

Prevalence and Risk Factors of Prediabetes in Madurai City

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ABSTRACT

Type 2 Diabetes is common today among people irrespective of age and as a known fact India has high prevalence of it. Preventing this growing rate of Type 2 Diabetes can be done by making prediabetes screening a mandatory measure as it poses a high risk factor. Hence, this study focuses on the prevalence and risk factors of prediabetes in Madurai City. A cross-sectional survey among people aged above 18 years was conducted and sixteen prediabetes screening centers were set up in different places in Madurai after ethical clearance. 1050 individuals volunteered with prior consent. Their demographics, anthropometric measurements, diets, physical activity, and medical history including blood pressure and venous fasting plasma glucose were collected. It was classified as prediabetes if the fasting plasma glucose was >100 mg/dl and <126 mg/dl and were not previously diagnosed with diabetes. Statistical significance for pair wise comparisons was assessed by one-way ANOVA test. Fasting blood sugar was computed with age, weight, body mass index (BMI), family history, physical activity, polycystic ovarian disease, and gestational diabetes mellitus. Chi square test was used to compare the categorical outcomes between the study groups. P value <0.05 was considered statistically significant. 15% were prediabetes and other contributing factors found were family history, elevated serum cholesterol levels and blood pressure, BMI, and lifestyle changes. Therefore, the study suggests that lifestyle modifications among prediabetes like strict calorie restriction, low fat and high fiber rich food with regular exercise will help prevent diabetes.

Keywords: Anthropometric measurements, Prediabetes, Prevalence, Type 2 diabetes mellitus

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INTRODUCTION

Prediabetes is defined as a condition in which the fasting blood glucose level is between 100 mg/dl and 125 mg/dl or Glycated hemoglobin is between 5.7% and 6.4% and the 2 h value in Oral glucose tolerance test is 140–199 mg/dl. We can use the term “Impaired Fasting Glucose” or “Impaired Glucose Tolerance” or both for prediabetes. Globally, the number of impaired glucose tolerance was estimated as 318 million that majorly included people from middle and low income countries and mostly under the age of 50 years.^[1] Furthermore, about one third of them were from the age group between 20 and 39 years.^[2] According to a study by the Indian Council of Medical Research-India Diabetes, the prevalence of diabetes and prediabetes in India is 62.2 million and 77.2 million respectively. Focusing on Tamil Nadu, it is estimated to have 3.9 million prediabetes.^[2] The globally increasing diabetes if left untreated will lead to diabetic complications such as Diabetic Nephropathy, Diabetic Neuropathy, Diabetic Retinopathy, Cardiac Diseases, and Stroke. To prevent the people from Diabetes and its consequences, prediabetes screening is essential. It assists in identifying the risk factors and actively treating them. The city of Madurai is developing in all the fields and especially lifestyle has seen great changes. Hence, this study concentrates on the prevalence of prediabetes in Madurai city.

METHODS

Arthur Asirvatham Hospital conducted Madurai Diabetes Prevention Programme in about sixteen screening centers in Madurai. The screening took place with prior approval from the ethics committee and with announcement to the people in all the sixteen centers. The participants came voluntarily. The study was conducted during November 2019. The participants' demographic details like age, sex, occupation were collected. Furthermore, anthropometric measurements such as height, weight, waist, and hip were measured using the measurement tape. Body mass index (BMI) and waist hip ratio were calculated using the standard formula:

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$BMI = \text{Weight in kg} / \text{Height in m}^2$,

$\text{Waist Hip Ratio} = \text{Waist} / \text{Hip}$.

As per the World Health Organization, if the Waist Hip Ratio is above 0.90 for males and above 0.85 for females were considered as abdominal obesity.^[3] Likewise, if the BMI is between 18.5 and 24.9 it is considered as normal, between 25.0 and 29.9 as overweight and above 30 kg/m² obese. Blood Pressure of the individuals were measured using calibrated sphygmomanometer and digital blood pressure device. Diet history and other medical history of the participants were recorded. Across all sixteen centers, the participants' venous fasting plasma glucose for blood glucose levels and serum cholesterol were also collected. The test was performed in the hexokinase method in the laboratory for diagnosing blood glucose and cholesterol levels. The diagnostic criteria for prediabetes used in the present study are depicted in Table 1 and classification for hypertension is given in Table 2.

Inclusion Criteria

1. All adults aged 18 years and above residing in and around Madurai
2. Participants who willing to take part in the study.

Exclusion Criteria

1. Individuals diagnosed previously as Type 2 diabetes mellitus
2. Participants who refuse to take part in this study.

Statistical Analysis

For the purpose of the study, descriptive analysis was used for determining the mean and standard deviation for quantitative variables, frequency and proportion for categorical variables. One-way ANOVA, appropriate post hoc test was used to assess the statistical significance for pair wise comparisons. Fasting blood sugar was computed with variables such as age, weight, BMI, family history, physical activity, polycystic ovarian disease and gestational diabetes mellitus. Chi square test was used to compare the categorical outcomes between the study groups. $P < 0.05$ was considered statistically significant. IBM SPSS version 21 was used for all statistical computations.

RESULTS

The present study was done to identify the prevalence of prediabetes in Madurai city. A total 1050 people volunteered for the. It was found that the majority of the respondents were males with a number of 698 (66.48%). The number of female participants were 352 (33.52%). The number according to each age group category were 33 (3.14%) in the age of 18–20 years, 130 (12.38%) in 21–30 years, 213 (20.29%) in 31–40 age group, 231 (22%) in 41–50 years, 233 (22.19%) in 51–60 years and 210 (20%) were in above 60 group. Distribution of the study participant were given Table 3.

It was also determined that among the participants 460 (43.81%) were sedentary workers, 407 (38.76%) were moderate workers and 183 (17.43%) were heavy workers. About 158 (15%) were diagnosed with prediabetics, 100 (9.7%) with diabetics, and 792 (75.42%) were examined to be non-diabetic. 226 (21.52%) of the study population were in normal weight. About 249 (23.71%) participants were overweight (BMI: 24–29.9), and 575 (54.76%) of them were obese (BMI $\geq$ 30). 462 (44%) participants had abnormal waist hip ratio. High serum blood cholesterol was found in 336 (32%) participants and majority of them (68%) have normal blood cholesterol. In the study group, 468 (44.57%) had family history of diabetes and 582 (55.43%) did not have family history of diabetes

Table 1: Diagnostic criteria for impaired fasting glucose used in the present study

WHO	ADA
FPG	FPG
110–125 mg/dl	100–125 mg/dl
6.1–6.9 mmol/L	5.6–6.9 mmol/L

American Diabetes Association. Diabetes Care.2014;37 Suppl 1: S81–90^[4]

Table 2: Classification of blood pressure for adults age 18 and older used in the study

Category	Systolic mmHg	AND/OR	Diastolic mmHg
Optimal	<120	AND/OR	<80
Normal	120–129	AND/OR	80–84
High Normal (Elevated)	130–139	AND/OR	85–89
Grade 1 Hypertension	140–159	AND/OR	90–99
Grade 2 Hypertension	160–179	AND/OR	100–109
Grade 3 Hypertension	>180	AND/OR	>110

The Indian Guidelines on Hypertension IV^[5]

DISCUSSION

The present study was conducted to identify the prevalence of prediabetes among the population of Madurai city. A total of 1050 individuals volunteered for the study that included 698 males and 352 female which contributed to 66.47% and 33.52%, respectively. The majority of the population was between the age of 41–50 and 51–60 years that contributed to about 22% and 22.16%, respectively, of the total population. The mean age for prediabetes was assessed as 47. Previous studies showed that the increase in age had higher chance of acquiring the complications of prediabetes^[6] This study also shows significance at $P < 0.005$ which is one of the most important risk factors to be considered. The outcome of the study proved that the prevalence of rediabetes is higher in men compared with women which correlates with the study done by Zaho *et al.* on prevalence of prediabetes and its Associated Risk Factors in Rural Areas of Ningbo, China in which they have found that among 4583 participants 35.15% of men and 29.10% of women were diagnosed with prediabetes. They concluded that this condition is prevalent in males than in females.^[7]

Prediabetes is a risk that can lead to diabetes. There are many factors that influence prediabetes. The study determined that 15% were prediabetic in which 9.6% were males and 5.4% were females. 9.7% (100) individuals were newly detected with diabetes, and 75.42% found to be healthy with no risk of diabetes.

Early studies reported that increased BMI lead to the increase in the level of serum cholesterol.^[8] This study showed that 23.1% of the participants were overweight (BMI –24–29.9) in which 17.52% were males and 6.190% were females. Compared to overweight participants, obese individuals were comparatively high of about 54.76% (BMI $\geq$ 30). In it, 36.38% were males and 18.38% were females. About 44% of the study population had abnormal waist

Table 3: Distribution of the study participants in percentage

Parameter	Male n (%)	Female n (%)	Total n	P-value
Gender	698 (66.47)	352 (33.52)	1050	
Family history				
Yes	318 (30.28)	150 (14.28)	468 (44.57)	0.000
No	380 (36.19)	202 (19.2)	582 (55.43)	0.000
Body mass index				
Normal	132 (12.571)	94 (8.952)	226 (21.52)	0.044
Overweight	184 (17.52)	65 (6.190)	249 (23.71)	0.200
Obese	382 (36.38)	193 (18.38)	575 (54.76)	0.054
Waist hip ratio				
Normal	493 (46.95)	95 (9.04)	588 (56)	0.054
Abnormal	205 (19.52)	257 (24.47)	462 (44)	000
Activity				
Sedentary	299 (28.47%)	161 (15.33)	460 (43.81)	0.000
Moderate	275 (26.19)	132 (12.57)	407 (38.76)	0.000
Heavy	124 (11.80)	59 (5.63)	183 (17.43)	0.050
Serum cholesterol				
Normal	481 (45.80)	233 (22.190)	714 (68)	0.040
Abnormal	217 (20.66)	119 (11.33)	336 (32)	0.050
Blood pressure				
Normal	183 (23%)	135 (22%)	318 (45%)	
Abnormal	641 (47%)	(91) 8%	733 (55%)	0.050
PCOD	-	8 (0.7)	8 (0.7)	-
GDM	-	2 (0.1)	2 (0.1)	-
Smoking	210 (20.0%)	0	210 (20.0%)	0.30
Alcohol	195 (18.6%)	0	195 (18.6%)	0.431
Fasting blood sugar				
Normal	602 (57.33%)	190 (18.0)	792 (75.42%)	0.050
Pre diabetic	101 (9.6%)	57 (5.4%)	158 (15%)	0.540
Diabetic	52 (4.95%)	48 (4.75%)	100 (9.7%)	0.540

hip ratio that was 19.52% males and 24.47% females. It indicated abdominal obesity as a strong and consistent predictor for diabetes. A study conducted by Satman *et al.* which comprised of 1082 members found that the prevalence of prediabetes due to obesity was 54%.^[9] Among the prediabetes patients, majority (44%) of them were men and are found to be obese. The female prediabetic obesity contributes to 23.5% of the population. The study also reveals that increase in body weight causes insulin resistance and may lead to the condition of prediabetes. This outcome correlated with the study conducted by Mainous *et al.* on Prevalence of prediabetes in England from 2003 to 2011: population-based, cross-sectional study in which they found that by 2011, 50.6% of the population involved in the study had prediabetes.^[10]

In this study, among prediabetes individuals, 74% males and 12% females were diagnosed with high blood pressure that is associated with prediabetes. From this, it is clear that males are highly susceptible to blood pressure than females. Moreover, the study also revealed that 47% of prediabetic males and 12.9% of female prediabetic participants had elevated serum cholesterol levels.

In case of Type 2 diabetes, heredity plays a major impact. Family history is one of the ways to assess diabetes to find the influence of heredity. The study showed that 44.57% of individuals have family history of positive diabetes. If one of the ancestors had diabetes, then it was confirmed that the offspring will also suffer with hypercholesterolemia which will lead to prediabetes and then to Type 2 diabetes.

Analyzing diabetes with physical activity aspects, people who practiced workouts regularly were less affected. People were classified according to their work type as sedentary, moderate and heavy workers. Sedentary work style leads to obesity and overweight which prolonged to prediabetes and diabetes. In this study, among the total population, 28.47% of males and 15.33% of females were sedentary workers. 38.76% were moderate workers, in which, 26.19% of them were males and 12.47% were females. 17.43% were heavy workers which comprised of 11.80% males and 5.63% females. Based on this outcome, it was concluded that sedentary and moderate workers are more prone to prediabetes and can rapidly move to diabetes.

Cigarette smoking and alcohol can pave way to many deadly diseases. It will decrease high density lipoprotein level and increases the low density lipoprotein level. In the study, 20% of the males were smokers and there are no female smokers. About 18.6% males were alcoholics.

People with polycystic ovarian disease have the chances to develop insulin resistance in their body. It is a state in which they can synthesis insulin but can't use it effectively. In our study, 0.7% and 0.1% of the females had history of polycystic ovarian disease and gestational diabetes mellitus respectively which were diagnosed as prediabetes during the study period.

From the statistical analysis, it was observed that fasting blood sugar compared with age ($P = 0.000$), family history ($P < 0.000$), sedentary workers ($P < 0.000$), obesity ($P = 0.05$), abnormal waist hip ratio ($P = 0.000$), serum cholesterol ($P = 0.05$), and elevated

blood pressure ($P = 0.05$) were associated with significant risk factors.

CONCLUSIONS

This community-based study proved that there is an increased prevalence of prediabetes for the past 10 years, and there is probability of progression from prediabetes to Type 2 Diabetes Mellitus. Hence, it can be concluded that proper lifestyle intervention by adding high fiber content, low calorie and low carbohydrate food in their regular diet along with 30 min of regular exercise can avoid diabetes and its consequences. Furthermore, by conducting diabetes awareness program once a month, regular monitoring of the subjects and motivating them for monthly blood sugar check-ups can reduce the higher prevalence of prediabetes, control blood pressure, and serum cholesterol levels of the people in future.

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REFERENCES

1. Madhu SV. RSSDI Diabetes Update 2016. Ch. 68. New Delhi, India: Jaypee Digital Explore Health Science; 2016. p. 376.
2. International Diabetes Federation. IDF Diabetes Atlas. 7th ed. Brussels, Belgium: International Diabetes Federation; 2015. Available from: <https://www.diabetesatlas.org>. [Last accessed 2016 Oct 03].
3. Vazquez G, Duval S, Jacobs DR Jr, Silventoinen K. Comparison of body mass index, waist circumference, and waist/hip ratio in predicting incident diabetes: A meta-analysis. *Epidemiol Rev* 2007;29:115-28.
4. American Diabetes Association. Diagnosis and classification of diabetes mellitus. *Diabetes Care* 2014;37 Suppl 1:S81-90. *Journal of the Associations of Physicians of India*. Vol. 67; 2019. Available from: [https://www.japi.org/q2d4e464/definition and classification](https://www.japi.org/q2d4e464/definition%20and%20classification). [Last accessed 2019 Oct 01].
5. Mohan V, Chandalia HB, Sridhar GR, Das AK, Madhu SV, Rao PV. RSSDI Textbook of Diabetes Mellitus-Prediabetes, Ch. 8. Tamil Nadu: Jaypee Digital; 2014.
6. American Diabetes Association. Standards of medical care in diabetes-2016 diabetes care. *Diabetes Care* 2016;39 Suppl 1:S52-9.
7. Zhao M, Lin H, Yuan Y, Wang F, Xi Y, Wen LM, *et al.* Prevalence of prediabetes and its associated risk factors in rural areas of Ningbo, China. *Int J Environ Res Public Health* 2016;13:808.
8. Tabák AG, Herder C, Rathmann W, Brunner EJ, Kivimäki M. Prediabetes: A high-risk state for diabetes development. *Lancet* 2012;379:2279-90.
9. Satman I, Omer B, Tutuncu Y, Kalaca S, Gedik S, Dincag N, *et al.* Twelve-year trends in the prevalence and risk factors of diabetes and prediabetes in Turkish adults. *Eur J Epidemiol* 2013;28:169-80.
10. Mainous AG 3rd, Tanner RJ, Baker R, Zayas CE, Harle CA. Prevalence of prediabetes in England from 2003 to 2011: Population-based, cross-sectional study. *BMJ Open* 2014;4:e005002.