

# Role of stress in newly detected type 2 diabetes mellitus and hypertension

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Received: 11-01-2017  
Revised: 27-02-2017  
Accepted: 15-03-2017

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## ABSTRACT

**Background:** Type 2 diabetes mellitus and hypertension are chronic diseases whose prevalence is increasing globally. Cardiovascular disease is a major cause of mortality and morbidity in diabetes and hypertension, and lifestyle and clinical risk factor do not fully account for the link between the conditions.

**Objective:** This study provides an overview of the evidences concerning the role of stressful life events as contributors of increasing the risk of developing type 2 diabetes mellitus and hypertension in the population.

**Material and Methods:** Prospective cross-sectional study comprising of 80 random cases of newly detected type 2 diabetes and hypertension. Strength of association with the outcome endurance of diabetes mellitus and hypertension with stress levels grouped as slight risk, moderate risk and at risk was evaluated and reported as RR (relative risk) with corresponding 95% confidence interval (CI)  $\chi^2$  used for trend, p-value of <0.05 was considered as statistically significant.

**Results:** Strong association found between exposure to stress and development of type 2 diabetes mellitus (RR=1.51, 95% CI=1.09-2.10) ( $p=0.02$ ). A positive linear trend was observed between hypertension and stress. For SBP ( $\chi^2$  for trend=18.5,  $df=2$ ,  $p=0.0001$  highly significant). DBP 7 times more risk of developing hypertension (RR=7.36, 95% CI=1.27-4.94),  $p=0.0006$  (highly significant).

**Conclusion:** Strong association was found between stress and development of hypertension and type 2 diabetes mellitus. In hypertensive's a positive linear trend

was seen between the two variables. In the diabetics, the relative risk with stress was 1.5 times. Stressful life events increase the risk of developing Type2 diabetes and hypertension.

**Key word:** Type 2 diabetes mellitus, stress, hypertension, association, life

## Introduction

Hypertension & type 2 Diabetes Mellitus are comorbid conditions. They are also called lifestyle diseases. These two diseases are closely linked to cardiovascular diseases which are major cause of morbidity and mortality in our population. It is well known that obesity, unbalanced diet, physical inactivity, socio behavioural factors such as smoking, alcohol and stress are major risk factors for hypertension and type 2 Diabetes mellitus.<sup>[1]</sup> The role of stress remains enigmatic in these lifestyle diseases. Chronic exposure to external stressors has also been implicated in diabetes onset.<sup>[2]</sup> Stress is the non specific response of the body to any demand. A stressor is an agent that produces stress at any time. The most commonly accepted definition of stress [mainly attributed to Richard S Lazarus] is, Stress is a condition or feeling experienced when a person perceives that demands exceed the person's social resources the individual is able to mobilize.<sup>[3]</sup> The scientists describe two types of stress, eustres [good stress] and distress [bad

stress].<sup>[4]</sup> Occasions such as marriage, reunion or an achievement are equally stressful as is the loss of a close family member or loss of a job.

The prevalence and incidence of both hypertension and diabetes mellitus are increasing. India happens to be the diabetes capital of the world, the rise of diabetes incidence will be stupendous in next two decades.<sup>[5]</sup> In 2008, an estimated 347 million people in the world had diabetes and the prevalence is growing, particularly in low- and middle- income countries. India had 69.2 million people living with diabetes (8.7 %) as per the 2015 data. Of these, it remained undiagnosed in more than 36 million people.<sup>[6]</sup> Overall prevalence for hypertension in India was 29.8 % (95% confidence interval: 26.7-33.0) significant differences in hypertension prevalence were noted between rural and urban parts [27.6% (23.2-32.0) and 33.8% (29.7-37.8);  $P=0.05$  ] Regional estimates for the prevalence of hypertension were as follows: 14.5% (13.3-

15.7), 31.7% (30.2-33.3), 181% (16.9-19.2), and 21.1% (20.1-22.0) for rural north, east, west and south India; and 28.8% (26.6-30.8), 34.5% (32.6-36.5), 35.8% (35.2-36.5) and 31.8% (30.4-33.1) for urban North, east, west and south India, respectively.<sup>[7]</sup>

A study conducted in 2002 investigated whether psychological stress represents a risk factor for hypertension. They tested this hypothesis by conducting a study on University students, a well established model of mild real-life stress. The students were examined shortly before a university examination, and a second time three months after - ward, during holiday. Autonomic cardiovascular regulations was assessed by a non- invasive approach, based on auto regressive analysis or RR interval variability (V) and of systolic arterial pressure (SAP) V. The overall levels of stress in the two sessions was gauged from the elevated salivary cortisol (5.6 + 0.5 various 2.4 + 0.2 ng/ml,  $P < 0.05$ ) and altered cytokine profile ( $p < 0.05$ ). During stress the RR interval was reduced and arterial pressure increased significant. The data supported the concept that mild real-life stress increases arterial pressure and impairs cardiovascular Homeostasis. The data supported the concept that mild real life stressors increases arterial pressure and impairs cardiovascular homeostasis.<sup>[8]</sup> A study conducted in Nigeria studied the relationship of stress and diabetes in 54 Nigerian diabetic patients. A constellation of significant stressful life situations was found among the diabetics such as early loss of father, being first borns, born of polygamous parents, being children of first wives etc.<sup>[9]</sup> This prospective cross sectioned study was conducted in order to study the role of stress in newly detected hypertension and diabetics.

### Materials and Methods

Prospective cross-sectional study was carried out on patients admitted in different wards of General Medicine and those attending Medicine OPD. The study was conducted for a period of 1 year. Patient diagnosed with Type-2 diabetes mellitus or hypertension were included in the study. Patients having both diabetes and

hypertension, Type – 1 diabetes mellitus, other type of diabetes like gestational diabetes mellitus and known case of diabetes mellitus and hypertension were not included.

All participants were subjected to thorough history, including history pertaining to any stressful event (according to Holmes and Rahe Scale). All subjects were subjected to clinical examination and included height, weight, blood pressure measurement. Routine laboratory investigations included complete hemogram (hemoglobin/TLC/DLC/PBF/platelet count), blood sugar, complete urine examination, renal function test, serum electrolytes (Na<sup>+</sup>, K<sup>+</sup>), lipid profiles (serum total cholesterol, serum triglycerides, serum high- density lipoprotein cholesterol, serum low density lipoprotein cholesterol), chest X- ray (P/A view) and 12 lead ECG. Diagnosis of diabetes was made according to the diagnostic criteria issued by the National diabetes data group and world health organisation i.e, Symptoms of diabetes plus random blood glucose concentration  $> 200$ mg/dl, Fasting blood glucose  $> 126$  mg/dl or Two hour plasma glucose  $> 200$ mg/dl during normal glucose tolerance test.

Hypertension was diagnosed when systolic blood pressure was 140mmHg or more and diastolic blood pressure was 90 mmHg or more as per guidelines of the seventh US joint National committee in Prevention, Detection, Evaluation and Treatment of High Pressure. Stress score was calculated according to the holmes and rahe stress scale. The numbers of life change units that apply to events in the past year of an individual's life are added and the final score gives a rough estimate of how stress affects health. A presumptive stressful life events scale has been designed using open ended questionnaires along with holmes and rahe social Readjustment rating scale. This is a scale of stressful life events experienced by the indian population. Most of the life events have been taken up from the holmes and rahe social readjustment scale with addition of lack of son, marriage of daughter or dependent sister, prophecy of astrologer and birth of daughter. In

the present study we have use the holmes and rahe SRSS because it is an internationally standardized rating scale. Data was analysed using computer software SPSS version 10.0 for windows and EPI – info version 6. Data presented as percentages for qualitative variables, mean and standard deviation for quantitative variables. Strength of association with the outcome endurance of diabetes mellitus and hypertension with stress levels grouped as slight risk, moderate risk and at risk was evaluated and reported as relatives risk (RR) with corresponding 95% confidence interval (CI). Difference in percentage was calculated using  $\chi^2$  / fisher's exact as well as  $\chi^2$  for trend. P-value of <0.05 was considered as statistically significant. All p- values reported are two -tailed.

**Results**

Age wise distribution, it was observed that maximum number of subject (60; 75.50%) belonged to the age group 40-69 years. Subject below 40(9, 11.25%) and above 70(11, 13.75%) years constitute a small percentage of the total. 52.5 % of total subjects comprised of newly detected T2 DM & 47.5 % newly detected hypertension Out of 38 subjects, 63.15% (24) were male and 36.85 % were female with hypertension and out of 42 subjects of T2 DM 56.15 % (24) were males and 42.85 % (18) were females.

**Table: 1 Associations of stress with systolic blood pressure (SBP)**

Stress score	SBP (mmHg)		Total
	>140	120-140	
<b>300+ (at risk)</b>	9	2	11
<b>150-299 (moderate risk)</b>	15	10	25
<b>&lt;150 slight risk</b>	1	1	2
<b>Total</b>	25	13	38

$\chi^2 = 18.5$ ;  $p=0.0001$  (Highly significant);  $df =2$

A strong association was found between exposure to stress and development of systolic

blood pressure and diastolic blood pressure. As depicted in table:1 and table:2, as the stress score increased so did the blood pressure(SBP>140 and DBP>90). A positive linear trend was associated with stress level. It was seen that as the level of stress increased from slight risk (<150) to at risk (>300), the level of systolic blood pressure increased. The association of diastolic blood pressure with stress was also highly significant. There was 7 times more risk of developing blood pressure with high stress levels. Association of stress and SBP was found to be statistically highly significant. (Table 1) Exposure to high levels of stress had 7.36 times more risk of high DBP (Table 2)

**Table: 2 Association of stress with diastolic blood pressure (DBP)**

Stress score	DBP (mmHg)		Total
	>90	80-90	
<b>300 + (at risk)</b>	9	2	11
<b>150-299 (moderate risk)</b>	2	23	25
<b>&lt; 150 slight risk</b>	1	1	2
<b>Total</b>	15	23	38

Fisher's exact test  $p = 0.0006$ ;  $RR = 7.36$ ; (Highly significant)  $95\% CI = 1.27-4.92$

**Table: 3 Associations of stress with newly detected type – 2 diabetes mellitus**

Stress score	Blood sugar level (mg/dl)		Total
	> 200	100-200	
<b>300 + (at risk)</b>	17	1	18
<b>150 – 299 (moderate risk)</b>	15	7	22
<b>&lt;150 (slight risk)</b>	-	2	2
<b>Total</b>	32	10	42

$RR = 1.51$  Fisher's exact test  $p = 0.02$  (Significant)  $95\% CI = 1.09 -2.10$

A strong association was found between exposure to stress and developing type 2 diabetes. As the stress score increased from slight risk (<150) to at risk (>300) the number of



patients increased from 2 to 18, out of 18 patients in the at risk category 17 had blood sugar levels higher than 200mg/dl. These patients are at 1.5 times greater risk of developing type 2 diabetes mellitus. Statistically significance is also observed between high stress level and developing T2 DM  $p= 0.02$ , there is 1.5 times more risk (RR=1.51, 95 % ci = 1.09-2.10). (Table 3)

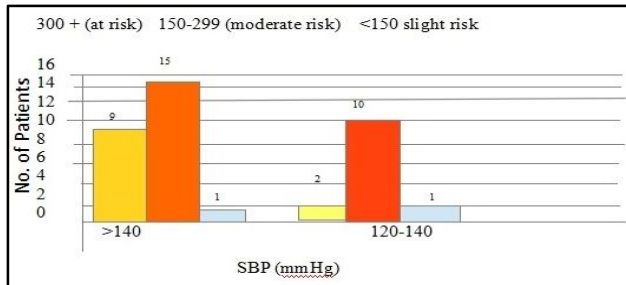


Fig.1 Association of stress with SBP

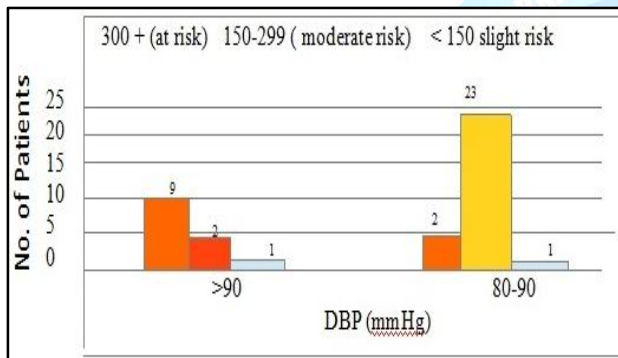


Fig.2 Association of stress with DBP

**Discussion**

The present study was undertaken with the objective of studying stress levels in newly detected type 2 diabetes mellitus and hypertension patients. Our study is consistent with the past studies. It was seen that people exposed to high level of stress were more at risk for developing HTN. A positive linear trend was associated with stress level. It was seen that as the level of stress increased from at slight risk (<150) to at risk (>300), the level of systolic blood pressure increased ( $\chi^2$  for trend = 18.5, df = 2,  $p= 0.001$  highly significant). The association of DBP with stress was also highly significant. There was 7 times more risk of developing blood pressure with the high stress level. Psychological stress represents a risk factor for HTN. Real life

stress condition produce changes in autonomic cardiac and vascular regulations. Lucini et al investigated this hypothesis and found that there was elevated salivary cortisol ( $p<0.05$ ) and altered cytokine profile ( $p<0.05$ ) in response to stress. Marker of autonomic regulation i.e relative risk (RR) interval was reduced and arterial pressure increased significantly.<sup>[8]</sup>

In Response to acute stress, body releases certain hormones and neurotransmitters. The Response to any stress involves the Hypothalamic- Pituitary - Adrenal axis (HPA - AXIS)<sup>[14]</sup> Work stress has reportedly been associated with an increased risk for cardiovascular disease. High imbalance was associated with a higher heart rate and higher systolic blood pressure during work. Logistic regression analysis revealed that heart rate (OR 1-SD increase 1.95 (95% CI, 1.02 to 3.77), vagal tone (OR 1-SD decrease 2.67 (95 % CI, 1.24 to 5.75) were independently associated with HTN. The result from the study suggested that the detrimental effects of work stress are partly mediated by increased heart rate re activity to a stressful work day, and increase in systolic blood pressure and lower vagal tone<sup>[10]</sup>

Apart from changes in diet and excersice pattern, the change to cash economy brings certain potential stresses. It is very difficult to assess what contribution stress might have in precipitating diabetes in people with a gentic susceptibility to the disease. The possibility that stress may be diabetogenic factor cannot be ignored and is pehaps one of the factor that have role in causing the high diabetes prevalence.<sup>[11]</sup> It is reported that self perceived stress is a significant risk factor for type 2 diabetes mellitus, self reported history of trauma and surgery were found to increase the risk of T2 DM.<sup>[12]</sup>Agardh et al found that exposure to long term stress affects the entire neuroendocrine system, activating the HPA axis and or the central sympathetic nervous system. Increased cortisol level following activation of HPA axis could play a role in the development of decrease glucose tolerance. Thus, cortisol has been shown to induce insulin resistance by increasing hepatic glucose

production, suppressing glucose usage and inhibiting insulin secretion<sup>[13]</sup>

The present study also supported this hypothesis and a strong association was found between exposure to stress and the development of T2 DM. There was 1.5 times increased risk of developing type 2 DM with high level of psychological stress, fisher's exact test show significant relationships. For the convenience of statistical evaluation the two subjects with slight risk were added in the moderate risk category.

Unhealthy lifestyle and stress are major risk factors for the development of hypertension and type -2 diabetes mellitus. It is need of the hour that comprehensive lifestyle changes be adopted to deal with these modifiable risk factors so as to attain optimum physical, emotional and spiritual health.

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Cite this article as: Kaur B, Bedi U. Role of stress in newly detected type 2 diabetes mellitus and hypertension. *Int J Med and Dent Sci* 2017;6(2):1493-1497.

Source of Support: Nil  
Conflict of Interest: No