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RESEARCH ARTICLE

Prevalence and risk factor of prediabetes: A cross-sectional study among young medical students in Mangalore

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ABSTRACT

Background: Diabetes has assumed the position of a common and widespread disease which finds roots in both manner of lifestyle and genetics. An indication of developing diabetes is the condition called prediabetes characterized by impaired fasting glucose, impaired glucose tolerance, or glycated hemoglobin. It is determined by several factors such as obesity, sedentary lifestyle, family history, gestational diabetes, a lack of physical activity, and ethnicity. Therefore, monitoring prevalence and risk factors responsible for identifying individuals susceptible to developing diabetes is important. **Objectives:** The present study was focused on primary objective to study the prevalence of prediabetes among the medical students of Mangalore while simultaneously investigating any association between the different risk factors with prediabetes prevalence. **Materials and Methods:** The study focused on a sample of 110 young adults aged 20–24 years, who were subjected to the WHO STEPwise approach for surveillance of risk to non-communicable diseases. The participants underwent physical and biochemical measurements while taking self-administered questionnaire. The data were analyzed using IBM SPSS 25.0 statistical package. College ethics committee clearance was taken. **Results:** The prevalence of diabetes and prediabetes was found to be 10% and 16.3%, respectively. The prevalence of prediabetes was higher in females than males. The regression results showed the presence of family history (0.84 [confidence interval (CI): 0.13–0.53, P = 0.27]), gender (0.218 [CI: 0.073–0.649, P = 0.027]), and body mass index of >25 (3.62[CI: 1.03 – 12.70, p=0.091]) to be significant risk factors of prediabetes. **Conclusion:** The sample population showed prevalence rates of diabetes in concurrence with the previous studies. As the prevalence rates continue to show consistency with no decline, therefore, it could be concluded that young population present susceptibility to developing diabetes. However, with lifestyle modification which also considers the family history and therefore genetic predisposition could help manage the situation effectively.

KEY WORDS: Prediabetes; Obesity; Body Mass Index; Fasting Plasma Glucose; Family History; Diabetes Mellitus

INTRODUCTION

Diabetes is defined as "*a metabolic disorder characterized by the presence of hyperglycemia due to defective insulin secretion, defective insulin action, or both.*" Prediabetes is the term given to the physiological state characterized by impaired fasting glucose, impaired glucose tolerance, or glycated hemoglobin ranging from 6% to 6.4%.[1] The American Diabetes Association classifies the occurrence of fasting plasma glucose between 100 and 125 mg/dL as an indicator of prediabetes.[2] The risk of developing prediabetes includes genetic disposition, obesity, sedentary lifestyle, family history, gestational diabetes, a lack of physical activity, and ethnicity.[3] If focused solely on young adolescents and adults the issues of obesity, family history of type 2 diabetes, and reaching puberty, exposes them to prediabetes. It also makes the young

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prediabetics prone to long-term risks of complications.[4,5] In addition, in obese individuals with the accumulation of intramyocellular lipids in increased visceral fat, the insulin sensitivity tends to modulate. It has also been found that the abnormalities in insulin signaling cause overaccumulation of different lipids in the skeletal muscles.[6,7] Thus, obesity as a precursor of prediabetes exerts the individual into a cyclical series of signaling errors and fat deposition.

Furthermore, sedentary behaviors and low levels of physical activity also find an association with fat deposition. The deposition of fat particularly leads to abdominal obesity which is an established risk factor paving way to metabolic diseases, which themselves are a cluster of hypertension, hyperglycemia, and dyslipidemia, placing the person at risk for type 2 diabetes and cardiovascular diseases.[8] In addition, the prediabetics also face multiple health risks other than progression to diabetes. These conditions include nephropathy, neuropathies, retinopathy, diseases of the kidney, macrovascular diseases, and heart diseases.[9] Hence, as understood from a broader perspective, the associated risk factors of family history, obesity, lifestyle, physical activity, and others find a complex relationship with the occurrence of prediabetic pathophysiology. These components of prediabetes result in errors of insulin resistance and early failure of beta cells,[10] therefore pushing the individual toward the development of diabetes.

As per the Atlas of Diabetes 2017, the world currently has 425 million diabetics, and their numbers will increase up to 629 million in 2045. Moreover, 325 million people around the globe currently face the risk of developing type 2 diabetes, which is an alarming concern. India alone has a current population of 82 million diabetics, second to all the Western Pacific countries taken together[11] India continues to face the risk of the highest increase in the number of diabetics around the world as predicted by the WHO. With more than half of its population <25 years of age,[12] India faces the risk of its working population suffering from diabetes in the future. Although many studies have been conducted to understand the incidence of prediabetes and the associated risk factors in the country, an assessment focusing solely on the young adults could supply an additional perspective. It could provide information concerning the health status of young India and what possible risks do the nation face concerning the growing burden of diabetes.

To assess the degree of such an epidemiologic tragedy, the present study was designed and focused on studying the prevalence of prediabetes among young adults in the Karnataka region.

The investigation in the given study followed the below-mentioned research objectives:

Primary research objective: To study the prevalence of prediabetes among the medical students of Mangalore.

Secondary research objective: To investigate any association between the different demographic and clinical characteristics with diabetes prevalence among study subjects.

MATERIALS AND METHODS

The study design was cross-sectional and conducted at the Physiology Department, A.J. Institute of Medical Sciences, Mangalore, Karnataka. The study was undertaken for 6 months from January 1 to June 30, 2018.

The target population included young adults belonging to the age group of 20–24 years of age. The respective age group was chosen as it allowed to ascertain the prevalence rates among the young population which makes up 50% of the total population of India. The participants formed the undergraduates and interns who were enrolled in the college during the time period of the study.

Furthermore, the study participants were screened from the target population on the basis of the following exclusion criteria:

- All cases of known diabetes.
- Any history of major surgery.
- Any known history of acute or chronic respiratory diseases, heart diseases, acute or chronic pancreatitis or pancreatic pseudocyst, chronic alcoholism, and malignancy.

Consequently, a total of 110 students made up the study sample.

The study was conducted as per the WHO STEPwise approach for surveillance of risk to non-communicable diseases. The three levels of the questionnaire, physical measurements, and biochemical measurements were adhered during investigation.[13] The pre-validated self-administered questionnaire helped gain information regarding the various risk factors such as gender, history of smoking, family history of diabetes, and physical activity.

The physical examination involved recording anthropometric measurements such as waist circumference, hip circumference, weight, and height. The weight measurements were recorded using an electronic weighing machine; height was recorded using stadiometer, while waist circumference was recorded with the help of non-stretchable measuring tape. The biochemical examinations entailed testing the fasting blood sugar levels which were assessed with aid from the biochemistry department of the college.

The participants who had fasting blood glucose levels of <100 mg/dL were diagnosed as non-diabetic, those having fasting blood glucose levels of ≥100 mg/dL and <126 mg/dL were diagnosed as prediabetics, while the individuals are having blood glucose level ≥126 mg/dL were diagnosed to be diabetics.[2] For diagnosing obesity, the waist circumference cutoff for Asians was used, wherein

a cutoff value of ≥90 cm for males and ≥80 cm for females defined central obesity. Concerning body mass index (BMI) considerations, a BMI of ≥25 kg/m^2 also served as an indicator for diagnosing obesity, for both males and females.[14]

The necessary clearance was obtained from the College Ethics Committee before the commencement of the study. All the participants were explained the research objectives and procedures. The participants gave written informed consent before taking part in the study.

Statistics

The statistical analysis of the collected data was performed using the IBM SPSS 25.0 statistical package. The analysis comprised of descriptive and inferential analysis. The descriptive analysis involved analyzing the frequency distribution, mean, standard deviation, and cross-tabulations. The test of association for non-parametric data, namely Chi-square analysis, was performed to test the association between the prevalence and associated risk factors. The variables which showed significant association were subjected to multinomial logistic regression to determine the odds ratio for the significant variables. The analysis was performed at a 90% confidence interval and $P < 0.100$ was considered to be statistically significant.

RESULTS

Table 1 shows the baseline characteristics of the study participants, presenting frequency distributions of the participants as per the different risk factors. Concerning the burden of diabetes and prediabetes, 10% of the participants suffered from diabetes, while 16.3% were diagnosed as prediabetics. However, 50% of the participants were diagnosed as non-diabetic.

The results of univariate analysis for determining the association between risk factors and prediabetes prevalence. As shown in Table 2, among all the factors, gender ($P = 0.025$), family history ($P = 0.015$), BMI ($P = 0.037$), and central obesity ($P = 0.013$) showed significant association with diabetes prevalence with $P < 0.05$.

The results from the multivariate analysis of the significantly associated risk factors are shown in Table 3. The risk factors of gender, BMI, and family history showed a significant relationship in predicting the outcome for prediabetes prevalence. The odds of a male being prediabetic are 0.218 higher as compared to females, while odds of the presence of a family history of diabetes influencing prediabetes is 0.084 times higher than no family history, whereas on the other hand, individuals having higher BMI had 3.623 times higher odds of acquiring diabetes as compared to those having BMI <22.9.

Table 1: Baseline characteristic of study participants

Risk factors	Total=110	Male=71	Female=39
Age mean (SD)	22.04 (1.41)	22.03 (1.43)	22 (1.50)
Family history *n* (%)			
Present	33 (70)	22 (30.9)	11 (28.2)
Absent	77 (30)	49 (69.0)	28 (71.7)
Socioeconomic status *n* (%)			
Low	22 (20)	11 (1.5)	11 (28.2)
Middle	58 (52.7)	43 (60.5)	15 (38.4)
High	30 (27.3)	17 (23.9)	13 (33.3)
Smoker Status *n* (%)			
Present	23 (20.9)	12 (16.9)	11 (28.2)
Absent	87 (79.1)	59 (83.1)	28 (71.7)
Physical Activity *n* (%)			
Sedentary	14 (12.7)	10 (15.4)	4 (8.9)
Light	41 (37.3)	29 (40.8)	12 (30.7)
Moderate	44 (40)	25 (35.2)	19 (48.7)
Heavy	11 (10)	7 (10.8)	4 (8.9)
BMI *n* (%)			
<22.9	49 (44.5)	23 (32.3)	20 (51.2)
23–24.9	18 (16.4)	11 (15.4)	7 (17.9)
≥25	43 (39.1)	37 (52.1)	12 (30.7)
Central obesity *n* (%)			
Present	59 (53.6)	44 (61.9)	15 (38.4)
Absent	51 (46.4)	27 (38.0)	24 (61.5)
Waist circumference	76.35 (8.1)	79.7 (8.2)	75 (9.5)

SD: Standard deviation, BMI: Body mass index

DISCUSSION

The findings from the present study show the prevalence of diabetes and prediabetes among the young adults in Karnataka as 10% and 16.3%, respectively. The study results, however, showed the prevalence of diabetes among male participants only, whereas no cases of diabetes were recorded for females. It could be attributed to the small sample size. However, the prevalence of prediabetes was higher in females. On the other hand, the absence of past family history for diabetes included a higher percentage of pre-diabetics (30.9%) and diabetics as well (28.2%). Furthermore, BMI of >25 was found in the majority of prediabetics (50%) and diabetics (36.4%). In addition, the presence of central obesity was not found to be prevalent among both pre-diabetics (27.8%), while, for most of the diabetes (72.7%), central obesity accounted as a risk factor. Concerning the secondary research objective, the risk factors showing association with the prevalence of diabetes/prediabetes were found to be gender, family history, BMI, and central obesity ($P < 0.05$). Further, regression analysis of the associated risk factors to obtain the odd ratios dropped central obesity as a predictor of prediabetes prevalence. The individual having a family history of diabetes had an odds ratio of 0.84 for developing prediabetes. Moreover, a BMI of

Table 2: Association between risk factors and prevalence

Risk factors	Normal (*n*=81)	Prediabetic (*n*=18)	Diabetic (*n*=11)	*P* value
Gender				<0.05
Male	55 (67.9)	5 (27.8)	11	
Female	26 (32.1)	13 (72.2)	0	
Family history *n* (%)				<0.05
Present	30 (37)	1 (5.6)	2 (18.2)	
Absent	51 (63)	17 (94.4)	9 (81.8)	
Socioeconomic status *n* (%)				0.911
Low	17 (21)	3 (16.7)	2 (18.2)	
Middle	41 (50.6)	10 (55.6)	7 (63.6)	
High	23 (28.4)	5 (77.8)	2 (18.2)	
Smoker status *n* (%)				0.284
Present	13 (16)	7 (38.9)	3 (27.3)	
Absent	68 (84)	11 (61.1)	8 (72.7)	
Physical activity *n* (%)				0.228
Sedentary	10 (12.3)	2 (11.1)	2 (18.2)	
Light	32 (39.5)	5 (27.8)	4 (36.4)	
Moderate	29 (35.8)	10 (55.6)	5 (45.5)	
Heavy	10 (12.3)	1 (5.6)	0	
BMI *n* (%)				<0.05
<22.9	30 (37)	9 (50)	4 (36.4)	
23–24.9	9 (11.1)	6 (33.3)	3 (27.3)	
≥25	42 (51.9)	3 (16.7)	4 (36.4)	
Central Obesity *n* (%)				<0.05
Present	46 (56.8)	5 (27.8)	8 (72.7)	
Absent	35 (43.2)	13 (72.2)	3 (27.3)	

BMI: Body mass index

Table 3: Odds ratio for prediabetes, diabetes, and associated risk factors

Factors	Prediabetes	
	Odds ratio (90% CI)	Significant
Gender		
Male	0.218 (0.073–0.649)	0.022
Family History		
Present	0.084 (0.13–0.533)	0.027
BMI		
≥25	3.623 (1.03–12.70)	0.091
23–24.9	10.034 (2.29–43.95)	0.010
Central obesity		
Present	0.595 (0.202–1.75)	0.43

CI: Confidence interval

23–24.9 had the highest odds ratio of 10.034 in comparison to BMI <22.1, while BMI of >25 also showed a meaningful relationship with prediabetes occurrence.

The prevalence estimates obtained in present investigations agreed with those reported by earlier studies of similar nature with the prevalence of prediabetes between 2% and 29% and diabetes between 2% and 16%.[15-17] A higher prevalence of diabetes among males was also reported in an earlier study even though the male population made up a minority of the sample size.[18] On the other hand, the higher rates of prediabetes prevalence in females were also found by an earlier study conducted in the South Indian region. The higher female prevalence rates were attributed to the sedentary lifestyle, tobacco consumption, dietary habits, and obesity.[16] With respect to the relationship of risk factors, family history was found to have a significant influence on prediabetes in the Northeastern regions of India as well.[19] The family history of diabetes predisposes an individual to all the pathophysiological risk factors of diabetes, therefore placing them at higher risk of prediabetes.[20]

A high BMI often finds an association with high risk of prediabetes, which was also reflected in the highest odds ratio of BMI for prediabetes in the present study. Therefore, it could also serve as a good indicator for the diagnosis of the prediabetic condition in both males and females. A study from Kanpur used the receiver operating characteristics approach for a sample of school students aged 17–19 years.

The results showed the use of BMI and waist circumference effective in predicting prediabetes. The study proposed cutoff values of ≥22.8 kg/m^2 in boys and ≥20.5 kg/m^2 in girls.[21] A similar approach could be adopted for analyzing the sample population belonging to higher age groups to obtain cut off values which could be applied at a large scale for prediabetes diagnosis. However, in an investigation focusing on rural India, the measures of central obesity were found to be more reliable with respect to diabetes and prediabetes. BMI being a measure of central obesity was marked as ignoring the regional body fat distribution therefore not finding an association as a risk factor.[22]

The study yielded significant insights into the prevalence of prediabetes in young adults. However, it suffered from some inherent limitations as well. The scope of the study was limited due to cost and time restraints, as well the professional restraints of the researcher as well. In the wake of reports of increased risk to diabetes, especially in the state of Karnataka, the sample size could be expanded to involve a larger sample population belonging to higher age groups as well. Furthermore, the present study did not consider the ethnicity of the students enrolled in the college. While comparing the prevalence rates between Asian Indians and US populations, the prediabetes occurrences were found to have higher odds for Hispanics and Blacks in comparison to Asian Indians.[23] As ethnic origin is one of the risk factors responsible for prediabetes, therefore, its inclusion could provide better insight into the state of prevalence and associated risks. Moreover, the generalizability of the given results limits them to the specific age group of 20–24 years, which could also benefit from a larger sample size.

CONCLUSION

The present study helped provide insights into the prevalence of prediabetes among young adults belonging to Mangalore, Karnataka. The risk factors of gender, family history, and BMI were found to be significantly influencing the occurrence of the prediabetic condition. The results obtained were comparable to the other studies conducted in the same region. To avoid the progression of prediabetes to diabetes, the necessary lifestyle changes which can help control BMI and therefore obesity are essential. Furthermore, the factor of gender and family history should be monitored through timely follow-ups and testing. Early intervention can help reduce the increase in the burden of diabetes on a healthy population.

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