

Study on Serum Cortisol and Perceived Stress Scale in the Police Constables

SANJEEV S. WALVEKAR¹, JEEVAN G. AMBEKAR², BASAVARAJ B. DEVARANAVADAGI³

ABSTRACT

Introduction: The occupational stress may be more among the police constables. Under the stressed conditions, the body secretes more Cortisol. Elevated serum cortisol levels significantly correlate with the symptoms of metabolic Syndrome. Perceived stress scale (PSS) is the most widely used psychological tool for measuring the perception of stress. The objective of this study was to examine the association between perceived stress and Serum Cortisol and also to explore stress as an occupational risk factor which may lead to metabolic syndrome.

Materials and Methods: We measured Serum Cortisol, Lipid profile, Blood Glucose and HbA1c in both Police constables and the general population. Also to evaluate the occupational stress, the questionnaire consisting of Perceived stress scale -14 items was used.

Results: A positive correlation was found between Serum Cortisol and perceived stress scale, Blood Glucose, HbA1c. The biochemical parameters were found to be elevated in police constables compared to controls. It was found that among 108 policemen, 38% were confirmed with cardiometabolic syndrome.

Conclusion: The relation between Serum Cortisol and perceived stress scale indicates the severity of occupational stress the police constables are experiencing. So the occupation based health program for lifestyle changes, modification in job related rules and regulations will help to avert further complications and keep police personnel healthy.

Keywords: Cardiometabolic syndrome, Lipid profile, Occupation

INTRODUCTION

The police department is the one which has to provide a continuous service to the humankind. It is the occupation which consists of maximum stress. Polices play the role of maintaining law and order in the society despite many limitations. Police work is regarded as stressful because of the individual risk of exposure to violence and the everyday involvement in a variety of traumatic incidents. They should be prepared themselves mentally and physically for responding efficiently and even for the unforeseen and unpredictable incidents. Occupational stress and workplace health have become common issues of great concern. Depending on the amount of time spent at the working place and the nature of work, the work stress increases and it has the direct impact on the health status leading to many health related complications. Occupational stress can affect the health when the stress of the workplace exceed the employee's ability to have some control over their situation or to cope in other ways. Stress is defined as "the non-specific response of the body to any demand placed upon it" [1]. The stress induced physiologic changes are usually adaptable and compensative. However, when stressful events do occur more frequently and their intensity crosses certain limits, then the physiological changes become pathological in nature [2].

Under normal circumstances, the body maintains or regulates the normal cortisol levels. Most healthy adults have a high cortisol level in the morning and a low cortisol level at night. But under the condition of the more stressed, the body secretes more cortisol. Cortisol is frequently referred to as the "stress hormone" because it is also secreted in higher levels during the body's fight or flight response to stress. It is also responsible for several stress-related changes in the body. Studies have been done to find relation between cortisol and metabolic syndrome [3]. Because of enormous stress, police personnel suffer from the disorders such as psychological disorders, gastrointestinal disorders, Insomnia etc. [4-6]. The incidence of cardiovascular (CV) diseases is more prevalent in police personnel than the general population [7]. The metabolic

syndrome is defined as the cluster of risk factors that increases the risk of heart disease and type 2 diabetes [8]. Dyslipidemia, raised blood pressure (BP), abdominal obesity, impaired glucose tolerance are the features of metabolic syndrome [9,10]. The studies also showed that morning cortisol levels are significantly correlated with the symptoms of metabolic syndrome, such as obesity, high blood pressure and a poor lipid profile [11-13]. Cortisol is released in response to Hypothalamic-pituitary-adrenal axis (HPA) and catecholamines are released by the sympathetic adrenal medullary (SAM) system. These two hormones help to cope with any form of stress. However, a prolonged and continuous stress will interfere these functions and leads to increased risk for physical and mental disorder [14]. It is reported that the patients with metabolic syndrome show hyperactivity of hypothalamic-pituitary-adrenal (HPA) axis that leads to a state of hypercortisolism which may be due to chronic stress, contributing to the development of insulin resistance, Type 2 diabetes, visceral fat and obesity [15].

The reasons mentioned for the high prevalence of CVD among policemen include occupational stress, irregular food habits, inadequate sleep and unhealthy habits like smoking and alcohol drinking [16]. Therefore, this study was planned to investigate the level of stress and to estimate prevalence of metabolic syndrome, which is a good predictor of cardiovascular morbidity. It was planned to assess the stress with the use of perceived stress scale (14 items) and serum cortisol estimation. Also, it was aimed to explore the effect of stress on glucose and lipid levels. Workplace program to promote health and fitness among policemen are usually very less. Hence the present study would help to implement the interventions to provide good health to this one of the important occupational group.

MATERIALS AND METHODS

Study design: This study was a cross-sectional study designed to explore the effect of stress as an occupational risk factor which may lead to a cardiometabolic syndrome.

Participants: In our study there were 108 male police constables as the study group from the Bijapur, Karnataka state and age-matched 108 subjects from the general population were the controls. Out of 108 control subjects, only 12 subjects scored 'perceived stress scale' score more than 28 (cutoff value) and the rest 96 subjects were grouped as 'Non stressed'. Hence, the study of stress and non stress in the control group was not carried over.

The participants were informed of the purpose of the current study. The detailed information about their past medical history, habits of smoking, alcohol intake was recorded through interview based medical examinations. Height, weight, waist circumference and hip circumference were measured. Blood pressure was measured using a sphygmomanometer in a sitting position following the rest for ten minutes. The study was reviewed and approved by the Ethics Committee on the Research of BLDE University, Sri B.M. Patil Medical College, Hospital and Research Center, Bijapur, Karnataka state, India.

Inclusion and exclusion criteria: The police constables (Males) those who complained about job related stress were randomly included in the study. The constables underlying medical conditions like rheumatoid arthritis, tuberculosis and any other infective conditions were excluded from the study.

Measurement of perceived stress and the scoring: To evaluate the occupational stress, the Perceived Stress Scale (PSS) was used which contains 14 items or questionnaires. Perceived Stress Scale is the most validated psychological tool for measuring the perception of stress. It measures the degree to which situations in one's life are considered as stressful. The perceived stress is the one which measures the level of stress based on stressful incidents, capability to face them at an individual level. The questions in the PSS-14 items were asked about the feelings and thoughts of the constables during the past month. The PSS consisted of 14 items [17], seven positive and seven negative. The negative element was intended to assess the lack of control and the negative affective reactions, while the positive element measured the degree of the ability to cope with the existing stressors. Each item was rated on a five-point scale from 0 = 'never' to 4 = 'very often', covering the previous month. The PSS scores are 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 summing across all the scale items. The scores ranged from 0 to 56, with higher scores indicating higher levels of perceived stress and the lower scores indicating lower levels of stress [18]. The PSS-Questionnaire-14 item translated into the local language (Kannada) was provided in case if it was required. The PSS score was divided into two sections. The score, 28 being the operational cutoff value of the upper bound and were labelled as 'stressed' and the score less than 28 as 'non stressed' respectively. This cut off value was selected in accordance with a similar study from Pakistan [19] and India [20].

Cardiometabolic syndrome: Diagnosis of the cardiometabolic syndrome was made using NCEP ATP III PANEL (National cholesterol education programme, adult training programme III) definition [21] and presence of metabolic syndrome was confirmed when three or more of the following risk factors were present: (1) Waist circumference: ≥ 90 cm (specific for Indians); (2) Blood pressure: $\geq 130/85$ mmHg; (3) Triglycerides ≥ 150 mg/dl; (4) HDL Cholesterol ≤ 40 mg/dl; and (5) Glucose intolerance (Fasting serum glucose ≥ 100 mg/dl, or reported treatment for diabetes). Cardiometabolic syndrome was considered to be present if there was the presence of three or more above mentioned risk factors.

Biochemical analysis: Blood samples were collected from the subjects with their overnight fasting. Plasma glucose was estimated using glucose oxidize method [22]. The fasting serum sample was used for estimation of lipids, including total cholesterol [23], triglycerides [24] and high density lipoprotein cholesterol (HDL-C) [25]. All the biochemical estimations were done on the same day

only. Serum cortisol was estimated by Elisa method [26]. HbA1c was measured by chemiluminescent microparticle immunoassay on Abbott instrument.

STATISTICAL ANALYSIS

Data were expressed as mean \pm SD. The independent t-test was used to determine the significance between study and control groups. The Pearson correlation coefficient was used to determine the correlation between stress level and variables of cardiometabolic syndrome.

RESULTS

[Table/Fig-1] shows the baseline characteristics of Police constables and Control group participants. There was no significant difference in the age of participants between two groups, suggesting an age matched distribution of participants. The other characteristics like Height, Weight, BMI, Waist / Hip ratio, Perceived stress scale values were found to be higher in the cases comparing to control group and also statistically significant. The table also shows the percentage distribution of habits and prevalence rate of Hypertension, Type 2 diabetes and Cardiometabolic syndrome in both the groups.

[Table/Fig-2] Shows the values of lipid profile, Fasting blood glucose, HbA1c and Serum Cortisol of cases and controls. Patients presented significantly higher values of all Biochemical parameters in cases except HDL. Cholesterol which was lowered in cases compared to controls. The values were statistically significant.

[Table/Fig-3] Shows the values of PSS and Biochemical parameters studied in the subjects (cases) grouped as 'Stressed' and 'Non stressed' based on PSS score 28 as the cut off value. It was observed that the values of Fasting blood glucose, HbA1c, serum Cortisol and

Characteristics	Cases (No: 108)	Controls (No: 108)	p-value
	Mean \pm S.D	Mean \pm S.D	
Age (Years)	42.73 \pm 10.10	43.23 \pm 8.28	0.356
Height (Cm)	170.00 \pm 5.25	162.50 \pm 9.60	< 0.001
Weight (Cm)	75.11 \pm 6.68	63.69 \pm 4.40	< 0.001
BMI (kg / m ²)	26.00 \pm 2.40	22.30 \pm 1.90	<0.001
Waist / Hip ratio	1.14 \pm 0.22	0.80 \pm 0.07	< 0.001
Systolic blood pressure (mmHg)	123.06 \pm 12.23	120.33 \pm 8.16	0.061
Diastolic blood pressure (mmHg)	78.63 \pm 13.63	76.11 \pm 13.29	0.171
Pulse rate (per/min)	82.44 \pm 6.67	80.33 \pm 6.89	0.023
Perceived stress scale	27.49 \pm 8.49	18.79 \pm 6.56	<0.001
Smoking	52 [48.1%]	30 [27.8 %]	
Tobacco chewing	32 [29.6 %]	29 [26.9 %]	
Alcohol consumption	65 [60.2 %]	20 [18.5 %]	
Hypertension	22 (20.4%)	09 [08.3%]	
Type 2 Diabetes	24 (22.2%)	12 [11.1%]	
Cardiometabolic syndrome	41 (38.0%)	13 [12.0%]	

[Table/Fig-1]: Basic characteristics in cases and controls

Parameter	Cases (n=108)	Controls (n=108)	p-value
Fasting blood glucose (mg/dl.)	115.01 \pm 45.92	97.90 \pm 6.20	< 0.001
Gly.HbA1c (%)	5.8 \pm 1.3	4.9 \pm 0.5	< 0.001
Triglyceride.(mg/dl.)	151.58 \pm 96.76	117.90 \pm 28.37	< 0.001
Total Cholesterol. (mg /dl.)	199.43 \pm 58.43	178.34 \pm 27.70	< 0.001
HDL. Cholesterol.(mg /dl.)	36.31 \pm 6.40	47.35 \pm 6.30	< 0.001
LDL. Cholesterol. (mg /dl.)	132.79 \pm 54.53	107.41 \pm 28.35	< 0.001
VLDL.Cholesterol.(mg/dl.)	30.31 \pm 19.35	23.58 \pm 5.67	< 0.001
Cortisol (μ g/dl)	25.00 \pm 13.64	9.69 \pm 4.94	< 0.001

[Table/Fig-2]: Biochemical parameters of the participants (cases and controls) variables are presented as mean \pm standard deviation (SD). HDL-C: high density lipoprotein cholesterol; LDL-C: low density lipoprotein cholesterol; VLDL: very low density lipoprotein cholesterol

PSS were found to be increased in 'Stressed' group comparing to 'Non stressed' group and the values were statistically significant. The values of Triglyceride, Total cholesterol, HDL cholesterol and VLDL cholesterol were found to be statistically insignificant though they were raised in the 'Stressed' group comparing to 'Non stressed' group.

[Table/Fig-4] Depicts the correlation coefficient between cortisol and other variables in cases (Stressed and Non stressed) as per PSS reference cutoff value. It was observed that Waist/Hip ratio, Fasting

Variables	Stressed	Non stressed	p-value
	(n=41)	(n= 67)	
Age (Years)	41.44 ± 10.34	42.61 ± 10.43	0.570
W/H Ratio	0.98 ± 0.08	0.97 ± 0.08	0.981
Systolic Blood pressure (mm Hg)	122.10 ± 11.92	123.64 ± 12.47	0.526
Diastolic Blood pressure (mm Hg)	77.71 ± 14.55	79.19 ± 13.12	0.584
Blood Glucose (Fasting) (mg /dl)	125.12 ± 45.98	105.94 ± 28.52	< 0.001
HbA1c (%)	6.02 ± 1.17	5.48 ± 0.60	< 0.001
Triglyceride (mg /dl)	163.73 ± 138.90	141.06 ± 61.30	0.246
Total cholesterol (mg /dl)	209.66 ± 67.03	193.16 ± 52.94	0.159
HDL cholesterol (mg /dl)	36.54 ± 8.04	36.18 ± 5.21	0.779
LDL cholesterol (mg /dl)	140.38 ± 57.69	128.77 ± 52.13	0.283
VLDL cholesterol (mg /dl)	32.75 ± 27.78	28.21 ± 12.25	0.246
Cortisol (µg/dl)	40.86 ± 11.01	14.09 ± 7.67	< 0.001
Perceived stress scale	35.78 ± 6.00	22.42 ± 5.13	< 0.001

[Table/Fig-3]: Demographic characteristics of police constables grouped as stressed and non stressed with PSS Score 28 as the cut off value

Variables	Stressed	p-value	Non Stressed	p-value
	(n=41) 'r' value		(n=67) 'r' value	
Age (Years)	0.038	0.406	0.180	0.073
W/H Ratio	0.408	0.004*	0.090	0.233
Systolic Blood pressure (mm Hg)	-0.005	0.488	0.152	0.109
Diastolic Blood pressure (mm Hg)	0.068	0.335	0.085	0.246
Blood Glucose (Fasting) (mg /dl)	0.357	0.011*	0.013	0.459
HbA1c (%)	0.424	0.003*	0.048	0.349
Triglyceride (mg /dl)	0.097	0.274	0.085	0.247
Total cholesterol (mg /dl)	-0.122	0.225	-0.144	0.123
HDL cholesterol (mg /dl)	-0.018	0.454	0.070	0.287
LDL cholesterol (mg /dl)	-0.185	0.123	-0.173	0.081
VLDL cholesterol (mg /dl)	0.097	0.274	0.085	0.247
Perceived stress scale	0.479	0.001*	0.191	0.061

[Table/Fig-4]: Correlation coefficient between Cortisol and other variables in cases (Non stressed and stressed as per PSS reference cut off value) [* = Statistically significant at 0.01]

Variables	Overall (n=76)'r' value	p-value	Stressed (n=29) 'r' value	p-value	Non stressed (n= 47) 'r' value	p-value
Age (Years)	-0.016	0.445	0.206	0.142	0.095	0.262
W/H Ratio	0.395	0.000*	0.478	0.004*	-0.075	0.307
Systolic Blood pressure (mm Hg)	-0.082	0.240	-0.136	0.241	0.075	0.308
Diastolic Blood pressure (mm Hg)	-0.051	0.331	-0.003	0.493	0.038	0.401
Blood Glucose(Fasting) (mg /dl)	0.383	0.000*	0.343	0.034**	-0.021	0.443
HbA1c (%)	0.491	0.000*	0.407	0.014*	-0.033	0.414
Triglyceride (mg /dl)	0.071	0.272	-0.010	0.479	0.207	0.082
Total cholesterol (mg /dl)	-0.063	0.393	-0.220	0.125	-0.034	0.410
HDL cholesterol (mg /dl)	-0.193	0.047	-0.173	0.185	0.103	0.246
LDL cholesterol (mg /dl)	-0.060	0.303	-0.175	0.182	-0.109	0.233
VLDL cholesterol (mg /dl)	0.070	0.272	-0.010	0.479	0.207	0.082
Perceived stress scale	0.711	0.000*	0.500	0.003*	0.110	0.232

[Table/Fig-5]: Correlation coefficient between Cortisol and other variables in cases (Overall, stressed and Non Stressed after excluding the subjects with habits (Smoking, Tobacco chewing and Alcohol consumption) as per PSS reference cut off value) [* = statistically significant at 0.01] [** = statistically significant at 0.05]

blood glucose, HbA1c and PSS showed statistically significant positive correlation with Serum Cortisol.

[Table/Fig-5] Illustrates the correlation coefficient between serum cortisol and other variables in cases grouped as Stressed and Non stressed after excluding the subjects with the habits of Smoking, Tobacco chewing and Alcohol consumption. It was found that in the group 'Stressed' there was a positive correlation between Serum Cortisol and Waist/Hip ratio, Fasting blood glucose, HbA1c and PSS and also the values were statistically significant.

[Table/Fig-6] shows the results of multiple regression analysis, which is statistically significant and the association was found between serum cortisol and HbA1c ($\beta = 0.453$, $p < 0.001$), glucose ($\beta = 0.411$, $p = 0.001$) after adjusting age and waist to hip ratio.

DISCUSSION

Occupational stress is a result of the nature of work and working atmosphere [27] which leads to many disorders. Through the identification of risk factors and the introduction of appropriate measures, the stress and ill health in the workplace can be distinctly relieved. In our study, we evaluated perceived stress among police constables, including its sources and severity along with its correlation with other variables. The participants were categorized as 'stressed' and 'non stressed' based on the calculated score with the help of perceived stress scale (14 items). Out of 108 participants, 41 (38 %) subjects were found to be under stress. Since this study was undertaken with the aim of finding baseline information about the stress the policemen were reeling under, complete lifestyle aspects however were not assessed. This study revealed that there was a significant positive relationship between blood glucose, HbA1c and serum Cortisol among police constables. The findings from our study revealed that the participants in the study group with higher cortisol values were at higher risk for metabolic syndrome. The similar observations were made in earlier studies also [28].

We found that the most common manifestations of metabolic syndrome in police constables were Hypertriglyceridemia followed by low HDL Cholesterol. The other biochemical parameters studied also showed significantly elevated values compared to controls. It has been reported that blood pressure, triglyceride, and HDL-Cholesterol abnormalities were the most common metabolic abnormalities among the subjects in Taiwan [29]. Jovica jovanovic et al., reported that with the increase of occupational stress index, there was an increase in glucose, total cholesterol, LDL cholesterol and Triglyceride concentration in the stress exposed group [30].

Hypertension is an important CV disease risk factor and also one of the five components to define the metabolic syndrome [31]. In our study it was found that about 22.7 % police constables were hypertensive. Similarly, a study by Dr. Bakhtiyar Chaudhary et al., noted that prolonged exposure to work stress without proper coping

Variables	Beta	t' value	p-value
HbA1c	0.453	4.072	0.001
Blood Glucose	0.411	3.526	0.001
Triglyceride	0.077	0.639	0.525
T.Cholesterol	0.086	0.680	0.499
HDL.cholesterol	-0.141	-1.143	0.257

[Table/Fig-6]: Multiple regression analysis between Serum Cortisol and other variables after adjusting Age and Waist to Hip ratio

strategies, may exist as a potential risk factor for hypertension and coronary artery disease [32].

In addition to increasing the risk of CV disease, the metabolic syndrome may hasten the development of stroke and complication of diabetes mellitus like diabetic nephropathy, retinopathy and neuropathy [33]. With respect to the NCEP-ATP III criteria, the type 2-diabetes mellitus subjects having already fulfilled one criteria and another two are needed to diagnose metabolic syndrome, suggesting that the patients with type 2 diabetes mellitus, exhibit the features of metabolic syndrome and it often results in hyperglycemia. In our study it was found that about 14.8 % were of impaired fasting glucose and 19.4 % cases were already having Type 2 diabetes. Waist Circumference has the strongest associations with health risk factors [34]. The increased waist circumference has been thought to be a predictor of CV disease and is an important diagnostic marker for the metabolic syndrome [35]. The recommended waist circumference cutoff values were 90 cm for Asian males and 80 cm for Asian females [36]. In our study about 27.8% polices had a waist circumference above 90 cm. The studies done on the lifestyles of policemen indicate increased rate of addiction to smoking and alcohol habits. Smoking is associated with an increased prevalence of metabolic syndrome, independent of sex and BMI class. This increased risk is mainly related to lower HDL cholesterol, and higher triglycerides and waist circumference [37]. Our study also showed that the alcohol and smoking habits were more among policemen followed by their greater triglyceride level, waist circumferences and lower HDL level.

Cortisol is an important regulator of the protein, glucose and lipid metabolism [38]. There was no significant correlation between serum cortisol and lipid profile in our study. But in our study, we found a positive correlation between Serum Cortisol and perceived stress scale, Blood Glucose and HbA1c, which corroborate the findings of other workers [39]. However, there are inconsistent reports about the correlation between Serum Cortisol and the parameters of metabolic syndrome [40]. Our study indicates that the scoring rate of perceived stress scale in police constables was higher than General Population and further it gives the impression about the occupational stress they were born. In earlier studies, the Perceived Stress Scale has been used involving police officers. Franke et al., found that increased PSS value was associated with CVD risk in police officers [41]. But Yoo and colleagues observed that the PSS was not significantly associated with the metabolic syndrome in law enforcement officers [42]. Though the results of each of these studies vary, these studies commonly used the cross-sectional study design. The usual general conception is that the policemen form a physically fit group in the society and based on this merit only they get the recruitment. However, it is not maintained in their service life by most of them. It was reflected with the reasons they mentioned like, long duty hours, irregular diet, limited choice of food while on duty, disrupted sleep time, etc. The studies done in association between metabolic syndrome and policemen, revealed about their nature of work, stress they face and other related factors. Physical Fitness was found to be ignored by policemen and less number of them are continuing to exercise daily. Stress is considered as the integral part of the life. The job related stress becomes a dominant aspect for some people and leads to the complications like coronary heart disease, diabetes mellitus

and other health related disorders [43]. There is a need of serious attempt to reduce the job related stress, like the modifiable changes in the police department, improved training to them to have self efficacy and coping skills with the stress oriented situations [44]. The other aspects like arranging health checkups annually or biannually, also to instruct awareness and benefits of weight reduction, regular exercise and early diagnosis etc [45].

The findings of the present study performed among 108 police constables indicate that 38 % of the subjects have the metabolic syndrome. This is significantly higher than the prevalence of 13 % in the General population. The coexistence of other components of metabolic syndrome in this study is in the line of other studies revealed.

CONCLUSION

The findings of the current study emphasize the need to implement occupation based health program for lifestyle changes, modification in job related rules and regulations and other risk factors of Cardiometabolic syndrome. Also, the considerable amount of occupational stress found in this study among the police constables should trigger further work or research in this topic.

LIMITATIONS

The limitations of this study is that it was a cross-sectional design and perceived stress scale results were based on the self reported by the police constables.

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PARTICULARS OF CONTRIBUTORS:

1. Lecturer, Department of Biochemistry, BLDE University's Shri B.M.Patil Medical College, Hospital & Research Centre, Karnataka, India.
2. Professor, Department of Biochemistry, BLDE University's Shri B.M.Patil Medical College, Hospital & Research Centre, Karnataka, India.
3. Professor and Head of Department, Department of Biochemistry, BLDE University's Shri B.M.Patil Medical College, Hospital & Research Centre, Karnataka, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Sanjeev S. Walvekar,
Lecturer, Department of Biochemistry, BLDE University's Shri B.M.Patil Medical College,
Hospital & Research Centre, Karnataka, India.
E-mail : walvekarsanjeev@rediffmail.com

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