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SHORT COMMUNICATION

INCIDENCE OF PRE-DIABETES AND ITS RISK FACTORS IN RURAL MAHARASHTRA, INDIA

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Abstract: Pre-diabetes is a metabolic state that relates to insulin resistance resulting in non-diabetic hyperglycemia, as diagnosed by blood glucose levels between 110-125 mg/dL on overnight fasting or postprandial values between 140-200 mg/dL.[1] 'Pre-diabetes' is considered as a distinct entity under ICD-10 classification with diagnostic code R73-09.[2]It is an intermediate state between normal glucose regulation and type 2 diabetes mellitus (T2DM). Mostimportantly, being a reversible condition, it presents the last window of opportunity for action against impending T2DM.[3] Adopting healthy lifestyle with changes in work profile, physical activity, dietary pattern and weight has shown to have beneficial effects in halting the progression to T2DM.[1,4]

Key words: Pre-diabetes; hyperglycemia; type 2 diabetes mellitus; T2DM

INTRODUCTION

Pre-diabetes is a metabolic state that relates to insulin resistance resulting in non-diabetic hyperglycemia, as diagnosed by blood glucose levels between 110-125 mg/dL on overnight fasting or postprandial values between 140-200 mg/dL.[1] 'Pre-diabetes' is considered as a distinct entity under ICD-10 classification with diagnostic code R73-09.[2]It is an intermediate state between normal glucose regulation and type 2 diabetes mellitus (T2DM). Most importantly, being a reversible condition, it presents the last window of opportunity for action against impending T2DM.[3] Adopting healthy lifestyle with changes in work profile, physical activity, dietary pattern and weight has shown to have beneficial effects in halting the progression to T2DM.[1,4]

Globally the prevalence of diabetes and pre-diabetes was 6% and 7.3% in 2007 and is expected to increase to 7.5% and 8% respectively by the year 2025.[5]In India, a multistate study estimated that there were 62.4 million diabetics and 77.2 million pre-diabetics in 2011. Across the states, the prevalence of diabetes and pre-diabetes ranged between 5.3%-13.6% and 8.1%-14.6% respectively.[6]The incidence of pre-diabetes has been reported from different countries. A study done in 2004 in Mauritius reported incidence of pre-diabetes as 15.3/1000PY.[7]In 2007, Shanghai Diabetes Community-based Survey[8] concluded that the 3-year cumulative incidence of pre-diabetes was 37/1000PY. In India, the incidence of pre-diabetes was 77/1000PY in 1993 among the metropolitan population.[9] Similarly, a research conducted in Chennai, India in 2008 revealed the incidence of pre-diabetes to be 13.1/1000PY over 8 yrs.[10] Though 70% of the Indians reside in the villages, no literature is available on incidence of pre-diabetes for the rural population. We followed a cohort of adults aged > 25 years in rural Wardha, Maharashtra, India over one year for exploring the incidence of T2DM. The data of euglycemic subjects was analysed with an aim to study the incidence of pre-diabetes and its causative factors.

MATERIALS AND METHODS

A community-based follow-up study was conducted in Seloo Block of Wardha district, India in 2014. In the baseline survey, residents aged more than 25 years (n=306) who attended Diabetes screening OPD at Rural Health Training Centre (RHTC), Seloo were interviewed. After obtaining informed consent, individuals underwent questionnaire-based assessment, a physical and blood examination. Fasting blood glucose was measured with a standardized glucometer. Subjects were diagnosed as having normal glucose tolerance (NGT): < 110 mg/dL; pre-diabetes: 110–125 mg/dL; and T2DM: > 125 mg/dL. In 2015, a follow-up survey was done using same protocol by providing home visit. The sample size was not measured as all the eligible subjects attending Diabetes screening OPD at RHTC, Seloo and willing to participate were included. An incident pre-diabetes was defined as an individual with normal blood glucose at the baseline survey and having pre-diabetes during the follow-up survey. Incidence was reported as rates per 1000PY (95% CI). To account for changes in risk factors over one year, adjusted odds ratio (AOR) was calculated using the generalized estimation equation. The study protocol was approved by the Jawaharlal Nehru Medical College, Sawangi (M), and institutional ethics committee.

RESULTS

In the baseline survey, out of 306 surveyed subjects, 18 (5.9 %), 51 (16.7%) and 237 (77.5%) had diabetes, pre-diabetes and euglycemia respectively. In 2015, 84.5% euglycemic subjects (200/237) were reexamined. Among the non-respondents (n=37), the reason for loss to follow up were; couldn't be traced (25), migrated (5), died (1), refused to participate (5), missing forms (1) and pregnant (1). Excluding those with incident diabetes (n=20), 180 euglycemic individuals were considered for the analysis. There were 16 incident pre-diabetes cases with a crude incidence of 28.6 (22.5-35.8) per 1000PY. The incidence was 23.4/1000PY among women while 33.6/1000PY in men. In multivariate analysis (Table 1), the risk of pre-diabetes was higher among obese people with BMI > 23kg/m^2 (OR:6.9,CI:1.2-3.6). Use of addicting substances predisposed to pre-diabetes than the nonusers [smoking (OR:2.2,CI:1.1-4.2) and alcoholics (OR:2.2,CI:1.0-4.6)]. The population attributable risk of obesity, smoking and alcohol use was 24.5%, 13.4% and 18.7% respectively. Contrary to the expectation, age of the study subjects, family history of DM and physical inactivity did not pose independent risk for development of pre-diabetes.

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Table 1: Incidence rates and the risk of T2DM as stratified by risk factors

Risk factors	Number	Incident prediabetes	Incidence/1000 PY	Adjusted OR (95% CI)	p value*
All	180	16	28.6 (22.5-35.8)	-	-
Gender					
Female	88	7	23.4 (15.8-33.4)	1.0	
Male	92	9	33.6 (24.5-44.5)	1.6 (0.7-3.8.)	0.292
Age in years					
<35	46	3	21.7 (11.9-36.1)	1.0	
35-50	74	6	27.2 (18.1-39.1)	1.1 (0.5-2.4)	0.851
>50	60	7	34.6 (24.0-48.0)	1.0 (0.7-2.5)	0.382
Education					
No schooling	59	4	21.4 (12.6-33.7)	1.0	
Attended school	121	12	31.9 (24.2-41.0)	1.3 (0.6-2.4)	0.515
Work status					
Unemployed	69	5	21.8 (13.5-33.2)	1.0	
Employed	111	11	32.5 (24.5-42.2)	1.5 (0.7-3.3)	0.344
PCI in Rupees					
<2400	175	15	28.5 (22.2-36.0)	1.0	
≥2400	5	1	29.8 (11.2-62.3)	1.1 (0.4-3.2)	0.852
Family history of T2DM					
Absent	163	14	28.5 (22.0-36.3)	1.0	
Present	17	4	29.4 (14.6-51.9)	1.2 (0.6-2.2)	0.597
BMI					
<23.0	133	9	22.5 (16.1-30.4)	1.0	
≥23.0	47	7	43.3 (30.2-59.7)	2.1 (1.2-3.6)	0.006
Physical activity					
Active	154	15	23.5 (12.1-40.6)	1.0	
Inactive	26	3	29.8 (22.9-38.0)	6.9 (0.9-51.7)	0.062
Smoking					
Absent	155	16	27.8 (21.4-35.5)	1.0	
Present	25	2	34.0 (17.7-58.1)	2.2 (1.1-4.2)	0.026
Alcohol intake					
Absent	153	12	26.1 (19.7-33.9)	1.0	
Present	27	6	39.1 (24.1-59.2)	2.2 (1.0-4.6.)	0.046

PCI: Per Capita Income in Indian Rupees, T2DM: Type 2 Diabetes mellitus, BMI: Body mass index
*p value for Adjusted ORs for the association of risk factors

DISCUSSION

In the present study, incidence of pre-diabetes was reported to be 28.6/1000PY.There was a wide variety in the incidence of pre-diabetes reported from various studies in south India. Though in South India, Bai P V *et al.,*[9] in 1993 reported the incidence of pre-diabetes as 77/1000PY over one year, Mohan *et al.,*[10] in 2008 reported that the incidence of pre-diabetes was 13.1/1000PY over 8 years in Chennai residents. There was wide variation amongst the incidence rates in other Indian studies. The differences stress the need for region-wise surveillance of non-communicable diseases and its risk factors.

Obesity, smoking and alcohol use independently predicted occurrence of pre-diabetes. Similar finding was reported from studies in central India.[11,12] The role of obesity is specific as a risk factor for pre-diabetes and diabetes as reported by Mohan et al in 2008[10], who reported the relative risk of occurrence of diabetes to be twice among centrally obese south Indian population. Smoking and alcohol consumption were identified as a risk factors for pre-diabetics in the present study. Cullmann *et al.,* [13] reported that the alcohol consumption and binge drinking increased the risk of pre-diabetes in men (OR 1.42, 95% CI 1.00-2.03). High consumption of beer and wine was shown to increase the pre-diabetes risk by 84% and 141% respectively. Also smoking has a derogatory effect on glucose metabolism right from impaired fasting glucose, development of diabetes and the diabetic complications. Smokers were twice as likely to have pre-diabetes as the nonsmokers and among the smokers, number of cigarette smoked was found to have positive dose-response relationship with HbA1c.[14]

Family history was not found to be significantly associated with pre-diabetes. It is in line with the findings from other Indian studies which found that having family history of diabetes didn't risk people of prediabetes.[10,11] The predilection of family history of diabetes in leading to pre-diabetes mediates through obesity, as reported by a meta-analysis of studies on European population.[15] It also means that having history of diabetes in the family is not the unavoidable curse; And making health choices in diet, exercise and weight can defuse the progression to imminent diabetes. The coverage of 85% cohort and accounting for changes in the risk factors were the strength of the present study. The limitation was that the role of diet, central obesity, stress, blood pressure and lipid profile was not studied for logistic reasons.

In conclusion, in the present study modifiable risk factors (BMI, smoking and alcohol use) attributed more than the half of the burden of pre-diabetes. Identifying people with these risk factors and blood glucose testing among hospital visitors (patients and care givers) and in the community can be the first step to intervene. Secondly, interceding these high risk groups in weight reduction and de-addiction program may revert the pre-diabetes to normalcy and ultimately restrict the momentum for diabetes progression. We advise further research on efficacy of dietary modifications and physical activity for weight

reduction and role of awareness against the hazards of addictions in curing pre-diabetes

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