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Prevalence of diabetes mellitus and role of stress in diabetes in rural Pondicherry – An union territory of India

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ABSTRACT

Background: Prevalence of diabetes is increasing in India. So, to measure prevalence of diabetes mellitus and association of stress with diabetes study was conducted. **Methods:** Cross-sectional study was done on 1403 subjects above 25 years from 2 villages of Puducherry. Fasting blood glucose was measured. Those with >126 mg/dl were subjected for Oral Glucose Tolerance Test. A case control study was done for stress component. The stress was measured using Presumptive Stressful Life Events. **Results:** The Period prevalence of Diabetes Mellitus (DM) was 5.8%. Of the 71 cases, 31 were newly diagnosed. The response rate was (88%). Stress was associated with DM (OR, 8). **Conclusions:** Study reported high prevalence of DM. Almost half the diabetes is hidden in community. Stress is an important risk factor for development of diabetes. **Key words:** Diabetes Prevalence, Rural India diabetes, stress, Presumptive Stressful Life Events.

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Introduction:

Diabetes mellitus (DM) ranks twelfth in all-cause mortality worldwide. ^[1] One percent of Disability Adjusted Life Years is contributed by DM. ^[2] Multi-centric study showed prevalence of diabetes as 3.4% in rural India in 2004. ^[3] In rural South India, the prevalence ranged from 3.1% to 13.2%. ^[4-7] Main risk factors for Diabetes Mellitus include modifiable variables like Body Mass Index (BMI), physical inactivity, diet, and non-modifiable variables like age, family history of DM. ^[8] Studies have been done considering different psychological aspects like depressive symptoms, work stress etc. in association with diabetes. ^{[9], [10]} though some studies have shown the evidence of association between diabetes and stress, it needs strengthening as measurement of stress has multiple facets. Stress being a modifiable risk factor, its role in development of diabetes has to be studied. A case control study was conducted in an

attempt to strengthen the epidemiological evidence of the association between stress and diabetes. The WHO has stressed on diabetes epidemiology which in turn, would be helpful in carrying out appropriate interventions. ^[11]

Prevalence of type 2 DM in rural population is an important public health issue, as 80% of India's population in rural areas. There is relatively less number of studies in rural areas. The latest prevalence of diabetes in Puducherry was from a study in 1984. ^[12] However periodic strengthening of epidemiology is essential. This might be useful in local modifications in planning, implementation and evaluation of National Program for control of Diabetes, Cardio-vascular diseases and Stroke. In this background, the current study was undertaken with following objectives

1. To measure the one year period prevalence of Diabetes Mellitus among adults >25 years of age in a rural Puducherry.
2. To study the association of stress in the form of stressful life events with DM

Material And Methods:

The study was carried out in the two villages, Ramanathapuram and Pillaiyarkuppam, of the four villages under Rural Health Centre (RHC), the rural field practice area of Department of Preventive and Social Medicine, Jawaharlal Institute of Postgraduate Medical Education and Research, Puducherry, India during January 2007 to April 2008. These villages were chosen as they were closer to the center, and they would facilitate collecting fasting blood samples in the early mornings. The study was approved by JIPMER ethics committee in December 2006. It was a Cross-Sectional Study combined with case control study.

Sample size was calculated using available prevalence studies from adjacent Tamil Nadu (6.4%-11%) which are geographically and socio-culturally similar to study area.^{[13],[14]} Based on the lowest prevalence of 6.4% ($\alpha = 0.05$ and relative precision of 20%), the sample size was 1403. The age group above 25 years was considered based on recommendations of WHO STEP-wise approach to surveillance (STEPS) for non-communicable diseases. Based on proportion of population >25 years age sample (643 and 760 from Ramanathapuram and Pillaiyarkuppam respectively) from each village was drawn. Pilot study showed that if individual subjects were chosen by random or systematic random sampling method, there was dissatisfaction among the people left out, which made poor community participation. Hence, instead of individual subjects as the units of sampling, streets (thereby every one above 25 years in the street) were chosen for study. There were nine streets each in both villages, of which four and six streets were selected from Ramanathapuram and Pillaiyarkuppam village randomly so that proportionate sampling was satisfied (629 and 794 respectively). There were no exclusion criteria.

The subjects were interviewed with a pre-tested questionnaire regarding demographic details, social and biological variables and behavioral components. Anthropometric measurements like height and weight were also measured. Detailed family history of diabetes was taken. This was verified either by blood glucose measurement of the parents of the study subjects or in the person's absence, by other circumstantial evidences like physician report, diet

modification or drugs usage. For purposes of this study, if the response was "diabetes status of parents not known", it was assumed to be "No family history of DM". The family history was considered when there was history of diabetes in parents. Physical activity was measured using International Physical Activity Questionnaire. Height was measured using Microtoise tape with sensitivity of 0.1 cm. Weight was measured using Digital weighing machine (sensitivity of 100g). BMI was classified as per WHO guidelines.^[15]

WHO recommends use of glucometer to measure blood glucose for epidemiological purposes.^[16] The glucometer (OneTouch sure step) was standardized and correlation co-efficient was 0.8. The glucometer measured plasma glucose levels. After informed consent, the questionnaire based interviews were made in the evening along with briefing on need for overnight fasting (minimum 8 hrs) for testing fasting blood glucose. Next morning, after confirming fasting, blood glucose was measured. All those who had Fasting Blood Glucose more than 126mg/dl were subjected to OGTT. OGTT was done on a different day Based on WHO criteria.^[16] These incident diabetes cases were considered as cases and equal numbers of matched controls were taken from the same study group having normal blood glucose. The controls were matched for age, gender and Body Mass Index (BMI). Age and BMI were matched within ± 2 yrs, and BMI ± 2 kg/m² respectively. BMI was also matched in order to measure the independent effect (without confounding) of stress on diabetes. Stress was measured in form of Presumptive Stressful Life Events scoring system.^[17] This gives the score for each stressful event and total score for each individual is calculated. Those who had stress score more than (mean -1SD) one Standard Deviation were considered as having stress. Data was analyzed by SPSS. Fischer's Exact test and Mc Nemar test was used in appropriate situation.

Results:

Out of 1403 subjects approached within the data collection period 1223 were available for fasting blood glucose examination. Baseline features are as shown in the table 1. The coverage of target sample was 87.2 %. Reasons for non response included non-availability for blood glucose testing on more than three visits (169) and refusal to give consent (11). There was no significant difference in demographic distribution of study subjects (1223) with sample frame. There was no significant age difference between those who were contacted and not contacted. The details of those who were not contacted are shown in table 2.

Table 1 Baseline features of study population

| Variable | Category | n | % |
|---------------------|--------------------------|-------------------|-------|
| Age | 25- 29 | 243 | 19.8 |
| | 30-39 | 356 | 29.1 |
| | 40-49 | 244 | 20.0 |
| | 50-59 | 181 | 14.8 |
| | 60-69 | 117 | 9.6 |
| | ≥70 | 82 | 6.8 |
| | Total | 1223 | 100 |
| Gender | Male | 617 | 50.5 |
| | Female | 606 | 49.5 |
| | Total | 1223 | 100 |
| Education | No schooling | 380 | 31.1 |
| | Primary | 117 | 9.6 |
| | Secondary | 596 | 48.7 |
| | Postsecondary | 69 | 5.7 |
| | >Graduation | 61 | 5.0 |
| | Total | 1223 | 100 |
| Occupation | Skill I | 441 | 36.1 |
| | Skill II | 296 | 24.2 |
| | Skill III | 9 | 0.7 |
| | Skill IV | 19 | 1.6 |
| | Non-workers ^β | 458 | 37.4 |
| | Total | 1223 | 100 |
| SES (Rs) | I (>2400) | 108 | 8.8 |
| | II (1200-2,399) | 300 | 24.5 |
| | III (720-1,199) | 375 | 30.7 |
| | IV (360- 719) | 366 | 29.9 |
| | V (<360) | 73 | 6.1 |
| | Total | 1223 | 100 |
| BMI | Underweight | 276 | 22.8 |
| | Normal | 706 | 58.3 |
| | Overweight | 192 | 15.8 |
| | Obese | 38 | 3.1 |
| | Total | 1212 [¥] | 100 |
| Physical activity | Low | 259 | 21.2 |
| | Moderate | 604 | 49.4 |
| | High | 360 | 29.4 |
| | Total | 1223 | 100.0 |
| Smoking | Non-smokers | 463 | 75.0 |
| | <10 | 130 | 21.1 |
| | 10.1-20 | 16 | 2.6 |
| | >20 | 8 | 1.3 |
| | Total | 617* | 100.0 |
| Alcohol (gms/day) | Abstainers | 358 | 58.1 |
| | <39.99 | 150 | 24.3 |
| | 40-59.99 | 33 | 5.3 |
| | >60 | 76 | 12.3 |
| | Total | 617* | 100.0 |
| Family h/o diabetes | No | 1109 | 90.7 |
| | Yes | 114 | 9.3 |
| | Total | 1223 | 100.0 |

[¥]For 11 individuals BMI could not be calculated as they had Kyphosis which hindered accurate height measurements

*Smoking and alcohol only males were considered total males 617.

A total of 71 (40 known and 31 newly detected diabetics) diabetics were identified in the study population. The prevalence of diabetes mellitus was 5.8%. The age and gender adjusted prevalence of diabetes was 5.82% (Standardized for distribution of rural Puducherry as per census 2001). The proportion of known diabetics was 56.7% and of newly detected diabetics was 43.3%. There were no cases of gestational diabetes. Considering the age at diagnosis and clinical features indicated that all cases were probably been type 2 diabetes.

Mean stress score was 348(±147.7). Both matched and unmatched analysis was done. The odds ratio was 10.5 (1.3-90.7) in unmatched analysis (table 3) and 8 (1.1-60.1) in matched analysis (table 4).

Discussion :

Despite adopting the WHO standards, certain differences in findings while comparing with other studies could be due to differences in methodologies for measuring blood glucose, guidelines used for diagnosis of diabetes mellitus, age groups considered as well as differences in studies done in different times and geographical situations. The age and gender distribution, SES, educational status, BMI of study sample was comparable with rural Puducherry. [18],[19]

The age and gender adjusted prevalence of diabetes in the present study was 5.82%. Considering studies from rural areas in last decade, a Tamil Nadu and Srilankan studies were comparable with the present study. [13] [20] On the other hand, a multicentric study and rural Mysore study reported much lower prevalence of 1.9% and 3.8% respectively. [4, 21] A Nagpur study reported prevalence of diabetes as 3.7% among >30 years, which was lower compared to present study. [22] The prevalence in rural Pakistan and Bangladesh were (2.3%-3.3%) lower compared to present study. [23-24] However studies from rural Maharashtra, Tamil Nadu and Andhra Pradesh reported higher prevalence 9.3%, 9.2% and 13.2% respectively. [5] [13],[25]

Though the prevalence of DM was 5.8% in our study, the methodology adopted did not allow detection of isolated post-prandial blood glucose abnormality. This was because the first step in the screening was

Table 2 Age-Gender Distribution of the sample that could not be contacted

| Age group | M (%) | F (%) | Total | |
|-----------|----------|----------|-------|-------|
| 25-29 | 17(56.7) | 13 43.3) | 30 | 16.7 |
| 30-39 | 36(52.2) | 33 47.8) | 69 | 38.3 |
| 40-49 | 26(55.3) | 21(46.7) | 47 | 26.1 |
| 50-59 | 8 (50.0) | 8 (50.0) | 16 | 8.9 |
| 60-69 | 7 (46.7) | 8 (53.3) | 15 | 8.3 |
| ≥70 | 1 (33.3) | 2 (66.7) | 3 | 1.7 |
| Total | 95 52.8) | 85(47.2) | 180 | 100.0 |

Table 3 Unmatched analysis of case control study for exposure of stress

| Stress level* | Number of cases | Number of controls | Odds ratio (CI) | p value |
|---------------|-----------------|--------------------|--------------------|---------|
| < Mean - 1 SD | 1 | 8 | 1 | |
| >Mean - 1 SD | 29 | 22 | 10.5 (1.3 to 90.7) | 0.03* |
| Total | 30 | 30 | | |

Matching was done for age, gender and BMI, *Fisher Exact Test

Table 4 Matched pair analysis of case control study for exposure of stress

| | | Controls | | Total |
|-------|------------------|------------------|-----------------|-------|
| | | Exposure present | Exposure absent | |
| Cases | Exposure present | 21 | 8 | 29 |
| | Exposure absent | 1 | 0 | 1 |
| Total | | 22 | 8 | 30 |

Odds ratio after matched pair analysis is 8 (CI 1.1-60.1), p=0.02 Mc Nemar test

fasting blood glucose abnormality (>126mg/dl). Hence this could be an underestimate of actual prevalence. Such methodology could lead to 25 to 30% lesser values compared to situation when both fasting and 2 hour post glucose blood test is adopted. [16],[26] Hence, the prevalence of DM might be about 25% higher than the 5.8% (i.e. 7.2%).

To summarize, the prevalence of diabetes in this study was comparable with studies from rural areas of Tamil Nadu, lower than Andhra Pradesh, Maharashtra, and higher than Karnataka, north Indian studies. The reasons for higher prevalence could be

due to high prevalence of high risk BMI (34.3%) in the population and average per capita income in Puducherry is very high compared to other states/UT as Puducherry. [27]

The proportion of newly detected diabetes was 43.3%. Several rural Indian studies also reported similar proportions of 'newly diagnosed diabetes' cases ranging from rural areas. [5],[13],[14],[24] This high proportion might reflect the unawareness and absence of regular screening system for diabetes.

The prevalence of diabetes has increased in rural Puducherry over time (1.8% to 5.8% from 1986 to 2008). [12] Increase in geriatric population could be one of the reasons for this secular trend. Similar temporal change was observed in Tamil Nadu and Malaysia. [15] [28]

The risk of metabolic syndrome varied from 1.2 to 2.1-fold for more severe depressive symptoms or very stressful life events. [9] This association was lower than the present study. Further, this study measures only the stressful life events but not the individual perceptions to it. Agardh EE et al reported Relative Risk of 3.7 for type 2 diabetes with low Sense of coherence and RR of 2.2 with lower decision latitude. However high work demand was not associated with diabetes in that study. [10] Low Sense of coherence rather than just high work load was associated with diabetes. This also indicates that individual perception to work load is also important. These evidences showed that the stress, in the form of stressful life events is important risk factors for development of diabetes. This implies that some stress management facilities like meditation, yoga etc. must be available to community in order to cope up stressful events. This study could not take the perception of individual for those life events and personality type of an individual.

The study had following Limitations and weakness Most of the studies considered the measurements of waist circumference as marker of abdominal obesity acts as relatively specific measure of insulin resistance and is an important variable to be measured. However due to reasons stated in methodology we could not measure it.

The coverage was 87% of the calculated sample size within the allotted time frame work for data collection (January 2007 to December 2007, apart from three months time for procedural procurement of glucometer and its strips). Despite this high coverage close to 90%, the non-response (as explained in results) could have an influence on the

findings. However the balance population of 180 had a similarity in age-sex composition to the rest of subjects studied, thereby possibly leading to a similar direction of results.

The sample size was calculated assuming simple random sampling, but for feasibility stratified sampling was done, this could have lead to sampling error.

This is an underestimate of period prevalence as the methodology adopted did not allow detection of isolated post-prandial blood glucose abnormality (discussed in detail earlier). Stress was measured using streefull life events, considering general reaction to situation, thi would lead to under estimate of stress as such. This could have lead to underestimation of strength of association.

Conclusions:

The prevalence of diabetes among >25 year population in rural Puducherry was 5.8%, which is relatively higher than other parts of India. This further calls for starting facilities for regular check-ups, treatment and monitoring of complications even at Primary Health Center. Further, the stress must be laid on preventive and promotive services in order to check the growing prevalence of diabetes in Puducherry and implementation of NPCDS is to be done on priority. The new cases were almost half of the known cases which also undermine the importance of screening program. This also calls for studies on effectiveness of mass screening program and its cost-effectiveness.

Through case control design the study evidenced that stress as stressful life events significant risk factor for development of diabetes. De stressing facilities should be made available to the community and studies related to feasibility of such programs must be done.

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