Original Article*

Stress and Undetected Hyperglycemia in Southern Indian Coastal Population Affected by Tsunami

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Abstract

Aim : Natural calamities are known to result in higher stress conditions and also result in adverse health outcomes including development of non-communicable diseases. The impact of tsunami on mental stress and prevalence of hyperglycemic conditions was assessed in a population affected by the calamity in coastal populations of southern India.

Methods : Two populations similar in demography and physical characteristics, but, one affected by tsunami were selected for a comparative study. Subjects aged 20 years or above were randomly selected (control population n = 1176; tsunami population n = 1184). Details of stress were assessed using Harvard trauma questionnaire and scores were assigned. Glucose tolerance was assessed using 2h capillary blood glucose (75gms glucose load) and diagnosis was made using WHO criteria.

Results : Stress score was significantly higher in tsunami population. Although the total prevalence of diabetes was similar (control - 10.0 %; tsunami population - 10.5 %) prevalence of undetected diabetes (5.7 % vs. 3.8 %; Z = 9.54, P < 0.001) and impaired glucose tolerance (9.8 % vs. 8.3 %; Z = 12.83, P < 0.001) higher in the tsunami area. Stress score was higher in women and in the young in the tsunami area.

Conclusion : Population affected by tsunami was under high stress and also showed a high prevalence of undetected diabetes and impaired glucose tolerance. ©

Introduction

On 26th of December 2004, several regions in South East Asia were exposed to a traumatic experience of tsunami. Southern coastal parts of India were badly affected by this natural calamity which resulted in severe devastation and death. As an aftermath of such natural calamities, the survivors are immediately exposed to spread of infectious diseases which is well documented and health care authorities are well aware of this. However the health outcome on chronic human disorders are less known and documented.

Cardiovascular diseases (CVD), diabetes and gastro-intestinal diseases have been shown to be associated with post-traumatic stress conditions.[1] It is also reported that natural calamities such as earthquake result in worsening of metabolic control in subjects with diabetes.[2,3]

Prevalence of diabetes is high in India especially in the urban areas.[4] Socio economic parameters influence the prevalence as well as the proportion of undiagnosed diabetes. Considering the impact of tsunami on the living conditions as well as on the mental and the physical stress inflicted on the victims, a study was conducted to examine whether this situation has increased mental stress and the prevalence of hyperglycemic conditions namely impaired glucose tolerance and undiagnosed diabetes. The study was designed to compare the prevalence of these conditions in two population samples who resembled in their demographic and physical characteristics but only one of them was affected by the tsunami disaster.

Methods

Two population samples (age ≥ 20 years) were chosen from the coastal areas of Chennai (Madras), one from a location which was badly affected by tsunami (Tsunami population) and the other from another location which was not affected by tsunami (Control population). Both belonged to the poor income group who were mostly involved in fishing and its related activities.

With the estimates of undetected diabetes of 2% in non-tsunami area (control population) and a higher

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prevalence of 5% in the tsunami population, the sample size required from each area was 551, with an α error of 5% and the power of 80%. It was decided to screen approximately 1000 subjects in each group.

With the help of volunteers from each locality, enumeration of eligible subjects was done. Colonies with adult population of approximately 25,000 were chosen from each of the two selected areas. Alternate blocks of houses were selected and all eligible members were requested to participate in the study. Subjects aged 20 years or above and of both sexes were eligible to participate in the study. House visits were made by volunteers and the study team to explain the purpose of the study and to motivate them to participate in the study. The selected numbers in the tsunami and control populations were 1463 and 1398 respectively.

Signed informed consent was obtained from each participant. The ethics committee of the institution approved the study protocol.

The study was conducted from 15th April to 27th June 2005. On each day, approximately 50 subjects were requested to assemble for the screening in a Community hall between 7.00 and 8.00 am.

A proforma was filled up with details of occupation, family income, physical activity, habits and personal details of known history of diseases. A similar proforma has been used in previous epidemiological surveys and validated.[5] Mental stress was evaluated using the Harvard Trauma Questionnaire for disaster stress assessment.[6] From the part IV of the questionnaire, items relevant to our situation were selected. For each item, minimum and maximum scores were 1 and 4 respectively. The questions were translated into local language and a trained psychologist interviewed the subjects to fill up the questionnaire. The minimum and maximum scores were 17 and 68 respectively for the total number of responses. Stress assessment was not done for known cases of diabetes.

All subjects except those on treatment for diabetes underwent a 2h post glucose measurement after an oral glucose load of 75grams.[7] Postprandial blood glucose, 2h after the usual breakfast, was estimated for the known diabetic subjects. Capillary blood samples were tested using a glucometer (One touch Ultra – Lifescan Johnson and Johnson). The correlation between the glucometer and venous plasma glucose values were tested in 100 blood samples and it was found to be $r = 0.91$, $P < 0.0001$, with coefficient of variation of 3.5 % between the readings.

Age, height, weight and blood pressure were measured by standard procedures,[5] body mass index was calculated. Hypertension was diagnosed if the systolic blood pressure was greater than 130 mmHg and diastolic greater than 85 mmHg or if there was history of treatment for hypertension.

Diagnosis of diabetes was made if the 2h blood glucose was $\geq$ 200 milligram per decilitre or personal details of known diabetes with the history of treatment was available. Diagnosis of impaired glucose tolerance was made if the blood glucose value ranged between 140 – 199 milligram per decilitre.

Statistical analysis

Mean and standard deviation are reported for measurable variables and Student's 't' was used for comparison of means. 'Z' test was done for comparison of proportions. Correlations between the stress score and other variables were calculated using Pearson's correlation test. Prevalence of diabetes and impaired glucose tolerance were age–standardized by the direct standardization method using the census data of 2001 for the city of Chennai, Tamilnadu. The P value of < 0.05 was considered to be significant.

RESULTS

The response rates were 80.9% (1184/1463) in the tsunami population and 84.1% (1176 / 1398) in the control population. Table 1 shows the description of the

Table 1 : Description of the study populations

	Control population	Tsunami population
Total screened, n	1176	1184
M : F n, (%)	541 : 635 (46.0 : 54)	466 : 718 (40.0 : 60.0)
Age (years)*	39.2 ± 12.9	41.7 ± 13.2
BMI (kg/m^2)*	23.3 ± 4.8	23.7 ± 4.7
BP Systolic (mmHg)*	120.9 ± 8.2	115.8 ± 17.8
BP Diastolic(mmHg)*	80.0 ± 9.6	78.4 ± 10.8
Hypertension	444 (40.0)[a]	388 (34.8)
Positive Family history of diabetes(n,%)	278 (24.0)	310 (26.0)
Occupation (n, %)		
Employed	342 (29.1)	375 (31.7)
Manual workers/ Labourers	716 (60.9)	662 (55.9)
Un employed	118 (10.0)	147 (12.4)
Education (n, %)		
No formal education	319 (27.1)	327 (27.6)
School	795 (67.6)	823 (69.5)
College	48 (4.1)	28 (2.4)
Technical	14 (1.1)	6 (0.51)
Smoking (n,%)		
Nil	999 (84.9)	984 (83.1)
Previous	34 (2.9)	48 (4.1)
< 20 /day	126 (10.7)	135 (11.4)
> 20 /day	17 (1.5)	17 (1.4)
Alcohol		
Nil	813 (69.1)	930 (78.5)
Once a week	161 (13.7)	111 (9.4)
Daily	49 (4.2)	35 (3.0)
Occasionally	125 (10.6)	73 (6.2)
Previously	28 (2.4)	35 (3.0)
Mean plasma glucose (mmol/l)	7.1 ± 3.9	6.9 ± 3.8

*Mean ± SD; **a** - $z = 2.568$, $p = 0.010$

two populations. They were similar with respect to all demographic variables. In both the areas more than 50 % of the population were manual workers, majority were involved in fishing and related activities. Nearly 73% had school education.

Table 2 shows that a higher percentage (61.3 %) of the tsunami population had a stress score above the median value (>35) compared with control population (35.8%) (Z = 8.01, P < 0.001). In both the groups women had a higher stress score than men. Though women of both populations had higher stress score than men significant difference existed between the women of the two populations in their stress score (Z = 8.62 ; P <0.001).

Blood glucose and the stress score were not significantly correlated in both the groups. In both control and tsunami populations prevalence of undetected diabetes and impaired glucose tolerance were similar in both categories of stress score (Table 2).

Table 3 shows the age standardized prevalence of diabetes and impaired glucose tolerance in the two populations. There was no significant inter-group difference in the prevalence of total diabetes. Prevalence of undiagnosed diabetes and impaired glucose tolerance were significantly higher in the tsunami population (undetected diabetes mellitus : Z = 9.54, P< 0.001; for impaired glucose tolerance : Z = 12.8, P < 0.001).

The stress score and age were negatively correlated (r = -0.05, P = 0.02) in the tsunami population but the correlation was positive in the control population (r = 0.07, P=0.005).

Table 2 : Stress scores and its relation to dysglycaemia in the populations

		≤ median (≤ 35) n (%)	> median (> 35) n (%)
Control	Total	708 (64.2)	395 (35.8)
	Male	394 (76.8)	119 (23.2)
	Female	314 (53.2)	276 (46.8)[a]
Undetected diabetes		31 (4.3)	18 (4.5)
Impaired glucose tolerance		66 (9.3)	36 (9.1)
Tsunami	Total	432 (38.7)	683 (61.3)[*]
	Male	235 (53.3)	206 (46.7)
	Female	197 (29.2)	477 (70.8)[b,c]
Undetected diabetes		30 (6.9)	44 (6.4)
Impaired glucose tolerance		45 (10.4)	82 (12.0)

a – Z = 8.09 ; P < 0.001, intra-group gender difference -control. b – Z = 8.02; P <0.001; intra-group gender difference - Tsunami. c – Z =8.62; P < 0.001 ; Control Vs Tsunami. * Z = 8.01; P < 0.001 Tsunami Vs Control

Table 3 : Age-standardized prevalence of hyperglycemia in the two populations

	Control (%)			Tsunami (%)		
	Total	Men	Women	Total	Men	Women
Total	10.0	9.1	10.4	10.5	9.8	10.6
Undetected diabetes	3.8	3.1	4.4[c]	5.7[a]	5.5	5.6
Impaired glucose tolerance	8.3	8.3	7.9	9.8[b]	8.7	10.7[d]

a – Z = 9.54, P < 0.001; b –Z = 12.83, P < 0.001 = Total group. c = Z = 4.52, P < 0.001; d = Z = 8.56, P < 0.001; c& d = intra group gender difference

Discussion

The subjects affected by tsunami had higher stress score. Prevalence of diabetes was found to be similar in both areas, however, undetected diabetes and impaired glucose tolerance were higher in the tsunami-hit area. This may probably be related to the acute stress phenomenon, which is known to cause higher prevalence of metabolic disorders. There is growing evidence that psychological stress caused by traumatic events result in increased medical morbidity including the onset of different diseases and premature death.[8]

Considering the similarities between the two populations with respect to social and economic attributes, the likelihood of having significant difference in undetected proportion of diabetes is meager. Therefore, it is possible that the higher number of undiagnosed diabetes constituted new cases unmasked by the traumatic exposure. This hypothesis is also supported by the higher occurrence of impaired glucose tolerance in the tsunami-hit population. It was also seen that women had higher stress score in both the areas. Prevalence of impaired glucose tolerance was higher in women in the tsunami hit area. Gender differences in the post traumatic stress disorder have been reported[9,10] with markedly worse outcomes in women.

The younger population is the earning members of the families and most of them were involved in fishing related activities. The observation of a higher prevalence of stress in younger subjects in tsunami affected area may be related to lower job opportunities which existed after the calamity and also due to the financial loss incurred. It may also be due to the slow rehabilitation and fear of venturing to the sea after this calamity.

Post traumatic worsening of glycemic control has been reported from Japan following the Kobe[2] and Hanshin-Awaji earthquake[11,12] from Turkey following the Marmara earthquake[3] and from Taiwan[13] also.

Although tsunami hit population had a higher stress score and higher prevalence of undetected diabetes and impaired glucose tolerance, a direct association between these factors was not observed. This may probably be due to the interplay of multiple risk factors with individual variations in their thresholds, especially in their metabolic responses to stress phenomenon.

The study has shown a high level of stress among the tsunami affected population which may have resulted in a higher prevalence of new cases of diabetes and impaired glucose tolerance in them.

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