

## Original Research Article

# Prevalence of type 2 diabetes mellitus in rural population of India- a study from Western Uttar Pradesh

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### ABSTRACT

**Background:** Diabetes is a major challenge for a resource-limited country like India. Majority of the patients are diagnosed late in the course of illness with presence of complications. There is limited data on diabetes from rural India. Present study is an attempt to provide data on diabetes in rural India. The overall objective of present study was to estimate the prevalence of Type 2 diabetes mellitus in rural population above 25 years age in district Etawah and neighbouring areas of Uttar Pradesh, India.

**Methods:** The study was planned to determine the prevalence of diabetes mellitus in rural community by health camp and door to door approach. Fasting capillary blood glucose was first determined using a glucose meter (SD check code free, SD biosensor Inc. Korea). All the adults were given 75gm of glucose dissolved in 200ml water which was drunk over a period of up to 5 minutes and the 2-hour post load capillary blood glucose was estimated. Diabetic status was confirmed by taking blood samples for fasting and postprandial blood sugar levels in a fluoride vacutainer. Fasting plasma glucose  $\geq 126$ mg/dl and or 2-hour postprandial glucose  $\geq 200$ mg/dl were taken as the diagnostic criteria for diagnosis.

**Results:** Prevalence of type 2 diabetes in the rural population was found to be 8.03%. Prevalence was higher in female population (9.91%) as compared to males (6.79%). 19.74 % of participants over 70 yrs of age were diabetics while diabetes was present only in 2.95% of participants in the age group of 25-39 year. The maximum number of diabetes were in the age group of 50-59 years. 10.04 % of participants were diagnosed to be Prediabetics. 35.77% of the diabetics were newly diagnosed.

**Conclusions:** Present study shows there is high prevalence of type 2 diabetes in rural area of western Uttar Pradesh, India.

**Keywords:** Blood glucose, Prediabetes, Rural India, Type 2 diabetes mellitus

### INTRODUCTION

Diabetes mellitus (DM) refers to a group of common metabolic disorders that share the phenotype of hyperglycaemia with disturbance of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action or both. Several distinct types of DM are caused by a complex interaction of genetics and

environmental factors. Depending on the etiology of the DM, factors contributing to hyperglycaemia include reduced insulin secretion, decreased glucose utilization and increased glucose production.<sup>1</sup> Ancient Indian texts make mention of the disease "Madhumeha" which would correspond to the modern term "Diabetes mellitus", suggesting that diabetes must have been present in India even before 2500 BC. Although there is no evidence as to

how prevalent the condition was, a recent article hypothesizes that it could have been quite common in India, even in ancient times.<sup>2</sup>

The Indian Council of Medical Research India Diabetes Study (ICMR-INDIAB study) showed that India had 62.4 million people with diabetes in 2011. These numbers are projected to increase to 101.2 million by 2030.<sup>3</sup>

According to world diabetes atlas close to one-fifth of all adults with diabetes in the world live in the South-East Asia Region. Current estimates indicate that 8.8% of the adult population, or 78.1 million people, have diabetes, 69.2 million of whom live in India. The number of people with diabetes in India will increase to 123 million by 2040- 12.1% of the adult population. A further 36.5 million people have IGT, and this will increase to 65.3 million by 2040. India has the second highest prevalence of diabetes among adults at 9.1% in the south East Asian region. About 1.1 million people die from diabetes related illnesses in India every year.<sup>4</sup>

It has been estimated by IDF that in India as many as more than half (52.1%) of all people with diabetes, are unaware of their disease.<sup>4</sup> Even among known diabetes patients, less than one third have their diabetes under good control.<sup>5,6</sup> There is also evidence to show that poverty and poor access to health care, coupled with low education, are linked to a high rate of diabetes related complications.<sup>7,8</sup>

Unfortunately, the vast majority of India's population (70%) lives in rural areas.<sup>9</sup> Screening for diabetes is seldom done in rural areas, resulting in a much greater burden of undiagnosed diabetes in rural areas.<sup>4</sup> Most of these cases are type 2 diabetes. The earlier a person is diagnosed and management initiated, the better the chances of preventing harmful and costly complications. There is an urgent need to screen, diagnose and provide appropriate care to people with diabetes. Diabetes is traditionally known as a "silent disease," exhibiting no symptoms until it progresses to severe target organ damage. Case detection, therefore, requires active and opportunistic screening efforts.<sup>10</sup>

There were several studies done for the prevalence of Type 2 diabetes mellitus but most of them were conducted in urban setting. Present study was therefore undertaken to find out the prevalence of types 2 diabetes in the rural area of Western Uttar Pradesh, India.

## METHODS

Present study was conducted in rural areas around the Uttar Pradesh University of Medical Sciences in the neighbouring districts of Etawah and Mainpuri for duration of 1<sup>st</sup> January 2015 to 31<sup>st</sup> December 2016. A total of 4244 participants were screened for presence of diabetes.

### *Inclusion criteria*

- Age above 25 years
- Fasting for ten hours prior to screening
- Willing to give informed consent

### *Exclusion criteria*

- Secondary causes of hyperglycaemia such as pregnancy, corticosteroid therapy and other pharmacotherapy leading to hyperglycaemia, chronic calcific pancreatitis or any other organic disease causing hyperglycaemia.
- Known cases of type 1 diabetes.
- Patients living in urban areas.

Participants were recruited via the health camp approach. Local panchayats and village heads were consulted to ensure maximum participation. After written or verbal informed consent was obtained, informants were given a unique study identification number to de-identify the informants at the point of collection. Participants then completed a brief survey form in which basic demographic information including address, age and gender. In order to standardise the blood glucose measurements, participants were requested to attend the survey early in the morning, after an overnight fast of 8-12 hours. Fasting capillary blood glucose was first determined using a glucose meter (SD check code free, SD biosensor Inc. Korea) All the adults were given 75gm of glucose dissolved in 250-300ml water which was drunk over a period of up to 5 minutes and the 2-hour post load capillary blood glucose was estimated.

Diabetes was defined on fulfilment of criteria laid down by the WHO consultation group report and international diabetes federation IDF, i.e. plasma fasting blood glucose  $\geq 126$ mg/dl or 2-hour plasma post-glucose value  $\geq 200$ mg/dl OR HbA1c  $> 6.5\%$  and known cases of type 2 diabetes mellitus. Prediabetes was diagnosed on plasma fasting blood glucose 100mg/dL (5.6mmol/L) to 125mg/dL (6.9mmol/L) (impaired fasting glucose) or 2-hour plasma post-glucose value 140mg/dL (7.8mmol/L) to 199mg/dL (11.0mmol/L) (impaired glucose tolerance).<sup>4</sup>

The participants diagnosed as Diabetics were then asked to follow up in our institute for further evaluation. Diabetic status was confirmed by taking blood samples for fasting and postprandial blood sugar levels and HbA1c which were then measured in biochemistry lab using by kit based GOD-POD method and immunoturbidimetric methods respectively.

Statistical analysis of data was performed using Statistical Package for Social Sciences version 21.0. Categorical variables were expressed as absolute number and percentage and continuous variables were expressed as mean and standard deviation (SD).

## RESULTS

Demographic characteristics of study population are presented in Table 1. Majority of the participants were between 25 to 39 years of age. This age group included 47.88% (2032 out of 4244) of the study population. 833 participants were between the age group of 40 to 49 years. 769 participants were between the age group of 50 to 59 years. In 60 to 69 years' age group, there were 458 participants. In above 70-year age group, there were 152 participants. Maximum age was 85 years. Mean age was 42.58±9.4 years. Female population constituted 39.96% (1696 out of 4244) of the study population. Male study

population constituted 60.04% of the total study population.

**Table 1: Age distribution of study population.**

Age (in years)	No. of participants	Percentage
25-39	2032	47.88%
40-49	833	19.63%
50-59	769	18.12%
60-69	458	10.79%
≥70	152	4%
Total	4244	100.00%

**Table 2: Sex distribution of diabetics.**

Sex	No. of diabetics	Percentage	No. of prediabetics	Percentage
Total	341	8.03%	426	10.04%
Male	173	6.79%	187	7.34%
Female	168	9.91%	239	14.09%

**Table 3: Age distribution of diabetic patients.**

Age (in years)	No. of diabetics	Percentage of participants in the age group	Percentage of total diabetics
25-39	60	2.95%	17.60 %
40-49	77	9.24%	22.60 %
50-59	100	13.00%	29.30 %
60-69	74	16.16%	21.70 %
≥70	30	19.74%	8.8 %

**Table 4: Mean age, anthropometric data and biochemical profile of diabetic patients.**

Characteristics	Sex		Total
	Males	Females	
Age	51.62±12.3	51.83±11.74	51.72±12.36
Duration of diabetes (years)	4.59±2.3	3.33±1.69	3.97±2.5
BMI	25.27±4.08	25.19±4.40	25.23±4.2
FBS	196.63±77.79	190.84±61.321	193.74±70.02
PPBS	323.70±97.06	322.01±98.90	322.85±97.86
HbA1C	9.16±2.1	8.98±2.2	9.07±2.15

BMI= Body mass index, FBS= Fasting blood sugar, PPBS= Post prandial blood sugar, HbA1c= Glycated haemoglobin.

Prevalence of type 2 diabetes in the rural population was found to be 8.03%. Prevalence was higher in female population (9.91%) as compared to males (6.79 %). 10.04% of participants were diagnosed to be prediabetics. Females had more prevalence of prediabetes (14.09 %) as compared to males (7.34 %) (Table 2).

Prevalence of diabetics increased with age 19.74% of participants over 70 years of age were diabetics while only 2.95% of participants in the age group of 25-39 year. The maximum number of diabetes were in the age group of 50-59 yrs followed by 40-49 years and 60-69 years (Table 3). 35.77% of the diabetics were newly diagnosed i.e. diagnosed during the study while 64.23% were

known diabetics. Mean age of diabetic population was 51.72 years. Mean duration of diabetes was 3.97 years. Average BMI was 25.23kg/m<sup>2</sup>. Average FBS was 193.74mg/dl. Average PPBS was 322.85mg/dl. Average HbA1c was 9.07. The mean characteristic of both male and female were similar except for duration of diabetes which was lower for females (3.3 year compared to 4.59 year for males) (Table 4).

## DISCUSSION

Being situated in a rural setup of Saifai which is 20km from the district Headquarter of Etawah, Uttar Pradesh India, provided us with a unique opportunity to detect this burden of undiagnosed diabetics and provide diagnostic

and management facilities to the diagnosed patients for prevention and management of diabetic complications.

In the present study, we had recruited 4244 participants out of which 341 (8.03%) were diagnosed as diabetics with prevalence of diabetes amongst males being 6.79% and females was 9.91%. Females had a higher prevalence most probably due to poor exposure to health care facilities, poor education and poor health care seeking behavior as evident by more females being newly diagnosed i.e. 54% despite only being 39% of the study population. This is similar to finding of Ahmad et al who also showed that prevalence of diabetes was higher in females.<sup>11</sup>

In large metropolitan cities in India (Mumbai, Delhi, Calcutta, Chennai, Bangalore, and Hyderabad), the prevalence of diabetes among adults (aged  $\geq 20$  years) ranges from 8-18%.<sup>12-21</sup> The prevalence of type 2 diabetes mellitus is 3-9% in rural areas.<sup>22</sup> Few studies have shown prevalence as high as 13.2% in rural areas.<sup>23</sup> Many studies suggest that it is rapidly increasing even in rural areas.<sup>23,24</sup>

The prevalence of prediabetics in the present study was 10.4%. In the ICMR-INDIAB study the rural prevalence of prediabetes was 7.4%, 8.1%, 14.6% and 11.4% respectively for Tamil Nadu, Jharkhand Chandigarh and Maharashtra, India.<sup>3</sup>

The Age wise prevalence of diabetes in present study was 2.94% for 25-39 year, 9.24% for 40-49 year, 13.0% for 50-59 year, 16.16% for 60-69 year and 19.74% for >69 years which is similar to the findings by Shrivastava S and Ghorpade who found prevalence of diabetes as 19.8% (60-69 years), 17.1% (40-49 years), 16.8% (50-59 years), and 13.6% (>69 years) amongst 958 study subjects in rural Pondicherry.<sup>25</sup>

The prevalence of newly diagnosed diabetics was very high i.e. 35.77% of diabetics which equates to 2.87% of the study population. This is similar to the findings of Vijaykumar G et al who reported a population prevalence of new diabetics to be 2.6%.<sup>26</sup> Little et al found the prevalence of newly diagnosed diabetics in rural Kerala to be 41.8% of total diabetics.<sup>27</sup> This high prevalence of undiagnosed diabetics might have emphasized upon poor healthcare-seeking behaviour of the study population.

## CONCLUSION

In conclusion, diabetes is highly prevalent in rural population of western Uttar Pradesh, India. If prediabetics are taken into consideration almost twenty percent of population is exposed to the deleterious effects of hyperglycaemia. Such patients are at risk of development of complications and hence early diagnosis and treatment is essential for these patients. More and more studies are needed to find out the prevalence of diabetes in rural area, which in turn will reflect the true

overall picture of the prevalence of diabetes in Indian population. As high as 35% of the diabetics were newly diagnosed during the course of study. This implies that many of them would have developed complications by the time they would have been ultimately diagnosed. The study emphasizes the need for improvement in knowledge and awareness, both among the general population as well as diabetic subjects in order to achieve prevention and better control of diabetes and its complications.

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## REFERENCES

1. Classification of diabetes mellitus and other categories of glucose intolerance. In: Alberti K, Zimmet P, De Fronzo R, eds. *International Textbook of Diabetes Mellitus*. Chichester: John Wiley and Sons Ltd; 1997:9-23.
2. Tipton MC. Susruta of India, an unrecognised contributor to the history of exercise physiology. *J Appl Physiol*. 2008;108:1553-6.
3. 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*. 2011;54:3022-7.
4. International Diabetes Federation. *IDF Diabetes Atlas*, 7th edition. Brussels, Belgium: International Diabetes Federation. 2015;7:55-63.
5. Deepa M, Deepa R, Shanthirani CS, Datta M, Unwin NC, Kapur A, et al. Awareness and knowledge of diabetes in Chennai-The Chennai urban rural epidemiology study (CURES-9). *J Assoc Physic India*. 2005;53:283-7.
6. Joshi SR, Das AK, Vijay VJ, Mohan V. Challenges in diabetes care in India: sheer numbers, lack of awareness and inadequate control. *J Assoc Physic India*. 2008;56:443-50.
7. Ramachandran A, Snehalatha C, Vijay V, King H. Impact of poverty on the prevalence of diabetes and its complications in urban southern India. *Dia Med*. 2002;19:130-5.
8. Kapur A, Bjork S, Nair J, Kelkar S, Ramachandran A. Socio-economic determinants of the cost of diabetes in India. *Dia Voice*. 2004;49:18-21.
9. Census of India. Rural urban distribution of population. office of the registrar general and census commissioner, India. Available from: [http://censusindia.gov.in/2011-prov-results/paper2/data\\_files/india/Rural\\_Urban\\_2011.pdf](http://censusindia.gov.in/2011-prov-results/paper2/data_files/india/Rural_Urban_2011.pdf). (Accessed on 7 nov 2016).
10. International Diabetes Federation. *The human, social and economic impact of diabetes*. Available from: <http://www.idf.org/home/index.cfm?node=41>.
11. Ahmad J, Masoodi MA, Mohd A, Rahid R, Ahmad R, Ahmad A, et al. Prevalence of diabetes mellitus and its

- associated risk factor in age group of 20 years and above in Kashmir, India. *AI Ameen J Med Sci.* 2011;4(1):38-44.
12. Iyer SR, Iyer RR, Upasani SV, Baitule MN. Diabetes mellitus in Dombivli-an urban population study. *J Assoc Physicians India.* 2001;49:713-6.
  13. Misra A, Pandey RM, Devi JR, Sharma R, Vikram NK, Khanna N. High prevalence of diabetes, obesity and dyslipidaemia in urban slum population in Northern India. *Int J Obes Relat Metab Disord.* 2001;25:1722-9.
  14. Prabhakaran D, Shah P, Chaturvedi V, Ramakrishnan L, Manhapra A, Reddy KS. Cardiovascular risk factor prevalence among men in a large industry of Northern India. *Natl Med J India.* 2005;18:59-65.
  15. Ramachandran A, Snehalatha C, Kapur A, Vijay V, Mohan V, Das AK, et al. Diabetes epidemiology study group in India. High prevalence of diabetes and impaired glucose tolerance in India: national urban diabetes survey. *Diabetologia.* 2001;44:1094-101.
  16. Ramachandran A, Snehalatha C, Latha E, Vijay V, Viswanathan M. Rising prevalence of NIDDM in urban population of India. *Diabetologia.* 1997;40:232-7.
  17. Mohan V, Shanthirani CS, Deepa R. Glucose intolerance (diabetes and IGT) in a selected South Indian population with special reference to family history, obesity and lifestyle factors- The Chennai urban population study (CUPS 14). *J Assoc Physic India.* 2003;51:771-7.
  18. Ramachandran A, Snehalatha C, Baskar AD, Mary S, Kumar CK, Selvam 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.* 2004;47:860-5.
  19. Mohan V, Deepa M, Deepa R, Shanthirani CS, Farooq S, Ganesan A, et al. Secular trends in the prevalence of diabetes and glucose tolerance in urban South India-the Chennai urban rural epidemiology study (CURES-17). *Diabetologia.* 2006;49:1175-8.
  20. 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;31:893-8.
  21. Bai PV, Krishnaswami CV, Chellamariappan M. Prevalence and incidence of type-2 diabetes and impaired glucose tolerance in a selected Indian urban population. *J Assoc Physic India.* 1999;47:1060-4.
  22. K Park. Park's Textbook of preventive and social medicine. 20th edition. Jabalpur India: M/s Banarsidas Bhanot; 2009:341-345.
  23. Chow CK, Raju PK, Raju R, Reddy KS, Cardona M, Celermajer DS, et al. The prevalence and management of diabetes in rural India. *Dia Care.* 2006;29:1717-8.
  24. Deo SS, Zantye A, Mokal R, Mithbawkar S, Rane S. To identify the risk factors for high prevalence of diabetes and impaired glucose tolerance in Indian rural population. *Int J Diab Dev Countries.* 2006;26:19-23.
  25. Shrivastava S, Ghorpade A. (2014). High prevalence of type 2 diabetes mellitus and its risk factors among the rural population of Pondicherry, South India. *J Res Health Sci.* 2014;14(4):258-63
  26. Vijayakumar G, Arun R, Kutty VR. High prevalence of type 2 diabetes mellitus and other metabolic disorders in rural Central Kerala. *J Assoc Physic India.* 2009;57:563-7.
  27. 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):3-11.

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