



Original Research Article

Hypertension and its associated factors among type 2 diabetes mellitus patients in a tertiary care centre in South India: A cross-sectional study

Sanjay Kambar^{1,2,*}¹KLES Dr Prabhakar Kore Hospital & Medical Research Centre, Belgaum, Karnataka, India²Dept. of Community Medicine, KLE University's J. N. Medical College, Belgaum, Karnataka, India

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ABSTRACT

Background: Hypertension (HTN) is a serious risk factor for cardio-vascular disease which is the leading cause of mortality among type-2 diabetes mellitus (T2DM) patients. There is insufficient data regarding prevalence of hypertension among T2DM patients. The objective of this study was to determine the prevalence of hypertension and its associated factors among T2DM patients attending the preventive diabetes clinic at KLEs Dr Prabhakar Kore Hospital, Belagavi.

Materials and Methods: An institution-based cross-sectional study was conducted from November 2019 to January 2020 done among 522 T2DM patients who presented to the preventive diabetes clinic. Data were collected using an interviewer-administered questionnaire. Written informed consent was obtained from each participant.

Results: There were 522 participants with a mean age of 49.81 ± 9.53 . Three hundred and sixty-nine (70.7%) of the study participants were 40 years old and above. The prevalence of hypertension among T2DM was 57.7%. The majority (41.8%) of hypertensive patients were stage 1. Age, education status, BMI and tobacco use were significantly associated with HTN in the multivariable analysis.

Conclusions: The prevalence of hypertension was high. Patients who are both hypertensive and diabetic are at an increased risk of cardio-vascular disease. Health screening and health promotion will ensure that the patients are prudent regarding their health.

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1. Introduction

Hypertension and Diabetes mellitus are major health threats which can present with various complications without any symptoms.¹ Diabetes increases risk of life-threatening cardio-vascular disease which is worsened by hypertension. Various mechanisms such as oxidative stress, inflammation contribute to macrovascular and microvascular complications of diabetes and hypertension.²⁻⁴

In India, the prevalence of hypertension was 25.3% and a reported 1.6 million deaths due to hypertension.^{5,6} The prevalence of diabetes in India was 7.7%.⁷ Also, by 2035, the estimated number of diabetes mellitus patients would

increase to 109 million.⁸ Studies done in Karnataka showed the prevalence of hypertension among diabetes mellitus patients at 25.6% and 63.43%.^{9,10}

Hypertension is a controllable albeit serious risk factor for many diseases and its asymptomatic nature makes it an underdiagnosed co-morbidity.¹¹ Both hypertension and diabetes mellitus make patients liable for end organ damage in the form of cardiovascular and renal diseases.^{12,13} Moreover, hypertension increases the risk of cardiovascular disease in diabetic patients.¹⁴ Determining the prevalence of hypertension among diabetes mellitus patients is worthy of attention as it aids the policy makers in providing guidelines and also in planning and allocation of important health resources to curtail the impact of both diseases. Discerning the associated factors of hypertension in diabetic

* Corresponding author.

E-mail address: sanjaykambar@yahoo.com (S. Kambar).

patients will empower healthcare professionals to tackle the ramifications of both diseases. The objective of this study was to determine the prevalence of hypertension and its associated factors among T2DM patients attending the preventive diabetes clinic at KLEs Dr Prabhakar Kore Hospital, Belagavi.

2. Materials and Methods

An institution-based cross-sectional study was conducted from November 2019 to January 2020 at KLEs Dr Prabhakar Kore Hospital, Belagavi, Karnataka, India.

All T2DM patients aged more than 18 years who presented to the preventive diabetic clinic at KLEs Dr Prabhakar Kore Hospital, Belagavi were included in the study. Patients who had history of hypertension before the diagnosis of T2DM, and pregnant women were excluded from the study.

Participants were explained about the study and written informed consent was obtained from each of the participants before commencing the interview. An interviewer-administered questionnaire was used to collect the data.

Participants with Systolic Blood Pressure (SBP) \geq 140 mmHg and/or Diastolic Blood Pressure (DBP) \geq 90 mmHg or patients who were on antihypertensive therapy were taken as hypertensive patients. SBP of 120-139 mmHg and/ or DBP of 80-89 is pre-hypertension. SBP of 140-159 mmHg and /or 90-99 mmHg is Stage 1 hypertension. SBP of 160-179 mmHg and/ or DBP of 100-109 is Stage 2 hypertension.¹⁵

A poor glycemic control was considered when a patient had HbA1c $>7\%$.¹⁶ Current tobacco consumer is a person who consumed tobacco in any form at least once in the last month prior to the date of interview.

Study participants were identified by checking for type 2 diabetes mellitus diagnosis in the medical record. When a patient has a FBG of ≥ 126 mg/dl, HbA1C $\geq 6.5\%$, or are on any form of medication for T2DM, they are considered as a diabetic patient.¹⁷

Height (cm) and body weight (kg) were measured to the nearest 0.1 unit. Body mass index (BMI) was calculated as weight divided by height squared (kg/m^2).

Blood pressure (BP) was recorded using a mercury-free sphygmomanometer. Two measurements were taken 10 minutes apart, and the mean value was taken. Venous blood sample were collected for FBG and HbA1c and sent to the laboratory within the hospital. FBG and HbA1c were measured using glucometer and Direct Enzymatic HbA1c Assay respectively.¹⁸

Sociodemographic characteristics such as age, sex, marital status, occupation, monthly income, educational level, cigarette smoking, BMI, duration of T2DM were collected and, fasting blood glucose (FBG), and glycated hemoglobin (HbA1c) were taken. BMI was classified

into < 23 and ≥ 23 kg/m^2 based on Asian-Pacific cut off classification.¹⁹ Socio economic status was classified according to modified B.G. Prasad classification 2019.²⁰

2.1. Statistical analysis

Data were entered into Microsoft Excel and analysed using IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp., Armonk, NY, USA). Bivariable logistic regression analysis was performed to determine the association between the explanatory variables and outcome variable. In bivariate analysis, if P value were < 0.2 , those variables were entered into multivariable logistic regression wherein P value < 0.05 was considered statistically significant. Adjusted odds ratio (AOR) was used to determine the strength of association.

3. Results

There was a total of 522 T2DM patients with a mean age of 49.81 ± 9.53 . Three hundred and sixty-nine (70.7%) of the study participants were 40 years old and above. Majority of the participants were males (310 (59.4%)), had at least primary level schooling (385 (73.8%)), were married (337 (64.6%)), and were farmers (181 (34.7%)), were of Hindu religion (272 (52.1%)) and belonged to socio economic class III (224 (42.9%)). The mean duration of T2DM in the study participants was 10.59 ± 7.1 years. Majority (386 (73.1%)) had an abnormal BMI of ≥ 23 kg/m^2 . The mean HbA1C was 7.32 ± 1.07 . Two hundred and ninety-nine (57.3%) did not have adequate glycemic control at the time of interview. The mean FBG, Systolic Blood Pressure (SBP) and Diastolic Blood Pressure (DBP) were 149.12 ± 16.67 , 133.97 ± 21.02 and 85.15 ± 14.33 respectively. Majority of the participants were on oral hypoglycemic agents for treatment of T2DM. One hundred and seven (20.5%) participants were current tobacco consumers.

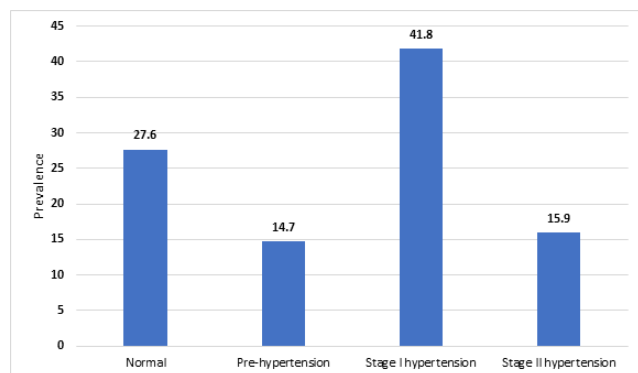
We found the prevalence of hypertension among T2DM to be 57.7% (301/522). The majority (41.8%) of hypertensive patients were stage 1. Eighty-three (15.9%) of study participants were stage 2; and 77 (14.7%) were in the pre-hypertensive stage (Figure 1). Hypertension was seen more among 40-60 years age group (199 (69.1%)), males (190 (61.3%)), participants who were illiterate (94 (68.6%)), government employee (45 (65.2%)), participants who were overweight/ obese (218 (56.5%)), who were tobacco consumers (69 (64.5%)) (Table 2).

Using binary logistic regression, crude association of the explanatory variables with the outcome variable. Age, gender, educational status, occupation, BMI, and tobacco consumption were a candidate for the final model. Age, education status, BMI and tobacco use were significantly associated with HTN in the multivariable analysis.

The odds of acquiring HTN increased with increase in age. It was 2.6 times higher in the age group of 40–59

Table 1: Socio-demographic and clinical characteristics of type 2 diabetes mellitus patients(n=522)

Variable	Categories	Frequency (%) / Mean (\pm SD)
Age (in years)	< 40	153 (29.3)
	40 - 60	288 (55.2)
	> 60	81 (15.5)
Gender	Male	310 (59.4)
	Female	212 (40.6)
Education status	Illiterate	137 (26.2)
	Primary School	177 (33.9)
	High School	160 (30.7)
Marital status	Graduate	48 (9.2)
	Married	337 (64.6)
Occupation	Unmarried	185 (35.4)
	Government employee	69 (13.2)
Socio economic status	Housewife	90 (17.2)
	Daily laborer	51 (9.8)
	Business	131 (25.1)
	Farmer	181 (34.7)
	Class I, II	70 (13.4)
Religion	Class III	224 (42.9)
	Class IV, V	228 (43.7)
	Hindu	272 (52.1)
Duration of DM	Muslim	197 (37.7)
	Christian	53 (10.2)
BMI		10.59 \pm 7.1
	< 23	136 (26.1)
Glycemic Control	\geq 23	386 (73.1)
	HbA1C	7.32 \pm 1.07
	Good	223 (42.7)
Blood pressure	Poor	299 (57.3)
	Fasting Blood Glucose	149.12 \pm 16.67
	Systolic Blood Pressure	133.97 \pm 21.02
Type of Medication for DM	Diastolic Blood Pressure	85.15 \pm 14.33
	OHA	361 (69.2)
	Insulin	57 (10.9)
Tobacco use status	Both	104 (19.9)
	Yes	107 (20.5)
Hypertension Self-Reported or on Treatment	No	415 (79.5)
	Yes	231 (44.3)
	No	291 (55.7)

**Fig. 1:** Grading of Blood pressure levels of T2DM patients (n=522)

(AOR=2.65, 95% CI (1.4–8.96)) and 2.8 times higher for those above 60 years (AOR=2.87, 95% CI (1.39–15.5)) than those below 40 years of age. Patients who were illiterate were 67% (AOR=1.67, 95% CI (1.24–2.89)) and those who were overweight or obese were 51% (AOR=1.51, 95% CI (1.3–2.12)) more likely to develop HTN. Patients who were not consuming tobacco were 42% (AOR=0.42, 95% CI (0.16–0.88)) less likely to develop HTN.

4. Discussion

We performed a study to determine the prevalence of hypertension and to identify its associated factors among T2DM patients. The prevalence of hypertension was 57.7%

Table 2: Factors associated with hypertension among type 2 diabetes mellitus patients (n=522)

Variable	Categories	Hypertension (Yes) (n = 301)	Hypertension (No) (n = 221)	COR (95% CI)	AOR (95% CI)
Age (in years)	< 40	39 (25.5)	114 (74.5)	1	1.00
	40-60	199 (69.1)	89 (30.9)	6.53 (4.2-10.16)	2.65 (1.4-8.96)*
	> 60	63 (77.8)	18 (22.2)	10.23 (5.41-19.36)	2.87 (1.39-15.5)*
Gender	Male	190 (61.3)	120 (38.7)	1.44 (1.01-2.05)	1.15 (0.83-3.66)
	Female	111 (52.4)	101 (47.6)	1	1.00
Education status	Illiterate	94 (68.6)	43 (31.4)	2.31 (1.45-3.69)	1.67 (1.24-2.89)*
	Primary School	86 (48.6)	91 (51.4)	1	1.00
	High School	94 (58.8)	66 (41.2)	1.51 (0.98-2.32)	0.96 (0.79-1.76)
	Graduate	27 (56.3)	21 (43.7)	1.36 (0.72-2.59)	1.33 (0.58-1.94)
Occupation	Government employee	45 (65.2)	24 (34.8)	1.73 (0.98-3.08)	1.56 (0.88-2.18)
	Housewife	57 (63.3)	33 (36.7)	1.59 (0.95-2.68)	1.1 (0.92-1.56)
	Daily laborer	29 (56.9)	22 (43.1)	1.22 (0.65-2.28)	1.19 (0.69-1.48)
	Business	76 (58.0)	55 (42.0)	1.28 (0.81-2.01)	1.33 (1.2-2.06)
	Farmer	94 (51.9)	87 (48.1)	1	1.00
BMI	< 23	83 (61.0)	53 (39.0)	1	1.00
	≥ 23	218 (56.5)	168 (43.5)	2.21 (1.18-4.79)	1.51 (1.3-2.12)*
Tobacco use status	Yes	69 (64.5)	38 (35.5)	1	1.00
	No	232 (55.9)	183 (44.1)	0.69 (0.45-1.09)	0.42 (0.16-0.88)*

* Significant at $p < 0.05$

which was similar to a study done in Ethiopia.²¹ The current findings are higher than studies by Jacob et al. and Venugopal et al. which showed prevalence of 25.6% and 44.8%.^{9,22} The prevalence is lower in percentage compared to a study done in Egypt which showed 68%.²³

The odds of getting HTN among T2DM patients increased with age. These findings were consistent with various studies done in Israel,²⁴ Nigeria,²⁵ Ethiopia,^{21,26} Egypt,²³ and Botswana.²⁷ With increase in age, there is arterial stiffness and remodelling and suppression of vasodilators like nitric oxide which narrows the arterial wall.^{2,3}

The odds of developing HTN were higher in patients who were illiterate. These findings are similar to a study done by Asresahegn et al.²⁸ One explanation could be that these patients lacked awareness regarding risk factors and complications of hypertension.

Patients with high BMI were more likely to develop HTN. This is in agreement with studies from different countries.^{21,24,26–29} Insulin also acts on the vascular system by inducing vasodilation through the synthesis of nitric oxide. Insulin resistance has an important role in pathogenesis of T2DM and it also impairs nitric oxide production and vasodilation.³⁰ T2DM patients who did not consume tobacco were less likely to develop HTN. This finding is in accordance with a study done in China.³¹ Tobacco contains nicotine which produces an acute hypertensive activity due to sympathetic system activation and causes arterial stiffness thereby having an

unfavourable effect on blood pressure.^{32,33}

The most common patterns of hypertension in our study were stage 1 hypertension followed by stage 2 hypertension and then pre-hypertension respectively. These findings were similar to studies done within Karnataka state.^{9,10}

Our study has a few limitations. The cause-effect relationship between hypertension and independent variables could not be established since this study is cross-sectional. The findings may be less applicable to the general population as it is a hospital-based study.

5. Conclusions

Increase in age, poor education status, increase in BMI and tobacco use were risk factors for developing hypertension. Hypertension has an asymptomatic nature and health education regarding the modifiable risk factors would ensure that the patients are wary of the possible complications of both hypertension and diabetes mellitus.

6. Source of Funding

None.

7. Conflict of Interest

The authors declare that there is no conflict of interest.

8. Ethical approval

The JNMC Institutional Ethics Committee on Human Subjects Research approved the study dated 19/11/2019 (Ref: MDC/DOME/138).

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Author biography

Sanjay Kambar, Professor, Specialist in Diabetes

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