An update on current knowledge. Annu Rev Public Health. 2013;34:337-54. Doi: 10.1146/annurev-publhealth-031912-114452.

[14] Crawford AA, Soderberg S, Kirschbaum C, Murphy L, Eliasson M, Ebrahim S, et al. Morning plasma cortisol as a cardiovascular risk factor: Findings from prospective cohort and Mendelian randomization studies. European Journal of Endocrinology. 2019;181:429-38.

[15] Shin Y, Kim Y. Association between psychosocial stress and cardiovascular disease in relation to low consumption of fruit and vegetables in middle-aged men. Nutrients. 2019;11:1915. Doi: 10.3390/nu11081915.

[16] Walvekar SS, Ambekar JG, Devaranavadagi BB. Study on serum cortisol and perceived stress scale in the police constables. Journal of Clinical and Diagnostic Research. 2015;9(2):BC10-14.

[17] Chandola T, Heraclides A, Kumari M. Psychophysiological biomarkers of workplace stressors. Neurosci Biobehav Rev. 2010;35(1):51-57.

[18] Chandola T, Brunner E, Marmot M. Chronic stress at work and the metabolic syndrome: prospective study. BMJ. 2006;332(7540):521-25.

[19] Park SB, Blumenthal JA, Lee SY, Georgiades A. Association of cortisol and the metabolic syndrome in Korean men and women. J Korean Med Sci. 2011;26(7):914-18.

[20] Csige I, Ujvárosy D, Szabó Z, Lőrincz I, Paragh G, Harangi M, Somodi S. The impact of obesity on the cardio vascular system. Journal of Diabetes Research. 2018; doi.org/ 10.1155/2018/3407306.

[21] Nyberg ST, Fransson EI, Heikkila K, Alfredsson L, Casini A, Clays E, et al. Job strain and cardiovascular disease risk factors: Meta-analysis of individual-participant data from 47,000 men and women. PloS one. 2013;8(6):e67323. Epub 2013/07/11.

[22] Schwarz PEH, Timpel P, Harst L, Greaves CJ, Ali MK, Lambert J, et al. Blood sugar regulation as a key focus for cardiovascular health promotion and prevention: An umbrella review. J Am Coll Cardiol. 2018;72(15):1829-44.

[23] Tran NTT, Blizzard CL, Luong KN, Truong NLV, Tran BQ, Otahal P, et al. The importance of waist circumference and body mass index in cross-sectional relationships with risk of cardiovascular disease in Vietnam. PLoS ONE. 2018;13(5):e0198202. https://doi.org/10.1371/journal. pone.0198202.

[24] Staiano AE, Reeder BA, Elliott S, Joffres MR, Pahwa P, Kirkland SA, et al. Physical activity level, waist circumference, and mortality. Appl Physiol Nutr Metab. 2012;37(5):1008-13.

[25] Hanna DR, Walker RJ, Smalls BL, Campbell JA, Dawson AZ, Egede LE. Prevalence and correlates of diagnosed and undiagnosed hypertension in the indigenous Kuna population of Panama. BMC Public Health. 2019;19(1):843. https://doi.org/10.1186/s12889-019-7211-5.

[26] Spruill TM, Butler MJ, Thomas SJ, Tajeu GS, Kalinowski J, Castañeda SF, et al. Association between high perceived stress over time and incident hypertension in black adults: Findings from the jackson heart study. J Am Heart Assoc. 2019;8(21):e012139. Doi: 10.1161. / JAHA.119.012139.).

[27] Lakshman A, Manikath N, Rahim A, Anilakumari VP. Prevalence and risk factors of hypertension among male occupational bus drivers in North Kerala, South India: A cross-sectional study, ISRN Prevent. Med. 2014;2014:318532.

[28] Erhiano E, Igbokwe VU, El-Khashab MMU, Okolo R, Awosan KJ. Prevalence of hypertension among commercial bus drivers in Sokoto, Sokoto State, Nigeria, International Invention Journal of Medicine and Medical Sciences. 2015;2(3):34-39.

[29] Granados JAT, Christine PJ, Ionides EL, Carnethon MR, Roux AVD, Kiefe CI, et al. Cardiovascular risk factors, depression, and alcohol consumption during joblessness and during recessions among young adults in CARDIA. Am J Epidemiol. 2018;187(11):2339-45.

[30] Munzel T, Hahad O, Daiber A. Double hazard of smoking and alcohol on vascular function in adolescents. European Heart Journal. 2019;40:354-56. Doi: 10.1093/ eurheartj/ehy430.

[31] Amadi CE, Grove TP, Mbakwem AC, Ozoh OB, Kushimo OA, Wood DA, et al. Prevalence of cardiometabolic risk factors among professional male long-distance bus drivers in Lagos, south-west Nigeria: A cross-sectional study. Cardiovascular Journal of Africa. 2018;29(02):106-14.

[32] Ghodsi S, Meysamie A, Abbasi M, Ghalehtaki R, Esteghamati A, Malekzadeh MM. Non-high-density lipoprotein fractions are strongly associated with the presence of metabolic syndrome independent of obesity and diabetes: A population-based study among Iranian adults. J Diabetes Metabolic disorders. 2017;16:25. Doi: 10.1186/s40200-017-0306-6.

[33] Yook JH, Lee DW, Kim MS, Hong YC. Cardiovascular disease risk differences between bus company employees and general workers according to the Korean National Health Insurance Data. Ann Occup Environ Med. 2018;30:32. Doi: 10.1186/s40557-018-0242-z. eCollection 2018.

[34] Kajani S, Curley S, McGillicuddy FC. Unravelling HDL-Looking beyond the Cholesterol surface to the quality within. International Journal of Medical Science. 2018;19(7):1971. Doi: 10.3390/ijms19071971.

[35] Srikanthan K, Feyh A, Visweshwar H, Shapiro J, Sodhi K. Systematic review of metabolic syndrome biomarkers: A panel for early detection, management, and risk stratification in the west Virginian population. International Journal of Medical Sciences. 2016;13(1):25-38. Doi: 10.7150/ijms.13800.

[36] Sangaleti CT, Trincaus MR, Baratieri T, Zarowy K, Ladika MB, Menon MU. Prevalence of cardiovascular risk factors among truck drivers in the South of Brazil. BMC Public Health. 2014;14:1063. Doi: https://doi.org/10.1186/1471-2458-14-1063.

PARTICULARS OF CONTRIBUTORS:

1. Lecturer, Department of Biochemistry, BLDE (DU) Sri. B.M. Patil Medical College, Hospital and Research Centre, Vijayapur, Karnataka, India.
2. Professor, Department of Biochemistry, BLDE (DU) Sri. B.M. Patil Medical College, Hospital and Research Centre, Vijayapur, Karnataka, India.
3. Professor, Department of Biochemistry, BLDE (DU) Sri. B.M. Patil Medical College, Hospital and Research Centre, Vijayapur, Karnataka, India.
4. Associate Professor, Department of Biochemistry, BLDE (DU) Sri. B.M. Patil Medical College, Hospital and Research Centre, Vijayapur, Karnataka, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Sanjeev Srinivas Walvekar,
Do No. 2, Mirdhe Galli, Meenaxi Chowk, Vijayapur, Karnataka, India.
E-mail: sanjeev.walvekar@bldedu.ac.in

PLAGIARISM CHECKING METHODS: [Jain H et al.]

- Plagiarism X-checker: Feb 22, 2021
- Manual Googling: Apr 22, 2021
- iThenticate Software: Apr 24, 2021 (9%)

ETYMOLOGY: Author Origin

AUTHOR DECLARATION:

- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Feb 20, 2021**
Date of Peer Review: **Mar 10, 2021**
Date of Acceptance: **Apr 23, 2021**
Date of Publishing: **May 01, 2021**