Original Article

Diabetes and Its Risk Factors In A Remote Rural Area Of South India: A Community Based Cross Sectional Survey

Running Title: Diabetes and Risk Factors in South India

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Abstract

Introduction: Diabetes is a major public health problem and one of the important risk factor for cardiovascular diseases and premature mortality in India. We aimed to study the diabetes and its association in a remote rural area of South India. *Methods*: This study was conducted in 20 villages located around a Rural Health Training Centre in Chunampet in Tamilnadu. This study was carried out in March 2018 to October 2018 with by Medical Interns and Medical Social Workers under the direct supervision of faculty from Community Medicine using a pretested questionnaire. *Results*: Prevalence of self-reported diabetes was 3.2% (2.9-3.6). Hypertensive patients were 12 times (aPR 12.1(9.6-15.2) more likely to have DM). With increase in age increase in prevalence of HT was 3% (aPR 1.03(1.02-1.04)). Married people were 5 times (aPR 5.2(2.1-12.9)) and separated people were 4 times (aPR 3.9(1.5-10.2)) more likely to have DM. Alcoholics were 37% (aPR 1.37(1.0-1.9)) more likely to have DM and non-vegetarians were 35% (aPR 0.65(0.5-0.9)) less likely to have DM. *Conclusion*: Diabetes in a remote rural area of South India was significantly associated with hypertension, increase in age, married and widows and vegetarian diet.

Keywords: Maternal Care Assistance Program, Facility-Based Delivery, Maternal Mortality Ratio, Infant Mortality Rate

Introduction

India is one of the epicentres of the diabetes pandemic [1]. Diabetes (DM) is a risk factor for many non- communicable diseases (NCDs) [1]. With more than 65 million people having the disease, DM is growing alarmingly in India. These numbers are projected to increase to 101.2 million by the year 2030 [2, 3]. Currently, India is considered the 'Diabetes Capital' of the world [4]. Main contributors for major NCDs including diabetes are—physical inactivity, unhealthy diet, smoking and alcohol consumption [5]. Even though evidence from large

prevalence studies is available in India, there is a need for community-based studies on various aspects of the disease [4, 6-8]. Not only is DM under-diagnosed, there is also a huge gap in managing the already diagnosed individuals [4, 6-8]. This gap is even more pronounced among the rural and neglected population [9]. So, to fill this gap there is a need to conduct and construct a population-based registry in the community, especially in the rural areas, this could in-turn be used as a tool for further follow up and management. With this background, we aimed to construct a population-based registry on self-reported diabetes patients in a remote rural area.

Methodology

Pondicherry Institute of Medical Sciences has established its Rural Health Training Centre (RHTC) in a remote rural area of Chunampet, situated in Chengalpattu district of Tamil Nadu, South India. The RHTC was established as per the Medical Council of India (MCI) norms for medical colleges and has been functioning since the year 2002. This centre serves around the clock through its outpatient and emergency medical services. The centre also caters to 20 near-by villages through its community health services. The services were offered at their door steps with the help of medical interns, post-graduates, medical social workers (MSWs) and Medical Officers (MOs). In the 20 villages served by the RHTC, a large-scale socio-demographic and morbidity survey was conducted in March 2018 to October 2018. For this survey a pretested 'data collection questionnaire' was used which contained socio-demographic, mortality and morbidity details associated with diabetes. A detailed data collection guide was prepared and the medical interns, MSWs and Auxiliary Nurse Midwifes (ANMs) were trained in data collection using this guide. The data collection was (directly) supervised by the faculty in-charge, post graduate and MOs of the RHTC. Persons with age 20 and above belonging to any of the 20 villages and having resided for more than six months were included in the study. Those found eligible as per the mentioned criteria were included in the study. Self-reported diabetes was defined as those respondents who were already diagnosed with diabetes and were either on treatment or had discontinued treatment or were not on treatment [10].The software used for data entry was EpiData software version 3.1 [11]. The quality of data collection was ensured by checking a subset of data collected in the field. Also, EpiData V 3.1 has quality checks to prevent data entry errors. Data was analysed with the help of Statistical Product and Service Solutions (SPSS) version 22 and STATA version 14 [12, 13]. We used SPSS for reporting frequency distribution and chi square test, while STATA was used for Prevalence Ratio (PR) and adjusted Prevalence Ratio (aPR). PR and aPR were calculated using Poisson regression. An ethical clearance for the survey was obtained from the Institute ethics board (Ref No - RC 100/18).

Results

In total 10,739 persons were included in the study, among them 346 were reported to have diabetes. Prevalence of self-reported diabetes was 3.2% (95% CI: 2.9-3.6). Hypertensive patients were 12 times (aPR 12.1; 95% CI: 9.6-15.2) more likely to have DM. With increase in age, increase in prevalence of HT was 3% (aPR1.03; 95% CI: 1.02-1.04). Married people were 5 times (aPR 5.2; 95% CI: 2.1-12.9) and widowed were 4 times (aPR 3.9; 95% CI: 1.5-10.2) more likely to have DM. Alcoholics were 37% (aPR 1.37; 95% CI: 1.0-1.9) more likely to have DM, while non-vegetarians were 35% (aPR 0.65; 95% CI: 0.5-0.9) less likely to have DM.

Discussion

One of the main findings in our study was 3.2% self-reported DM. Our results are

similar to those of Indian Council of Medical Research - INdia DIABetes Study (ICMR - INDIAB study) wherein self-reported and newly-diagnosed diabetes in rural Tamil Nadu were found to be 4.1% and 3.8%, respectively; the ratio of self-reported diabetes to newly-diagnosed diabetes in rural area was 1:0.9 and overall diabetes was 7.8 % [14]. This shows that nearly half of diabetics in rural India are still undiagnosed, there is thus a need for improved diagnosis of diabetes through active search in the community. While regional differences exist, in India the prevalence of diabetes in rural areas has quadrupled in the past 25 years. Few studies have found to have higher prevalence in a rural area of neighbouring Andhra Pradesh, however the sample population comprised only of individuals above 30 years of age. However, in our study we included persons above 20 years of age since identification at an earlier stage can help in modifying the risk factors thus preventing future complications [15, 16]. Chronic diseases have been the leading cause of death, globally. About 20% of Indians are estimated to suffer from a chronic condition. Type 2 DM is an international pandemic with high morbidity and mortality, having a great economic impact [15, 17]. Nearly 80 % of the global burden lies in low- and middle-income countries (LMICs) and India falls in this category [18]. Diabetes is a serious threat to rural regions, where it often goes unidentified; this problem is no longer confined only to urban areas of India [15, 19]. DM affects over 70 % of rural population of India, characterized by poverty, lack of awareness, illiteracy, inadequate health care services and poor access to health care services.

Our findings of increase in prevalence of DM with age, hypertension, among married, widowed and with alcohol intake was also noticed in other studies [1, 20, 21]. Higher prevalence among married and widowed compared to unmarried may be due to differential age. Unmarried are at lower risk and are younger. Prevalence was also high among those who consumed alcohol. Probability of diabetics being hypertensive was also high in our study. An interesting finding in our study was that non-vegetarians were 40% less likely to have diabetes than vegetarians, this contradicts findings from other studies [22-24]. This may be due to relatively smaller sample size of vegetarians. Also, since most non-vegetarians in this part of the country consume fish, which may be protective [25-27]. Vegetarians however might be consuming calorie dense foods, rich in sugars and fats. This aspect needs to be studied in details further in this population, using a detailed case control design [22-24]. Our study shows that there was no significant relationship of DM with gender, caste, socio-economic status, literacy level and smoking. In addition, there are a number of potential risk factors, including physical activity, family history, central obesity, abdominal obesity, poly-unsaturated fat consumption, and tobacco consumption, which are all associated with diabetes indicators, pre-diabetes, and/or diabetes in the research site and warrant future investigation [24].

A limitation of our study is that it is based on the self-reporting and can be considered as a self-reported prevalence but not a true prevalence study, as we have not actively screened the population for diabetes. Strengths of our study are, this is a population-based study covering a large sample size from a remote rural area, spreading across 20 villages. Our study has the certain policy implications. Presently, NCDs in rural area are managed through NCD clinics under the National Program for Cancer Diabetes and Cardio vascular disease (NPCDCS) programme. Individuals with NCDs (mainly diabetes and Hypertension) belonging to a particular Primary Health Centre area are managed through this NCD clinic. Our study adds strength to this concept by having a population-based registry;

updating this on serial surveys may help ensure proper management of DM in rural India.

Conclusion

Diabetes was found to be significantly associated with hypertension, increase in age, being married or widowed, alcohol and vegetarian diet in the remote rural area of South India under study. Diabetes diagnosis and management need to be improved in rural areas of India.

Table 1: Diabetes and its risk factor from a remote rural area of South India in 2018

Category	Total (N= 10739)	Diabetes n= 346 (%)	Chi square$	Prevalence Ratio (95% CI)#	Adjusted PR (95% CI)#
Gender			0.12		
Male	5328	186(03)		**1.2(1.0-1.5)**	1.1(0.8-1.3)
Female	5411	160(03)		Ref	Ref
Caste			<0.01		
BC	1457	68(05)		Ref	Ref
MBC	4491	157(04)		**0.7(0.6-1.0)**	1.0(0.7-1.3)
SC	475	121(03)		**0.5(0.4-0.7)**	0.8(0.6-1.1)
ST	17	0(0)		-	-
OC	16	0(0)		-	-
Age mean (SD)		42 (16)	<0.01	**1.0(1.0-1.1)**	**1.03 (1.02-1.04)**
Family members mean (SD)		4.4 (1.7)		**0.9(0.8-1.0)**	1.0(0.9-1.0)
Education			<0.01		
Literate	6736	181(03)		Ref	Ref
Illiterate	4002	165(04)		**1.5(1.2-1.9)**	0.8(0.7-1.0)
Marital Status			<0.01		
Married	7871	291(04)		**14.3(5.9-34.7)**	**5.2(2.1-12.9)**
Unmarried	1938	05(0)		Ref	Ref
Widow$	930	50(05)		**20.8(8.3-52.3)**	**3.9(1.5-10.2)**
Tobacco user			<0.01		
Never	10006	299(03)		Ref	Ref
Current	733	47(06)		**2.1(1.6-2.9)**	1.2(0.9-1.7)
Alcoholic			<0.01		
Never	9740	287(03)		Ref	Ref
Current	999	59(06)		**2.0(1.5-2.7)**	**1.37(1.0-1.9)**
Hypertension			<0.01		
No	10359	195(02)		Ref	Ref
Yes	380	151(40)		**21.1(17.1-26.1)**	**12.1(9.6-15.2)**
Diet			<0.01		
Veg	1009	58(06)		Ref	Ref
Non-Veg	9730	288(03)		**0.5(0.4-0.7)**	**0.65(0.5-0.9)**
Type of toilet facilities			0.08		-
Toilet present	3831	139(04)		Ref	Ref
No facility (Open defecation)	6908	207(03)		0.8(0.7-1.0)	0.8(0.7-1.1)
Type of house			0.33		
Katcha	2717	78(03)		Ref	-
Pucca	4462	142(03)		1.1(0.8-1.5)	-
Semi-pucca	3560	126(04)		1.2(0.9-1.6)	-

#-Bold significance p<0.05, @ <20 years, MBC – Most Backward Castes, SC- Scheduled Castes, ST – Scheduled Tribes, OC – Other Castes, .$-Widow, Widower, Separated

References

1. Unnikrishnan R, Anjana RM, Mohan V. Diabetes mellitus and its complications in India. Nat. Rev. Endocrinol. Nature Publishing Group; 2016. p. 357–70.
2. Federation ID, Atlas ID. International Diabetes Federation. IDF diabetes atlas, 6th edn Brussels, Belgium Int Diabetes Fed. 2013;
3. Atlas IDFD. Brussels: International Diabetes Federation; 2011. Int Diabetes Fed Sch. 2018;
4. Manjunath K, Christopher P, Gopichandran V, Rakesh PS, George K, Prasad JH. Quality of life of a patient with type 2 diabetes: a cross-sectional study in rural South India. J Fam Med Prim care. 2014;3:396–9.
5. Ministry of Helath and Family Welfare G of I. National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS). New Delhi; 2017.
6. Anitha Rani M, Shriraam V. Are Patients With Type 2 Diabetes Not Aware or Are They Unable to Practice Self-Care? A Qualitative Study in Rural South India. J Prim Care Community Health. 2019;10:2150132719865820.
7. Majella MG, Chinnakali P, Naik BN, Thekkur P, Nag B, Ramaswamy G. How much do persons with diabetes in a rural area of South India know about diabetes management? A step toward person-centered care. J Fam Med Prim care. 2017;6:605–9.
8. George H, Rakesh P, Krishna M, Alex R, Abraham VJ, George K, et al. Foot care knowledge and practices and the prevalence of peripheral neuropathy among people with diabetes attending a secondary care rural hospital in southern India. J Fam Med Prim care. 2013;2:27–32.
9. Deepa M, Bhansali A, Anjana RM,

   Pradeepa R, Joshi SR, Joshi PP, et al. Knowledge and awareness of diabetes in urban and rural India: The Indian Council of Medical Research India Diabetes Study (Phase I): Indian Council of Medical Research India Diabetes 4. Indian J Endocrinol Metab. 2014;18:379–85.
10. Chobanian A V, Bakris GL, Black HR, Cushman WC, Green LA, Izzo Jr JL, et al. The seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure: the JNC 7 report. Jama. American Medical Association; 2003;289:2560–71.
11. Epidata Association. Epidata Software [Internet]. 2014 [cited 2019 Aug 8]. Available from: https://www.epidata.dk/about.htm#about
12. IBM corporation. IBM SPSS Statistics, India [Internet]. 1989 [cited 2019 Oct 1]. Available from: https://www.ibm.com/in-en/analytics/spss-statistics-software
13. Stata Corp LLC. Stata data analysis and statistical Software [Internet]. [cited 2020 Mar 10]. Available from: https://www.stata.com/company/
14. Anjana RM, Pradeepa R, Deepa M, Datta M, Sudha V, Unnikrishnan R, et al. Prevalence of diabetes and prediabetes (impaired fasting glucose and/or impaired glucose tolerance) in urban and rural India: Phase i results of the Indian Council of Medical Research-INdia DIABetes (ICMR-INDIAB) study. Diabetologia [Internet]. Diabetologia; 2011 [cited 2020 Jul 28];54:3022–7. Available from: https://pubmed.ncbi.nlm.nih.gov/21959957/
15. Little M, Humphries S, Patel K, Dodd W, Dewey C. Factors associated with glucose tolerance, pre-diabetes, and type 2 diabetes in a rural community of south India: a cross-sectional study. Diabetol Metab Syndr. 2016;8:21.
16. Mohan V, Prathiba V, Pradeepa R. Tele-diabetology to Screen for

Diabetes and Associated Complications in Rural India: The Chunampet Rural Diabetes Prevention Project Model. J Diabetes Sci Technol. 2014;8:256–61.
17. Sharifirad G, Shojaezadeh D, Tavasoli E, Azadbakht L, Tol A. Socio-economic factors and diabetes consequences among patients with type 2 diabetes. J Educ Health Promot. Medknow; 2013;2:12.
18. The NCD Aliance. NCD Alliance Position Paper: Post-2015 Global Health Thematic Consultation. 2015.
19. Ebrahim S, Kinra S, Bowen L, Andersen E, Ben-Shlomo Y, Lyngdoh T, et al. The effect of rural-to-urban migration on obesity and diabetes in India: a cross-sectional study. PLoS Med. 2010;7:e1000268.
20. Zaman FA, Borang A. Prevalence of diabetes mellitus amongst rural hilly population of North Eastern India and its relationship with associated risk factors and related co-morbidities. J Nat Sci Biol Med. 2014;5:383–8.
21. Ghorpade AG, Majgi SM, Sarkar S, Kar SS, Roy G, Ananthanarayanan PH, et al. Diabetes in rural Pondicherry, India: a population-based studyof the incidence and risk factors. WHO South-East Asia J public Heal. India; 2013;2:149–55.
22. Tonstad S, Stewart K, Oda K, Batech M, Herring RP, Fraser GE. Vegetarian diets and incidence of diabetes in the Adventist Health Study-2. Nutr Metab Cardiovasc Dis. Nutr Metab Cardiovasc Dis; 2013;23:292–9.
23. Olfert MD, Wattick RA. Vegetarian Diets and the Risk of Diabetes. Curr. Diab. Rep. Current Medicine Group LLC 1; 2018.
24. Agrawal S, Millett CJ, Dhillon PK, Subramanian S, Ebrahim S. Type of vegetarian diet, obesity and diabetes in adult Indian population. Nutr J. BioMed Central Ltd.; 2014;13.
25. Deng A, Pattanaik S, Bhattacharya A, Yin J, Ross L, Liu C, et al. Fish consumption is associated with a decreased risk of death among adults with diabetes: 18-year follow-up of a national cohort. Nutr Metab Cardiovasc Dis [Internet]. Elsevier B.V.; 2018 [cited 2020 Aug 2];28:1012–20. Available from: https://pubmed.ncbi.nlm.nih.gov/30017435/
26. Hua L, Lei M, Xue S, Li X, Li S, Xie Q. Effect of fish oil supplementation combined with high-intensity interval training in newly diagnosed non-obese type 2 diabetes: A randomized controlled trial. J Clin Biochem Nutr [Internet]. The Society for Free Radical Research Japan; 2020 [cited 2020 Aug 2];66:146–51. Available from: https://pubmed.ncbi.nlm.nih.gov/32231411/
27. Gao C, Liu Y, Gan Y, Bao W, Peng X, Xing Q, et al. Effects of fish oil supplementation on glucose control and lipid levels among patients with type 2 diabetes mellitus: A Meta-analysis of randomized controlled trials. Lipids Health Dis [Internet]. BioMed Central Ltd.; 2020 [cited 2020 Aug 2];19. Available from: https://pubmed.ncbi.nlm.nih.gov/32384902/

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