Clinical Significance of Perceived Occupational Stress Influencing Body Mass and Osteopenia: A Pilot Study

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Abstract – Introduction: Studies demonstrating perceived occupational stress, obesity & osteopenia among industrial workers are very limited. This pilot study was conducted to analyze the inter-relationships, if any, between stress, obesity and osteopenia among industrial workers. Materials and Methods: All patients who attended the health camps aging from 18 years to 70 years of either sex were the subjects of the study. They were subjected to General Physical Examination along with measurement of anthropometric parameters (Body Mass Index, Waist to hip ratio) Blood pressure and Systemic examination. Perceived Stress Scale (4 point) accepted worldwide for assessment of Stress was given in the form of Clinical Questionnaire to the subjects. Blood samples from the patients were subjected to random blood sugar and lipid profile. Bone Scan was done to assess the Bone Density as a marker of Osteoporosis. Comparison of the parameters obtained were done using appropriate statistical methods. Correlations were done using Pearson's correlation co-efficient. All statistical tests were conducted at 5% level of significance.

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Results: The Body Mass Index & Waist to Hip ratio correlated with osteopenia. The Obese persons had increasing osteopenia along with increased lipid profiles. Overweight persons had slight osteopenia along with normal lipid profile. Persons who were perceived to be under stress had poor control of Blood Sugar inspite of being treated with oral hypoglycaemic agents. Most of the subjects had high scores on perceived stress scale, high incidence of substance abuse, lack of knowledge regarding healthy diet & healthy lifestyle.

Conclusion: Identification of factors contributing to stress & effective counselling will have a greater impact on mental & physical health of persons covered under ESIC Health Scheme. Regular Health Education Programmes will ensure a good Quality of life (including Healthy lifestyle)& prevents morbidity. Prevention of osteoporosis & obesity by regular health check ups, good exercise & healthy diet should be a major concern.

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I. INTRODUCTION

Stress refers to a psycho physiological response of a living organism to a perspective challenge, change or threat. Occupational stress (job stress) is a psychosocial disorder which is an impact of the interaction between the worker and his work environment on the worker themselves. If left unidentified it can cause serious physical and physiological illness to the individual, which affects both the individual and the organization. Occupational stress may occur due to stress factors at the individual level, or at the organization level or at the interface of the two. Industrial workers with perceived psychological stress can have impaired job performance and increased risk of stress-related illness such as hypertension, risk factors of coronary heart disease, depression, sleep disorders etc. [1]

It is also likely that stress-induced elevations of cortisol may contribute to a tendency to overeat, which in turn contributes to obesity. Obesity itself is associated with disturbances in Hypothalamic-Pituitary-Adrenal axis (HPA) function, leading to cortisol dysregulation. Obesity is associated with a state of chronic low grade inflammation which is associated with various systemic diseases. The relationship between the obesity and bone density in industrial workers with occupational stress has not been well documented. [2]

Hence, this pilot study was conducted to observe the relationship, if any between the occupational stress, obesity and bone mass in industrial workers under Employees' State Insurance Scheme.

II. MATERIALS AND METHODS

A cross-sectional study was conducted on all patients who attended the ESICMC & PGIMSR Model Hospital Health Camps (n = 105 out of total 300) aging from 18 years to 70 years of either sex. Patients with chronic diseases, infections, chronic medications, psychiatric disorders, cancers etc were excluded from the study. The data collection was done for around 8 hours so as to cover all those in the day shift. Perceived Stress Scale (4 point) accepted worldwide for assessment of Stress was given in the form of Clinical Questionnaire to the subjects which was formulated and adapted as suitable for the industrial workers. The questionnaires were constructed in English and later translated to the native language (Kannada) with the help of Expert. The researcher and the administration agreed prior that each participant would spend no more than ten minutes on the questionnaire. The time was considered critical as the absence of participant from work would mean production delay. The idea of research was clearly explained to the participants in a

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common gathering. The participants were allowed to interact with the researcher and clarify the concepts explained. Following this the participants who were willing to participate were asked to sign the informed consent forms. The subjects filled the questionnaire with the help of the researcher regarding understanding of questions. The 10-item scale assesses feelings and thoughts during the last month. The PSS measures the degree to which situations in one's life are perceived as stressful. It is more strongly related to life event impact scores as opposed to the number of stressful events, thereby representing one's appraisal of the events as being stressful. The participants were asked to rate their feelings on a scale of 0–4, with 0 indicating never and 4 indicating very often. The PSS scores range from 0 to 40, with higher scores indicating higher levels of stress.[3, 4]

General Physical Examination along with measurement of anthropometric parameters including Body Mass Index (BMI), Waist to hip (W/H) ratio, Blood pressure & Systemic examination (cardiovascular, respiratory, gastrointestinal, endocrine & neurological system) were carried out on all subjects Subjects stood barefoot during all anthropometric assessments. Waist circumference was measured by a tape measure at the midpoint between the upper iliac crest and lower costal margin in the midaxillary line. W/H ratio was correlated with Asian Standards. (Women 88-90, Men 100-102). BMI was categorized into three types: Normal (18.5-24.9), overweight (25-29.9) & Obese (30-39.9). [5, 6]

Blood samples from the patients were subjected to biochemical & Pathological investigations like blood sugar, lipid profile & Haemogram by the Laboratory Personnel under the supervision of the Faculty.

Dual Energy X-Ray Absorptiometry (DEXA) Bone Scan was done to assess the Bone Density. Bone Density was expressed as T-Score (T-score is a comparison of a person's bone density with that of a healthy 30-year-old of the same sex). A T-score of *-2.5 or lower* qualifies as osteoporosis. A T-score of *-1.0 to -2.5* signifies *osteopenia*, meaning below-normal bone density without full osteoporosis. [7]

Comparison of the parameters obtained were done using ONE WAY ANOVA test. Correlations between the anthropometric measurements, biochemical data, Perceived stress scale & the degree of osteopenia (based on bone density index) were done using Pearson's correlation co-efficient. All statistical tests were conducted at 5% level of significance using SPSS software & online statistical tools.

III. RESULTS

Based on the BMI, the subjects were grouped into Normal, Overweight & Obese persons. Perceived stress was more in obese group compared to overweight & normal group. Although osteopenia was increasing with increasing BMI, the increments were insignificant. Mean Arterial Pressure was increased in overweight & obese persons. Overweight persons had slight osteopenia along with normal lipid profile. The Obese persons had increasing osteopenia along with increased lipid profiles. Persons who were perceived to be under stress as per the Perceived Stress Scale Questionnaire had poor control of Blood Sugar with increasing BMI, inspite of being treated with oral hypoglycaemic agents. (TABLE 1)

In Normal & overweight subjects, stress was correlating negatively with obesity & increasing osteopenia. In obese group, stress was correlating positively with increasing W/H ratio & osteopenia. Also, W/H ratio correlated positively with increasing osteopenia in obese persons. Most of these correlations were statistically insignificant. (TABLE 2)

Many subjects who had high scores on perceived stress scale had high incidence of substance abuse, lack of knowledge regarding healthy diet & healthy lifestyle.

Table 1 : showing the comparison of measured parameters among the study group

	MEAN AGE(YRS)	PSS SCORE	BMI (Kg/m²)	W/H	MAP (mm Hg)	Bone Density (T Score)	RBS (mg/dl)	TOTAL CHOL (mg/dl)	LDL – C(mg/dl)	TG (mg/dl)
NORMAL (n=59)	33.90± 7.8	14.86± 1.5	20.37± 3.3	0.91± 0.1	92.97± 8.9	1.66 ± 0.5	89 ± 9.2	145 ± 15	92 ± 7.5	168 ± 8
OVER WEIGHT (n=29)	36.55±7.5	16.3± 0.9	27.4± 1.3	0.95± 0.1	99.21± 15.0	1.69 ± 0.5	106 ± 8.5	186 ± 18	118 ± 9.3	189 ± 12
OBESE (n=17)	42.06±6.0	16.9± 1.3	33.58± 3.3	0.99± 0.1	93.65± 11.9	1.76 ± 0.4	114 ± 10.6	209 ± 16.7	124 ± 8.6	215 ± 11.3
P VALUE		<0.05*	<0.05*	<0.05*	>0.05	>0.05	<0.05*	<0.05*	<0.05*	<0.05*

(* - p<0.05 – significant)

Table 2 : showing the correlations of measured parameters among the study group

	NORMAL (n=59)		OVERWEIGHT(n=29)		OBESE(n=17)	
	R value	P value	R value	P value	R value	P value
PSS & W/H	-0.09	0.49	-0.03	0.87	0.53	0.028*
W/H & BMD	0.03	0.82	0.40	0.03*	0.48	0.051
PSS & BMD	-0.27	0.038*	-0.04	0.83	0.17	0.514

(* - p<0.05 – significant)

IV. Discussion

According to the WHO report, "Raising Awareness of Stress at Work in Developing Countries" in 2007, occupational stress is one of the most common forms of stress in developing countries as the socioeconomic status, social inequalities and overpopulation forces employees to work based on job availability without a choice. Occupational stress (job stress) is a psychosocial disorder which is an impact of the interaction between the worker and his work environment on the worker themselves. Studies have shown that blue collar workers are highly vulnerable to occupational stress, both in developed and developing world. Those predominantly affected belong to the labour class as in other developing countries. Work-related stress and mental fatigue are mainly blamed on expectations of better performance, deadlines and competition over the last few years. According to the increasing financial burden to support families; health disorders neglected due to job conditions and work conflicts. [8]

In our study, most of the subjects had increased score of perceived Job stress which correlated with increasing body mass. The hypothalamic-pituitary-adrenal (HPA) axis plays a central role in the regulation of energy metabolism through the actions of the glucocorticoids. Stress may contribute to HPA axis dysregulation, tendency to overeat, which in turn contributes to a cascade starting with obesity and ending with type 2 diabetes and CVD. [9] Dallman et al. proposed a mechanism by which food intake is rewarded during periods of stress because eating becomes associated, through negative feedback, with a reduction of central corticotropin-releasing factor (CRF) activation, a core component of the stress response. Dysregulation of the HPA axis has been documented in individuals exposed to chronic stress. The Whitehall II Study found a higher incidence of obesity in people reporting higher levels of job stress. The majority of studies examining stress- HPA axis relationships have either focused on job stress alone or treated body mass index (BMI) as a confounding variable and controlled for it rather than examining its independent relationship to stress and HPA axis function. In a review of the findings from several of their studies, Bjorntorp and Rosmond

describe the neuroendocrine abnormalities associated with visceral obesity and report a decreased cortisol variability in relation to increased abdominal obesity. [10, 11]

Although we cannot establish causal pathways from this cross-sectional analysis, it is possible that higher stress levels caused altered HPA axis function, which in turn contributed to increases in BMI. But, the bidirectional nature of the relationship between BMI and stress, genetically mediated adaptations which might cause obesity and perceived stress as a consequence of social stigma associated with obesity cannot be ruled out. A key component of obesity is intra-abdominal accumulation of fat, which is responsible for a great portion of the increased CVD risk associated with obesity. [12]

Obese group in our study showed increasing osteopenia with increasing W/H ratio & BMI. In obesity, adipose tissue is infiltrated with an increased amount of macrophages, which are an important source of inflammatory cytokines. Obese humans express higher levels of TNF-a in adipose tissue than do lean individuals. Adipose tissue also produces other proinflammatory factors including interlukin-6 (IL-6) and C-reactive protein (CRP). Obesity has also been implicated in the development or progression of musculoskeletal diseases such as osteoarthritis, a common inflammatory bone disease. Obesity may decrease bone formation (osteoblastogenesis) while increasing adipogenesis because adipocyte and osteoblasts are derived from a common multi-potential mesenchymal stem cell. Obesity may increase bone resorption through upregulating proinflammatory cytokines such as IL-6 and TNF alpha. These proinflammatory cytokines are capable of stimulating osteoclast activity through the regulation of the RANKL/RANK/OPG pathway. Obesity is associated with significant increase in serum leptin and decrease in adiponectin. The action of leptin on bone appears to be complex and both positive and negative effects have been reported. [13, 14, 15]

V. Limitations of the Study

The results from this study might be limited to a localised region of Bangalore and cannot be directly compared with results from other parts of India considering the diversity in culture and other factors within the country. Another key limitation of this study is the number of study subjects. All statistical results are significant but certainly have a wide confidence interval. This clearly indicates a small sample size. Also, we have not measured any laboratory parameters indicative of stress like salivary cortisol, dehydro-epi-androsterone etc due to time constraints. To address these limitations, we are proposing a follow-up study of this sample to determine the prospective relationships among stress, obesity, and HPA axis dysfunction.

VI. Conclusion

Psychological stress appears to influence the body mass and osteopenia though the causal relationships among perceived stress, obesity, and HPA function remain to be elucidated. Identification of factors contributing to stress & effective counselling will have a greater impact on mental & physical health of industrial workers. Regular Health Education Programmes will ensure a good Quality of life (including Healthy lifestyle)& prevents morbidity. Prevention of osteoporosis & obesity by regular health check ups, good exercise & healthy diet should be a major concern.

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