Original Research Article

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Type 2 diabetes mellitus and its determinants among adults in an urban area of Kancheepuram district, Tamil Nadu

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ABSTRACT

Background: Type 2 diabetes mellitus (T2DM) is a modern day epidemic of epic proportions, affecting all strata of the society. The prevalence is becoming alarmingly high among younger age groups. The impact of this disease on physical, mental, social and economic wellbeing is huge and therefore warrants early detection and prevention. Aim of the study was to estimate the prevalence and determinants of T2DM among the adult population in an urban area. **Methods:** This cross sectional descriptive study was done in Anakaputhur, an urban area in Kancheepuram district. Based on 10.4% prevalence of T2DM, reported by the ICMR-INDIAB data (2011), the sample size was calculated to be 1680. Data was collected by convenient sampling method using a structured questionnaire from among the adult population. Fasting and postprandial plasma blood glucose was estimated. Data was analyzed using SPSS ver.16 software.

Results: Mean age of the participants was 44.2 years. Females constituted 51.1% and 19.4% were known hypertensives, 10.9% were smokers and 55.3% were overweight/obese. The prevalence of T2DM was found to be 21.2%. Around 20% of affected individuals were belonging to <45 years of age. Overweight and obesity were significantly associated with occurrence of diabetes mellitus.

Conclusions: This study has shown a high prevalence of Diabetes Mellitus. The associated determinants are found to be high and changing. This indicates that diabetes is resulting in an epidemiological and genetic transition of a disease of susceptibility. This necessitates the need for strategies for increasing the awareness, broad based screening, focused treatment and follow up.

Keywords: Macro-angiopathies, Modern epidemic, Non-communicable diseases

INTRODUCTION

Non communicable disease (NCD) are a major public health threat with an increasing burden on the Health Care Delivery System.¹ Non-communicable diseases last for a longer duration and are a result of a combination of modifiable and non-modifiable risk factors such as genetic, physiological, environmental and behavioral factors.² The current epidemic of non-communicable diseases in India is attributed to the increase in longevity and lifestyle changes resulting from urbanization.^{3,4} Diabetes mellitus (DM) is one of the main chronic non-communicable diseases prevalent in India.⁵

Diabetes Mellitus is a global epidemic in the new millennium.⁶ Diabetes is a chronic disease that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces.⁷ Diabetes mellitus is classified into four types:

- 1. Type 1 diabetes, which is caused by an autoimmune reaction, where the body's defense system attacks the insulin-producing beta cells in the pancreas. As a result, the body can no longer produce the insulin it needs.
- 2. Type 2 diabetes, where the body is able to produce insulin but either this is not sufficient or the body is unable to respond to its effects (insulin resistance), leading to a build-up of glucose levels.
- 3. Gestational diabetes, women develop a resistance to insulin and subsequent high blood glucose levels during pregnancy.
- 4. Impaired glucose tolerance (IGT) and impaired fasting glucose (IFG): People whose blood glucose levels are high but not as high as those in people with diabetes.

People with IGT or IFG and gestational diabetics are at high risk of progressing to Type 2 diabetes, although this is not inevitable.^{7,8}

Uncontrolled diabetes over a time leads to serious damage to the body, leading to micro and macroangiopathies.⁷ An overwhelmingly serious problem is that diabetes mellitus often cannot be diagnosed until complications appear.⁹ Asian Indian phenotype with high insulin resistance, increased abdominal fat deposition, high genetic predisposition and high susceptibility to environmental insults, are at a higher risk of developing diabetes and its complications.^{10,11}

Global prevalence of diabetes mellitus is about 9%.^{7,12} The prevalence of DM in India is found to be around 8.63%.⁸ However, the prevalence of DM in Tamil Nadu is found to be slightly higher at 10.4%.¹³ The prevalence of diabetes is expected to double by 2030 from 8.3 to 17.6% globally, excluding the high numbers of undiagnosed cases estimated as 175 millions.^{8,14-16} Around 51 million and 43 million of the diabetic population live in India and China respectively.¹⁷ The dramatic rise in the prevalence of diabetes mellitus and related disorders like obesity, hypertension and the metabolic syndrome could be related to the rapid changes in life style that has occurred in the last fifty years.⁸

Approximately 1.9% of the global disability adjusted life years (DALY) is attributed to diabetes.¹⁸ The International Diabetes Federation (IDF) estimates that 450 million people are living with diabetes, with 5.1 million dying from it annually worldwide.^{8,19} WHO projects that diabetes will be the seventh leading cause of death in 2030. In India, the risk of dying from NCDs was 26.1% in the year 2010. In 2015, an estimated 1.6 million deaths were directly caused by diabetes.¹⁹⁻²²

Diabetes mellitus is becoming alarmingly high among all the age groups impacting on their physical, mental and social wellbeing warranting an early detection and prevention. India is now becoming the diabetes capital of the World.²³ With this background; this study was planned with an objective to estimate the prevalence and determinants of type 2 diabetes mellitus (T2DM) among the adult population in an urban area of Kancheepuram district, Tamil Nadu.

METHODS

Study method

This is a health center based descriptive cross sectional study carried out in Anakaputhur area of Kancheepuram District.

Study area and population

This study was carried out among the adult population, aged more than 18 years visiting the Urban Health Training Center, Anakaputhur, which is the urban field practice area of our Medical College. The total population in the field practice area is approximately 45,562, with an adult population of 34,657 (Males - 16,129 and Females-18,528).

Study period

Study was carried out between October 2016 and March 2017.

Sample size and sampling method

The sample size was estimated using ICMR-INDIADIAB 2011 data, which showed that the prevalence of Diabetes as 10%.¹³ Based on this, the sample size was estimated using the formula $4pq/L^2$, where, prevalence (P) = 10%, Q = 90%, precision (L) = 15% of 'P' = 1.5. With 5% refusal rate, the estimated sample size was calculated as 1680. Convenient sampling method was used to carry out this study.

Data collection method

The following organogram gives a detailed picture of the data collection method used for this study.

Data collection

The study was carried out among 1680 adult population residing in Anakaputhur area of Kancheepuram District. By convenient sampling method patients coming to the Urban Health Training Centre attached to the Institution were selected as the study participants irrespective of their present morbidity status. The study was initiated after obtaining informed consent. Socio-demographic details of the study population were collected using a pretested structured questionnaire. However, the data of 46 study subjects were excluded, due to incomplete information. Thus only the data of 1634 study subjects were analyzed. Study participants who are already diagnosed as diabetics and participants who are on treatment were identified. A total of 309 study subjects were known diabetics. The rest of the study participants, 1325 were screened for their diabetes status using Fasting and post-prandial plasma glucose.

The Indian Council of Medical Research (ICMR) guideline was used to identify the study participants with diabetes mellitus, impaired glucose tolerance (IGT) and impaired fasting glucose (IFG).²⁴



Figure 1: Organogram of data collection.

Table 1: Diagnostic criteria of diabetes mellitus.

Normoglycemia	Pre diabetes (IFG & IGT)	Diabetes mellitus		
Fasting glucose	Fasting glucose	Fasting glucose		
(<110 mg/dl)	(>110 mg/dl and <126 mg/dl)	(>126 mg/dl)		
2 hrs nost prondial glucosa	ose 2 hrs. Post Prandial Glucose (>140 mg/dl and <200 mg/dl)	2 hrs. Post Prandial Glucose (>200 mg/dl),		
$\sim 140 \text{ mg/dl}$		symptoms of diabetes and casual plasma glucose		
(<140 mg/ul)		concentration >200 mg/dl		

Statistical analysis

Data collected was analyzed using SPSS Ver.16 software. Frequencies and percentage were calculated. Proportions were compared using Chi Square test to find out any association between the different variables studied.

Ethical considerations

The study was started after getting the ethical clearance from the Institutional Ethical Committee and after obtaining informed consent from the study participants.

RESULTS

The study on prevalence of diabetes mellitus and its determinants in an urban area was carried out among 1680 study subjects. However, the data of 46 study subjects were excluded from the analysis, due to

incomplete information. The study outcome showed interesting results which are described below:

Background characteristics of the study population are shown in Table 2. The mean age of the participants is 44.2 ± 15.9 years. Most of the participants, 56.6%belonged to 30-60 years of age. Females constituted 51.1% and 19.4% were known hypertensive. Nearly, 10.9% were smokers and 10.8% had history of consumption of alcohol.

Body mass index of the study participants is represented in Figure 2. Almost 32.5% of the study subjects were overweight and 22.8% were obese. Only 37.6% of the study subjects have a normal BMI.

The prevalence of T2DM is shown in Table 3. The prevalence of type 2 diabetes mellitus was found to be 21.2% (95% CI: 19.2 - 23.2) among the study population. Nearly, 26.3% suffered from impaired glucose tolerance

and almost 52.6% were found to be having normal random capillary blood glucose level.

Association between demographic factors and type 2 diabetes mellitus is represented in Table 4. It was found that overweight and obesity had statistically significant

association with the presence of diabetes mellitus (p<0.01). Whereas, other risk factors such as age, gender, history of hypertension, history of cardio vascular disease, history of smoking and history of alcoholism were not statistically associated with the presence of diabetes mellitus.

Table 2: Background characteristics of the study population.

S. No.	Characteristics	Frequency (N=1634)	Percentage (%)
1.	Age (in years)		
	<30	408	25
	30-45	508	31.1
	45-60	417	25.5
	>60	301	18.4
2.	Sex		
	Male	799	48.9
	Females	835	51.1
3.	Known case of diabetes		-
	Present	309	18.9
	Absent	1325	81.1
4.	History of hypertension		
	Present	317	19.4
	Absent	1317	80.6
5	History of CVD		
	Present	48	2.9
	Absent	1586	97.1
6.	History of smoking		
	Present	178	10.9
	Absent	1456	89.1
7.	History of alcoholism		
	Present	177	10.8
	Absent	1457	89.2



Figure 2: Body mass index of the study participants.

Table 3: Prevalence of type 2 diabetes mellitus.

S. No.	Characteristics	Frequency (N=1634)	Percentage	95%CI
1.	Normal	859	52.6	50.2 - 55.0
2.	Pre-diabetic (IFG+IGT)	429	26.3	24.2 - 28.4
3	Diabetes mellitus (known DM + newly diagnosed DM)	346	21.2	19.2 - 23.2

S. No.	Risk factors	N (1634)	Prevalence of DM (n=346)	Prevalence of DM (%)	Chi square	P value
1.	Age (in years)					
	>45	773	178	23	2.01	0.082
	<45	861	168	19.5	5.01	
2.	Gender					
	Males	799	154	19.3	3.4	0.066
	Females	835	192	23		
3.	History of hypertension					
	Present	317	78	24.6		0.086
	Absent	1317	268	20.3	2.1	
4.	History of cardio vascular diseases					
	Present	48	6	12.5		0.135
	Absent	1586	340	21.4	2.2	
5.	History of smoking					
	Present	178	31	17.4	1.69	0.193
	Absent	1456	315	21.6		
6.	History of alcoholism					
	Present	177	34	19.2	0.46	0.498
	Absent	1457	312	21.4		
7.	Body mass index					
	Overweight and obese	905	170	18.8	6.0	0.008*
	Normal and underweight	729	176	24.1	0.9	

 Table 4: Association between risk factors and type 2 diabetes mellitus.

*P value less than 0.05, Statistically Significant at 95% CI using Chi square test.

DISCUSSION

This study reflects diabetic status and its determinants among 1634 adults visiting the Urban Health Training Center, Anakaputhur, in Kancheepuram district, Tamil Nadu during the period between October 2016 and March 2017.

In this study, most of the participants (56.6%) belonged to 30-60 years of age. Females constituted 51.1% and 19.4% were known hypertensives. Nearly, 10.9% were smokers and 10.8% had history of consumption of alcohol. In a study conducted by Kinra et al, most of the participants (77%) belonged to 30-60 years of age group, which is similar to this study finding. It also stated that 14% had a history of smoking and 18% had a history of alcohol consumption, which was slightly high when compared to this study outcome.²⁵ In a study by Bharati et al, 57.4% belonged to 20-60 years of age, 60.3% were females, which is also similar to the findings of this study. However, only 4.2% had a history of alcohol consumption and 32.6% gave a history of hypertension.⁶ Similar findings were also seen in studies conducted by Simon et al, Animaw et al, Kumar et al and Shaopeng et al.^{23,26-28}

Almost 32.5% of the study subjects were found to be overweight and 22.8% were obese in this study. Only 37.6% of the study subjects have a normal BMI. A study done by Animaw et al, found that 9.3% were overweight and 2.1% were obese in their study area.²⁷ In a study by

Kumar et al, 38.4% of the males and 39.6% of the females were overweight and 10.7% of the males and 9.4% of females were found to be obese.²³

The overall prevalence of diabetes mellitus in this study was found to be 21.2%. Nearly, 26.3% of the study subjects were Pre-Diabetics, either they had impaired fasting glucose or impaired glucose tolerance. Similar result was seen in a study conducted in Kerala during 2017 by Simon C et al, where the prevalence of diabetes was found to be 18.7%.²⁶ A study conducted by Singh A et al, in Amritsar showed a prevalence of 23.2%.²⁹ Most other studies reported a much lower prevalence when compared to this study.

The prevalence of diabetes in most other studies like CURES-17 study by Mohan et al (15.5%), Ramachandran et al (12.1%), Kumar et al (10.6%), Tsirona S et al (10.68%), Anjana et al (10.4%), Rahman et all (Male – 9.4% and Female-8%), Bharati et al (8.4%), Aswathy et al (7.4%), Dar et al (6.3%), Shaopeng et al (6.2%) was found to be low when compared to the prevalence found in this study.^{13,23,30-34,6,17,28} A very low prevalence of 3.3% was reported by a study conducted in Ethiopia by Animaw et al.²⁷ The high prevalence of DM in this study may be due to the study setting, since this was a health center based study and the prevalence recorded could be high.

Body mass index of the study population was found to be significantly associated with the prevalence of diabetes in

this study. Age, gender, history of hypertension, history of cardio vascular disease, history of smoking and alcohol were not statistically associated with the prevalence of diabetes mellitus. In a study by Ramachandran et al, statistically significant association was found to be present between prevalence of diabetes and BMI, which was similar to this study finding. It also showed statistically significant association between prevalence of diabetes mellitus, monthly income and sedentary physical activity.³¹ Statistically significant association association was present between prevalence of diabetes and age, hypertension and blood cholesterol levels in a study conducted by Bharati et al.⁶

In a recent study by Singh et al, statistically significant association was found to be present between prevalence of diabetes and age, hypertension, triglycerides and cholesterol.²⁹ A study in Kerala, conducted by Aswathy et al, also showed a significant association between age, presence of co-morbidities and prevalence of diabetes. But gender was not statistically associated with prevalence of diabetes.³⁴ In another study in Kerala, conducted by Simon et al, BMI was not statistically associated with prevalence of diabetes, which differed from this study. But, it showed a significant association with age, family history of diabetes and sedentary life style.²⁶ In an Ethiopian study conducted by Animaw et al, a significant association was found between overweight, central obesity, hypertension and prevalence of diabetes.²⁷ Study by Shaopeng et al, showed a statistically significant association between alcohol consumption and prevalence of diabetes.²⁸

It can be found that there is statistically significant association existing between various risk factors and occurrence of diabetes mellitus in most of the similar studies conducted elsewhere. But the similar levels of association were not found in this study except for the body mass index. This needs to be investigated further to understand the epidemiological vagaries existing in our study area in this regard.

CONCLUSION

This study shows a high prevalence of diabetes mellitus (21.1%) among the study population. The identified prevalence can be a tip of the iceberg. There can be more people with undiagnosed or subclinical diabetes mellitus hidden in the community, who require regular screening, early diagnosis and prompt management. Moreover, the associated risk factors are also found to be on the rise. This indicates that diabetes is resulting in an epidemiological and genetic transition of disease susceptibility affecting a majority of the population. This necessitates the need for increased awareness creation, lifestyle modifications, broad based screening programs, focused treatment and follow up. These coordinated activities will help to reduce the diabetes burden among the vulnerable population in the long run.

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