Global Journal of Medicine and Public Health

www.gjmedph.org

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

Sumanth Mallikarjuna Majgi 1, Bala Soudarssanane M2, Gautam Roy3, Das Ashok Kumar4

1Assistant Professor, Department of Community Medicine, MMCRI, Mysore, India ,2Professor and Head, 3Professor, Department of Preventive and Social Medicine, 4 Department of Medicine,Medical Superintendent,Jawaharlal Institute of Postgraduate Medical Education and Research, Pondicherry, India

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 on1403 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.

Corresponding Author: :- Sumanth Mallikarjuna Majgi, Assistant Professor, Department of Community Medicine, MMCRI, Mysore, India

Email - drsumanthmmc@rediffmail.com

Funding: None

Conflict of interest: None

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	108	8.8
	(>2400)	300	24.5
	II (1200-2,399)	375	30.7
	III (720-1,199)	366	29.9
	IV (360- 719)	73	6.1
	V	1223	100
	(<360)		
	Total		
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		
		Exposure present	Exposure absent	Total
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.

References:

1. World Health Organization. World Health Statistics 2008. Future trends in global mortality: Major shifts in cause of death patterns. 2008. Geneva, WHO.
2. World Health Organization. Preventing chronic diseases: a vital investment .2005. Geneva, WHO
3. Mohan V, Mathur P, Deepa R, Deepa M, Shukla D et al. Urban rural differences in prevalence of self-reported diabetes in India - the WHO-ICMR Indian NCD risk factor surveillance. Diabetes Research Clinical Practice.2008;80:159-168.
4. Basavanagowdappa H, Prabhakar A, Prasannaraj P, Gurudev K, Virupaksha et al. Study of prevalence of diabetes mellitus and impaired fasting glucose in a rural population. International Journal of Diabetes in Developing Countries.2005;25:98-101.
5. Chow C, Raju P, Raju R, Reddy K, Cardona M, Celermajer D. The prevalence and management of diabetes in rural India. Diabetes Care .2006;29:1717-18.
6. Patadin S, Bots L, Abel R, Valkenburg H. Impaired glucose tolerance and diabetes mellitus in a rural population in south India. Diabetes Research Clinical Practice.1994; 24:47-53.
7. Ramachandran A, Snehalatha C, Kapur A, Vijay V, Mohan V, Das A et al. High prevalence of diabetes and impaired glucose tolerance in India: National Urban Diabetes Survey.
8. Park K. Epidemiology of chronic non-communicable diseases and conditions. Park's text Book of Preventive and Social Medicine. 19 ed. 2007. 301-45.
9. Raikkonen K, Matthews K, Kuller L. Depressive symptoms and stressful life events predict metabolic syndrome among middle-aged women. Diabetes Care. 2007;30[4]:872-7.
10. Agardh E, Ahlbom A, Anderson T, Efendic S, Grill V, Hallqvist J et al. Work stress and low sense of coherence is associated with type 2 diabetes in middle aged Sweedish women. Diabetes Care. 2003;26:719-24.
11. World Health Organization. TRS 916 Diet, nutrition and prevention of chronic diseases. 2003. Geneva, WHO.
12. Govindaraj V, Das A, Chandrasekhar S. Prevalence of diabetes mellitus in a rural population of Puducherry. Journal of Diabetes association of India.1984; 24:20.
13. Ramachandran A, Mary S, Yamuna A, Murugesan N, Snehalatha C. High Prevalence of Diabetes and Cardiovascular Risk Factors Associated With Urbanization in India. Diabetes Care.2008;31[5]:893-8.
14. Ramachandran A, Snehalatha C, Baskar A, Mary S, Sathishkumar C, Selvum S et al. Temporal changes in prevalence of diabetes and impaired glucose tolerance associated with lifestyle transition occurring in the rural population in India. Diabetologia.2003;47: 860-5.
15. Technical Report Series 894. WHO consultation on Obesity. Obesity: Preventing and managing global epidemic. 2000. Geneva, WHO.
16. Department of Non-communicable Disease Surveillance, World Health Organization. Definition, Diagnosis and Classification of Diabetes Mellitus and its Complications. 1999. Geneva, WHO
17. GurmeetSingh. Presumptive Stressful Life Event Scale (PSLES)– A new Stressful Life Event Scale for use in India. Indian Journal of Psychiatry. 1984;26[2]:107-14.

18. Planning Commission of India. National Human Development Report 2001. Planning Commission of India. 2002. New Delhi, Government of India.
19. Thiruselvakumar D, Soudarssanane M. Epidemiological study of obesity in rural Puducherry [M.D. Community Medicine], Puducherry. Puducherry University, 2007.
20. Illangasekera, Upali, Rambodagalla, Samanthi, Tennakoon, Silumini. Temporal trends in the prevalence of diabetes mellitus in a rural community in Sri Lanka. The Journal of the Royal Society for the Promotion of Health 2004 124: 92-94
21. Sadikot S, Nigam A, Das S, Bajaj S, Zargar A, Prasannakumar K. The burden of diabetes and impaired fasting glucose in India using the ADA1997 criteria: prevalence of diabetes in India study (PODIS). Diabetes Research Clinical Practice. 2004.66:293-300.
22. Kokiwar P, Gupta S, Durge P. Prevalence of diabetes in a rural area of central India. International Journal of Diabetes in Developing Countries. 2007;27[1]:8-10.
23. Sayeed M, Banu A, Khan A, Hussain M. Prevalence of diabetes and hypertension in a rural population of Bangladesh. Diabetes Care. 1995;18[4]:555-558.
24. Shera A, Jawad F, Maqsood A. prevalence of diabetes in Pakistan. Diabetes Research Clinical Practice.2007;76:219-222.
25. Deo S, Zantye A, Mokal R, Mithbawkar S, Rane S, Thakur K. To identify the risk factors for high prevalence of diabetes and impaired glucose tolerance in Indian rural population. International Journal of Diabetes in Developing Countries. 2006;26:19-23.
26. DECODE Study Group on behalf of the European Diabetes Epidemiology Study Group. Will new diagnostic criteria for diabetes mellitus change phenotype of patients with diabetes? Re analysis of European epidemiological data. British Medical Journal. 1998;317:371-5.
27. Central statistical organization. Ranking of states per capita income wise - constant (1999-00) prices.2008. available from: http://pbplanning.gov.in/pdf/Ranking%20of%20States%20Constant.pdf [last accessed on Dec 2009]
28. Zaini A. Where is Malaysia in the midst of the Asian epidemic of diabetes mellitus? Diabetes Research Clinical Practice. 2000;50[Suppl. 2]:S23-S28.

Access This Article Online

Quick Response Code:

Website: www.gjmedph.org