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Original Research Article

Prevalence of pre-diabetes and its associated risk factors among people in rural field practice area of Vydehi Institute of Medical Sciences and Research Centre, Bangalore

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ABSTRACT

Background: India harbours a significant diabetic population, with over 60 million adults affected, a substantial proportion of whom remain undiagnosed or untreated, elevating the risk of complications and premature mortality. Identifying prediabetes and advocating lifestyle modifications become imperative in such a scenario. This research aimed to gauge the prevalence of prediabetes and associated factors among adults in the rural field practice area of Vydehi institute of medical sciences and research centre, Bengaluru.
Methods: A cross-sectional study targeted individuals above 30 years in Vydehi institute of medical sciences and research centre's rural field practice area. A house-to-house survey screened for prediabetes.
Results: Among 895 subjects, 128 (14.3%) exhibited prediabetic conditions. Prediabetes was notably prevalent in the 36-40 age group (18.8%), with 52.3% being males. A majority (77.4%) lacked a family history of diabetes, and 62.5% belonged to the lower-middle class. Sedentary lifestyles were prevalent (83.6%), with 83.6% consuming mixed diets. Elevated BMI was common, and a statistically significant association existed between BMI, waist circumference, and prediabetes ($p<0.05$). Similarly, education level significantly correlated with blood glucose control ($p<0.01$). Merely 7.0% of subjects were aware of prediabetes, mainly through health personnel.
Conclusions: The study highlights a high prediabetes prevalence, coupled with low awareness and knowledge of blood sugar control. It underscores the necessity for strategic screening and intervention programs in the community to forestall prediabetes progression to diabetes.

Keywords: Prediabetes, Obesity, Diabetes, Rural

INTRODUCTION

Diabetes and its associated complications have become a serious health concern in the present decade. Because of rapid economic development and an increase in life expectancy, the number of individuals suffering from diabetes is increasing rapidly. International Diabetes Federation has estimated that worldwide the number of adult people aged between 20 to 79 years with diabetes will increase from 463 million in 2019 to 700 million by 2045.[1]

According to the US department of health and human services and American diabetes association "prediabetes" can be defined as a condition wherein the blood glucose level is above the normal level but below the threshold value of diabetes. These persons have a higher chance of developing diabetes in later life. Presently around the

world, approximately 373.9 million people are suffering from prediabetes and are at high risk of developing type 2 diabetes in the future. Among these prediabetic population 72.2% subjects live in middle- and low-income countries.[1] South East Asian countries contribute 11.8% of the diabetic and 7.7% of the prediabetic population of the world.[2]

In India, studies have shown that over a period of 3 years to 5 years nearly 40% to 50% of the prediabetic will develop type 2 diabetes.[3,4] In a large community-based cross-sectional study conducted in 15 states across India has shown that the prevalence of prediabetes is quite high in Northern India compared to the other sections of the country. This study has also shown that in the Southern part the occurrence of prediabetes was higher in person from the lower socioeconomic condition.[5]

In addition, studies have also pointed out several risk factors that are related to the prediabetes condition such as increased age, obesity, sedentary lifestyle, high blood pressure, smoking, alcoholism, and dyslipidemia.[6,7] In a cross-sectional study conducted among rural adults of Tamil Nadu has shown that the clustering risk factors such as male gender, age over 40 years, alcohol intake, systolic blood pressure high than 140 mm of Hg, and higher BMI are positively associated with the higher risk of being prediabetic.[8] Researchers believe that prediabetes represents only the tip of the problem named diabetes which can in the future leads to associated cardiovascular, renal and other highly morbid conditions. Hence, an early intervention and risk assessment can only save individuals from future complications of diabetes. In lieu of these epidemiological studies that can estimate the prevalence of prediabetes and can point out the associated risk factors are on demand.

However, no such epidemiological study was conducted in rural areas of Bangalore. There are only a few interventional studies and mostly they have been hospital-based studies. Therefore, this present study was taken up in the rural field practice area of Vydehi institute of medical sciences and research centre to investigate the prevalence of pre-diabetes and explore the risk factors associated with it.

METHODS

This cross-sectional study was conducted among the prediabetic patients of rural field practice area of VIMS and RC, Bangalore from July 2014 to October 2015. Total of 895 subjects above the age group of 30 years was screened for prediabetes by the house-to-house survey to achieve the sample size of 128. The inclusion criteria consisted of all the individuals who were newly diagnosed pre-diabetic subjects aged between 30 years and above residing permanently in the rural field practice area of Vydehi Institute of Medical Sciences and Research Centre with fasting glucose level of 100 mg/dl to 125 mg/dl and postprandial glucose level between 140 mg/dl to 199 mg/dl. Individuals who were already diabetic patients and seriously ill patients were excluded from the study.

A prior ethical certificate was obtained from the ethical committee of the institution. After the patients were included in the study, they were instructed to fill the patient consent forms and data on different parameters were noted down. Data obtained was coded and entered into Microsoft excel worksheet. This was analyzed using MS excel, SPSS version 21 and Open EPI version 3.01. The frequency distribution of the study subjects according to age, gender, religion, educational status, occupation, socioeconomic status was analyzed. To find the association between the factors, Chi-square test and Fisher exact test were applied. The statistical significance was evaluated at 5% level of significance.

RESULTS

Out of 895 subjects screened 128 were found to be prediabetic. The mean age of the study subjects was 46.8±8.25 years, 38 (29.7%) were in age group of 31-40 years, 45 (35.15%) aged between 41-50 years and 45 (35.15%) of them aged between 51-60 years. Mean BMI of study subjects was 25.5±2.1 kg/m^2. Obesity classification for Asians was used to categorize body mass index. Out of 128 subjects, 49 (38.3%) were in over weight category, 65 (50.8%) were obese grade 1 category, 6 (4.7%) were in obese grade 2 category and only 8 (6.2%) were in normal category.

The gender wise demographic and anthropometric information is detailed in Table 1. Women were comparatively younger than men but the age difference was not statistically significant (47.0±8.0 vs 46.6±8.5 years; p=0.7). The mean abdominal circumference of males was significantly higher than that of females (94.1±5.7 vs 87.8±7.4 1 kg/m^2; p<0.0001). There was no significant difference in systolic blood pressure and diastolic blood pressure. Gender difference was noted in fasting blood glucose (115.5±5.3 vs 113.0±6.2 mg/dl; p=0.025). There was significant gender difference in alcohol consumption, smoking and Indian diabetic risk score. There was no significant gender difference in family history of diabetes mellitus.

Among the prediabetics 122 (95.3%) had heard about diabetes and majority obtained information from health personnel (69.5%) and through family members (48.4%), 19 (14.8%) came to know through friends and 40 (31.3%) through media. Out of 128 subjects 9 (7.0%) knew what is prediabetes and got information from health personnel (Table 2).

Among 128 subjects 113 (88.3%) knew at least one risk factor for diabetes mellitus, 67 (52.3%) answered presence of family history of diabetes would lead to diabetes in future, 58 (45.3%) of them answered consuming sweets would lead to diabetes, 18 (14.2%) of

them answered age more than 35 years will lead to diabetes, 46 (35.9%) answered over weight or obesity would lead to diabetes, 38 (29.7%) answered lack of exercise would lead to diabetes, 4 (3.1%) answered smoking would lead to diabetes and 3 (2.3%) answered consumption of alcohol would lead to diabetes. 15 (11.7%) did not know who were at risk for developing diabetes. Frequent urination was the most common reported symptom of diabetes by 87 subjects (68%) followed by excess thirst (39.1%), 9 (7.0%) reported tiredness as early symptom and 22 (19.2%) did not know the symptoms of diabetes (Table 2).

The present study shows that literacy status has an important role in knowledge about control of blood glucose. According to this study the maximum number of people 90 (90%) educated up to high school had knowledge regarding control of blood glucose. Of the 17 people who were illiterate 52.9 % of them did not know that blood glucose could be controlled. There was strong association ($p<0.01$) suggesting that the knowledge on control of blood glucose was highly associated with educational level of the participants (Table 3).

Majority of the prediabetics had increased waist circumference (85.2%) and majority were found to be obese (57.8%) category. The association between body mass index and waist circumference was found statistically significant ($p<0.05$) (Table 4).

In this study 88.3% of the participants denied alcohol consumption and 81.3% of them denied tobacco use.

Table 1: Demographic and anthropometric details of study subjects.

Characteristics	Total, (n=128) (%)	Men, (n=67) (%)	Women, (n=61) (%)	P value
Values are mean and SD				
Age (in years)	46.8±8.25	47.0±8.0	46.6±8.5	0.7
BMI (kg/m^2)	25.5±2.1	25.34±1.8	25.64±2.4	0.4
Abdominal circumference (cm)	91.1±7.3	94.1±5.7	87.8±7.4	<0.0001
Blood pressure (mm/Hg)				
Systolic	119.2±10.7	120.5±10.7	117.7±10.6	0.14
Diastolic	76.5±7.4	77.3±8.4	75.6±6.2	0.19
Blood glucose (mg/dl)				
FBS	114.3±5.8	115.5±5.3	113.0±6.2	0.025
PPBS	156.8±8.7	157.2±8.4	156.4±9.1	0.6
Occupation				
Managerial	4 (3.1)	4 (6)	0	<0.0001
Clerical	5 (3.9)	5 (7.5)	0	
Skilled	21 (16.4)	18 (26.9)	3 (4.9)	
Unskilled	97 (75.8)	39 (58.2)	58 (95.1)	
Unemployed	1 (0.8)	1 (1.5)	0	
Education				
Illiterate	17	7 (10.4)	10 (16.4)	0.2
Literate	111	60 (89.6)	51 (83.6)	
Family history of diabetes mellitus				
Absent	99 (77.3)	50 (74.6)	49 (80.3)	0.7
one parent	27 (21.1)	16 (23.9)	11 (18.0)	
Both parents	2 (1.6)	1 (1.5)	1(1.6)	
Socio economic class				
Upper	3 (2.3)	2 (3.0)	1 (1.6)	0.272
Upper middle	29 (22.7)	16 (23.9)	13 (21.3)	
Lower middle	80 (62.5)	43 (64.2)	37 (60.7)	
Upper lower	16 (12.5)	6 (9.0)	10 (16.4)	
Diet				
Vegetarian	21 (16.4)	9 (13.4)	12 (19.7)	0.476
Mixed	107 (83.6)	58 (86.6)	49 (80.30)	
Exercise				
Sedentary	108 (84.40	56 (83.6)	52 (85.2)	0.796
Moderate	20 (15.6)	11 (16.4)	9 (14.8)	
Alcohol consumption				
Absent	113 (88.3)	53 (79.1)	60 (98.4)	0.003
Occasional	5 (3.9)	4 (6.0)	1 (1.6)	
Regular	10 (7.8)	10 (14.9)	0 (0)	

Continued.

Characteristics	Total, (n=128) (%)	Men, (n=67) (%)	Women, (n=61) (%)	P value
Smoking				
Absent	104 (81.3)	44 (65.7)	60 (98.4)	<0.0001
Occasional	4 (3.1)	3 (4.5)	1 (1.6)	
Regular	20 (15.6)	20 (29.9)	0 (0.0)	
IDRS score				
Low risk	20 (15.6)	11 (16.4)	9 (14.8)	0.04
Medium risk	55 (43.0)	36 (53.7)	19 (31.1)	
High risk	53 (41.4)	20 (29.9)	33 (54.1)	
SLI				
Medium	43 (33.6)	20 (29.9)	23 (37.7)	0.347
High	85 (66.4)	47 (70.1)	38 (62.3)	

Table 2: Source of information, knowledge regarding risk factors and symptoms of diabetes mellitus (n=128).

Variables	N	Percentage (%)
Source of information		
Health personnel	89	69.5
Friends	19	14.8
Family member	62	48.4
Television or radio	40	31.3
Newspaper	34	26.6
Knowledge regarding risk factors of diabetes mellitus		
Family history of diabetes	67	52.3
Consuming more sweets	58	45.3
Age more than 35 years	18	14.1
Overweight or obese	46	35.9
Lack of exercise	38	29.7
Smoking	4	3.1
Alcohol	3	2.3
Lack of knowledge	15	11.7
Knowledge regarding symptoms of diabetes mellitus		
Frequent urination	87	68.0
Excess thirst	50	39.1
Tiredness	9	7.0
Loss of appetite	4	3.1
Vision problem	4	3.1
Lack of knowledge	22	19.2

Table 3: Association between knowledge regarding blood glucose control and education.

Education level	Knowledge of blood glucose control, N (%)		Total, (n=128) (%)
	Yes, (n=109)	No, (n=19)	
Illiterate	8 (47.1)	9 (52.9)	17 (13.3)
Primary to high school	90 (90.0)	10 (10.0)	100 (78.1)
PUC-graduate	11 (100.0)	0 (0.0)	11 (8.6)
Total	109 (85.2)	19 (14.8)	128 (100)

$\chi 2$= 23.3, df= 2, p<0.01

Table 4: Association between waist circumference and body mass index.

Waist circumference	Body mass index (kg/m^2), N (%)			Total, (n=128) (%)
	Normal, (n=08)	Over weight, (n=49)	Obese, (n=71)	
Normal	4 (21.1)	7 (36.8)	8 (42.1)	19 (14.8)
Increased	4 (3.7)	42 (38.5)	63 (57.8)	109 (85.2)
Total	8 (6.2)	49 (38.3)	71 (55.5)	128 (100)

$\chi 2$=8.55, df= 2, p=0.013.

DISCUSSION

Prediabetes at present is an alarming condition that poses a great health threat and is an extremely important problem. The prevalence of prediabetes among individuals is more than diabetes. According to a survey in India, 14% population is suffering from prediabetes. However, in most of the cases, prediabetes remains an asymptomatic condition making the identification process more difficult.[9] Therefore, identification of prediabetes and its associated risk factor is needed so as to have a significant therapeutic impact.

The prevalence of prediabetes was found to be 14.3%. in the present study. This prevalence is higher than findings by Muthunarayanan et al in a study conducted among rural people from Tamil Nadu and by Ahmed et al in a study conducted in Kashmir among people aged 20 years and above.[8,10] However, this finding is similar to the finding by Balagopal et al. In this study they have reported a 13.5% prevalence of prediabetes among the rural population of Tamil Nadu.[11] On the other hand, Shamima et al have reported an age-adjusted prevalence of 22.4% in Bangladesh.[12] The study by Anjana et al in 15 states of India observed overall prevalence of 10.3%. which varied from 6% to 14.7%.[22]

In the present study, the mean age of overall study subjects was 46.8±8.2 years. Moreover, this study also indicates that chances of getting prediabetes increases with age. Muthunarayanan et al in a study conducted among rural adult population of Tamil Nadu have shown that age over 40 years acts as an individual risk factor for developing prediabetes.[8] Previously many community-based studies have shown a male predominance among the diabetic and prediabetic population.[5,11,13,14] Similar the present study also showed that males are more prone to develop a prediabetic condition than their female counterparts.

Cross-sectional and epidemiological studies in the past have suggested a strong correlation of obesity with prediabetes. A BMI of more than 23 has been reported to have a positive correlation with prediabetes.[5,8,11,15] The present study reported a high BMI in both male and female study subjects (25.4±1.8 kg/m^2 in males and 25.6±2.4 kg/m^2 in females) though there was no statistically significant association between body mass index and gender. Studies have also pointed out that a high waist to hip ratios can correctly predict the increased risk of developing diabetes.[16] On a similar note present study showed that the majority of the prediabetics had increased waist circumference (85.2%) and were found to be obese (57.8 %). The association between body mass index and waist circumference was found statistically significant ($p<0.05$).

Balagopal et al in their study, have shown that education plays a significant part in controlling blood sugar and thereby it prevents the spread of developing prediabetes. In that study, the authors have shown that in a rural area in Tamil Nadu 30.3% of the prediabetic subjects were illiterate compared to only 9.7% who had attended PUC or college.[11] Similarly, the present study also showed that the maximum number of people (90%) educated up to high school had knowledge regarding the control of blood glucose. Of the 17 people who were illiterate, 52.9% of them did not know that blood glucose could be controlled and a statistically significant association ($p<0.01$) was found between the education level of the respondents and control of blood glucose.

The present study revealed that majority, 85.2%, of the respondents knew that blood sugar can be controlled through medication. This finding is similar with the study of Mukhopadhyay et al, who have found that 81.3%, 71.9% and 65.6% of study subjects knew that blood sugar could be controlled by medicines, diet, and regular exercise respectively.[17] In addition, in the present study, the majority of the subjects said they led a sedentary lifestyle. Among all the respondents 83.6% were reported to be sedentary workers and only 16.4% were moderately physically active. Similarly, the study by Balagopal et al reported that 62% of the prediabetic subjects had a sedentary lifestyle and 15.2% were moderate workers.[11]

Among other risk factors associated with prediabetes, the present study found that 22.7% of the participants had a family history of diabetes where either both or any one of the parents had diabetes. Previous studies have shown that family history was a strong predictor of developing diabetes.[18] Ghorpade et al had reported a significant association between developing diabetes with age group, sex, per capita income, and educational status, family history of type 2 diabetes, overweight, and alcohol use.[19]

Ishikawa et al have stressed that hypertension has a significant association with the prediabetes.[20] In another study conducted in Indonesia, it was reported that hypertension, old-age, male gender, low education level, and smoking are some of the risk factors positively associated with prediabetes.[21] In contrast to the previous studies, the present study reported no such correlation of hypertension with prediabetes. This study showed that 74.2% of the respondents had a normal systolic and diastolic blood pressure. Among males79.1% and among females 98.4% denied alcohol consumption. Similarly, 81.3% of participants in study denied tobacco addiction.

This may limit the potential to capture long-term trends or changes in the frequency of prediabetes and associated variables. The study was restricted to villages in the Bangalore area, and it was conducted over a very short period of time (July 2014 to October 2015).

CONCLUSION

The study provides valuable insights into the prevalence of prediabetes in a specific population, shedding light on its significance as a public health concern. By comparing its findings with previous research, study contributes to our understanding of prediabetes prevalence across different demographics. It identifies age, gender, and

obesity as significant factors associated with prediabetes, highlighting areas for targeted intervention and prevention strategies.

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