

# Risk Factor Analysis among Type 2 Diabetes Mellitus and Hypertension Patients in an Urban Population - A Cross Sectional Community based Study

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## ABSTRACT

**Introduction:** Diabetes and hypertension are among the most common non-communicable diseases affecting our population. They are the important risk factors for cardiovascular morbidity and mortality. The objective of the study to determine the burden and Risk factors of diabetes and hypertension among people residing in area covered under UHTC of Sri Ram MurtiSmarak Institute of Medical sciences Bareilly.

**Material and methods:** A cross-sectional study was done on 669 people from February 2014 to February 2015 among adults in the age group of 30 year and above residing in area covered under UHTC of Sri Ram MurtiSmarak Institute of Medical sciences Bareilly. A Simple random sampling technique was adopted to achieve the desired sample size. House to house survey was done for collecting data. Ethical clearances were taken from the institution. Descriptive analysis, Chi square, T test and binary logistic regression analysis was done to see the statistical association between risk factors and type 2 diabetes and hypertension individuals.

**Results:** In total, 669 individuals were taken for the present study. Out of this 102(15.2%) were found to be diabetic mellitus, 183(27.3%) were hypertension and 49 (7.3%) individuals were suffering with both diabetic mellitus & hypertension. There was highly significant association between age and gender of individuals having both diabetes mellitus and hypertension. It can be seen that as the physical activity increases prevalence decreases in patients having both Diabetes Mellitus and Hypertension

**Conclusions:** To reduce the disease burden due to diabetes and hypertension, primary prevention measures such as health education regarding adoption of healthy lifestyle should be instituted. Interventions such as screening and early initiation of treatment should also be made for controlling the diseases and preventing its complications.

**Keywords:** Diabetes, Hypertension, Survey, Age Group

## INTRODUCTION

Diabetes mellitus is a frequent and a serious disease with chronic complications and constitutes a substantial load for both patient and health care system. According to the International Diabetes Federation (IDF) Diabetes Atlas 2011, the number of inhabitants living with diabetes is expected to rise from 366 million in 2011 to 552 million by 2030 if preventive programs are not put in place.<sup>1</sup> The prevalence of diabetes for all age-groups globally was estimated to be 2.8% in 2000 and 4.4% in 2030.<sup>2</sup> Type-2 diabetes mellitus

(T2DM) is the main form of diabetes worldwide, explaining 90% of cases worldwide.<sup>3</sup> gender, age, and ethnic setting are significant factor in determining the threat of developing T2DM.<sup>4</sup> A disturbing pattern has become evident in which the prevalence of obesity and T2DM in children is raising noticeably.<sup>5</sup> Cardiovascular disease is the main cause of morbidity and mortality among diabetic patients, explaining 75% of hospitalizations and 70-80% of deaths.<sup>6,7</sup> In fact, coronary heart disease (CHD) is the most important cause of death among diabetic patients, who have a two to four times higher risk of CHD mortality and incidence of nonfatal CHD events equated with patients without diabetes.<sup>8</sup> Diabetes mellitus and hypertension are inter-related diseases that powerfully predispose an individual to atherosclerotic cardiovascular disease.<sup>9,10</sup> Hypertension is about twice as common in individuals with diabetes as in those without.<sup>10</sup> The prevalence of simultaneous hypertension and diabetes emerges to be increasing in industrialized nations because populations are aging and both hypertension and non-insulin dependent diabetes mellitus incidence increases with age.<sup>9,10</sup> Indeed, an figured 35-75% of diabetic cardiovascular and renal complications can be attributed to hypertension.<sup>9,10</sup> Hypertension also contributes to diabetic retinopathy, which is the most important cause of newly diagnosed blindness.<sup>10</sup> For all these causes, hypertension and diabetes should

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be known and treated early and insistently <sup>11</sup> mortality and 9% for any main atherosclerotic cardiovascular incident. Hence this study was undertaken with the objective of determining the burden of diabetes and hypertension among people attending urban wards (slum and non-slum locality) of Bareilly city and subsequent formulation of suitable preventive measures based on the inferences from the study.

## MATERIAL AND METHODS

The design for the current study was a descriptive cross-sectional community based study. The study subjects consisted of males and females in the age group of 30 years and above and belonging to Bareilly city.

**Sampling frame:** The sampling frame consisted of urban wards (slum and non-slum locality) of Bareilly City. All men and women aged 30 year and above in selected localities were included in the sampling frame of our study.

**Sample size:** The study conducted by Anjana et al.,<sup>12</sup> "Prevalence of diabetes and pre-diabetes in urban and rural India. The study revealed that overall prevalence of diabetes in Chandigarh was 13.6%, 10.4% in Tamil Nadu, 8.4% in Maharashtra and in Jharkhand 5.3%. In Chandigarh, a city of North India, the prevalence was 14.2% in urban areas and in the rural areas, the prevalence was 8.3%. So, Chandigarh was considered for calculating the sample size. Using the formula  $4pq/d^2$  i.e. p is 14.2%, d is 20% relative error so 580 sample size came out, than adding 15% non-respondent i.e., 87, approximately sample size came out taking round figure to be 669.

**Methodology:** The present study was carried out in area covered under Urban Health Training Centre of Sri Ram Murti Smarak Institute of Medical sciences Bareilly. UHTC covered both slum area and non-slum area. 1 Slum area was selected and 1 Non-slum area was selected through simple random sampling for obtaining desired sample size. Ethical clearances were taken from the institution.

House to house survey was done and information about the purpose of study was given to all study subjects and a verbal consent was taken from them, before taking socio demographic information using pre-tested interview schedule. Houses were selected using simple random sampling. All eligible individuals in the visited house were included in the study. The subjects were briefed about the procedure of investigation and advised to remain fasting till their blood sample for blood sugar examination was collected. Blood Pressure was measured by calibrated mercury sphygmomanometer. Subjects were asked to sit quietly for at least 5 minutes, with feet on the floor, and arm supported at heart level. Two measurements were made at least 5 minutes apart and the average was recorded as the final blood pressure.

**Waist circumference:** Waist circumference (WC) was assessed at the end of normal ending, with the arms relaxed on the sides, at the midpoint between the lower margin of the last palpable rib and the top of the iliac crest (hip bone). The

data was analyzed using cut-off points of 90 cm in men and 80 cm in women.<sup>13</sup>

**Waist hip ratio:** Waist hip ratio (WHR) was computed by dividing waist circumference (in cm) by hip circumference (cm). Hip circumference was assessed at a level parallel to the floor, at the largest circumference of the buttocks. The cut-off points are 0.95 in men and 0.80 in women to denote abdominal obesity.<sup>13</sup>

**Physical activity:** Assessed based on WHO India-ICMR.<sup>14</sup>

**Body mass index (BMI):** Measure for indicating nutritional status in adults. It is defined as a person's weight in kilograms divided by the square of the person's height in metres ( $\text{kg}/\text{m}^2$ ). Obesity classification according to WHO for Asia-Pacific region is underweight ( $<18.5$ ), normal (18.5–22.9), overweight (23–24.9), obesity grade 1 (25–30), and obesity grade 2 ( $\geq 30$ ).<sup>15</sup>

**Weight:** Subjects weight was recorded using weighing machine to the nearest 100 grams without footwear and light clothing.

**Height:** For assessing the height subjects were asked to stand upright without shoes with their back against the walls, heels together and eyes directed forward. The investigator stood on the subject's left side and firmly holds the chin of the subject with the left hand, with a ruler placed horizontally in the sagittal plane over head of the subject applying a slight pressure to reduce thickness of the hair. This point was then marked on the wall with the help of a pencil. The reading was noted to the nearest 0.1 cm.

BMI was calculated by using the formula: weight in (kg)/ Height in meter<sup>2</sup>

**Hypertension:** Blood Pressure was assessed by calibrated mercury sphygmomanometer. Subjects were asked to sit quietly for at least 5 minutes, with feet on the floor, and arm supported at heart level. Two measurements were made at least 5 minutes apart and the average was recorded as the final blood pressure. Hypertension is determined as systolic blood pressure (SBP)  $\geq 140$  mmHg or diastolic blood pressure (DBP)  $\geq 90$  mmHg as per Joint National Committee (JNC-7) or having a history of formerly known disease. Pre HTN was defined as SBP between 120 and 139 mmHg or DBP between 80 and 89 mm Hg.<sup>16</sup>

**Type 2 diabetes mellitus:** The subjects were informed about the procedure of investigation and advised to remain fasting till their blood sample for blood sugar examination was collected. Analyzed either by the past history of known diabetes or fasting plasma glucose  $\geq 126$  mg/dl, and impaired fasting glucose (pre diabetes) was determined as fasting plasma glucose between 100 and 125 mg/dl.<sup>17</sup>

**Inclusion criteria:** All individuals 30 years of age and above irrespective of disease status were screened for diabetes.

**Exclusion criteria:** Type 1 diabetes patients, pregnant females, those who were seriously ill, Non-cooperative subjects.

## STATISTICAL ANALYSIS

The data thus collected were entered and analyzed in Microsoft Office Excel and SPSS Version 16.0. This study reports numbers and proportions of the variables under study. Mean and standard deviation of demographic and anthropometric factors were tabulated as descriptive statistics, group statistics explained by frequency and percentages, Chi square test. Whereas t-test was used for comparing the means. Binary logistic regression analysis was executed simultaneously to evaluate the effects of age, gender, obesity. A significance level of 5% was used for all of the statistical tests.

## RESULT

In total, 669 individuals were taken for the present study. Out of this 102(15.2%) were found to be diabetic mellitus, 183(27.3%) were hypertension and 49 (7.3%) individuals were suffering with both diabetic mellitus & hypertension.

As shown in the table 1, 102 subjects who were positive for diabetes mellitus, in which this cross tabulation predicts 49 to be positive hypertensive and 53 to be non hypertensive patients. Out of 183 positive hypertensive patients, the table predicts 49 to be positive diabetes mellitus and 134 to be non diabetes mellitus patients. Above explanation illustrates that 49 individual patients were positive for both diabetic mellitus & hypertension. There was found significant association between diabetes mellitus and hypertension.

Table 2 demonstrates the distribution of 102 positive Diabetes mellitus patients according to age- gender. Majority of DM patients were belonging to older age group i.e., 60-69 years. In which percentage of female DM patients were higher as compare to male DM patients. Followed by age group 40-49 years. In this age group percentage of female DM patients were prominent. Age group 70 and above, there were only eleven individuals diagnosed with DM. Out of total DM patient's female patients (53.9%) were higher

		Hypertension			Chi square P value
		Positive (%)	Negative (%)	Total (%)	
Diabetes Mellitus	Positive	49(26.8)	53(10.9)	102(15.2)	25.91 0.000
	Negative	134(73.2)	433(89.1)	567(84.8)	
Total (%)		183(100.0)	486(100.0)	669(100.0)	

**Table-1:** 2x2 Contingency table showing association between diabetic mellitus & hypertension

Age group	Diabetes Mellitus			Chi square P value
	Male (%)	Female (%)	Total (%)	
30-39	11(23.4)	3(5.5)	14(13.7)	11.12 0.025
40-49	9(19.1)	17(30.9)	26(25.5)	
50-59	6(12.8)	5(9.1)	11(10.8)	
60-69	19(40.4)	21(38.2)	40(39.2)	
≥70	2(4.3)	9(16.4)	11(10.8)	
Total	47(100.0)	55(100.0)	102(100.0)	

**Table-2:** Association between age and gender among Diabetes mellitus patients

Age group	Hypertension			Chi square P value
	Male (%)	Female (%)	Total (%)	
30-39	18(32.7)	19(14.8)	37(20.2)	38.98 0.000
40-49	3(5.5)	34(26.6)	37(20.2)	
50-59	16(29.1)	6(4.7)	22(12.0)	
60-69	11(20.0)	54(42.2)	65(35.5)	
≥70	7(12.7)	15(11.7)	22(12.0)	
Total	55(100.0)	128(100.0)	183(100.0)	

**Table-3:** Association between age and gender among Hypertensive patients

Age group	Patients having both Diabetes Mellitus and Hypertension			Chi square P value
	Male (%)	Female (%)	Total (%)	
30-39	6(42.9)	0(0.0)	6(12.2)	35.43, 0.000
40-49	0(0.0)	18(51.4)	18(36.7)	
50-59	4(28.6)	0(0.0)	4(8.2)	
60-69	4(28.6)	9(25.7)	13(26.5)	
≥70	0(0.0)	8(22.9)	8(16.3)	
Total	14(100.0)	35(100.0)	49(100.0)	

**Table-4:** Association between age and gender of patients having both Diabetes Mellitus and Hypertension

in comparison to male patients (46.1%). Found significant association between age and gender of DM patients.

Table 3 shows the highly significant association between age and gender of individuals having hypertension. Total 183 individuals were suffering with hypertension, in which majority of female enduring hypertension, i.e., 69.9%. While merely 30.1% of total were male hypertensive patients. Hypertensive patients were highest in the age group 60-69 years. In which number of female were approximately four

times more than male hypertensive patients. Pursued by age group 40-49 years. In which only three male found, all rest of them were female hypertensive patients. Minimum number of hypertensive patients were seen in the age group 50-59 years and above 70 years.

Table 4 depicts the distribution of 49 individuals who were positive with both diabetes mellitus and hypertension according to age- gender. Majority of patients were belonging to age group 40-49 years. In this age group all the patients

Physical activity	Patients having both Diabetes Mellitus and Hypertension		Total	Chi square P value
	Present (%)	Absent (%)		
Sedentary	17(10.3)	148(89.7)	165	14.571, 0.002
Moderate	24(10.8)	198(89.2)	222	
Vigorous	8(2.9)	274(97.1)	282	
Total	49(7.3)	620(92.7)	669	
Body Mass Index (kg/m <sup>2</sup> )				
<18.5 (Underweight)	0(0.0)	45(100.0)	45	4.87, 0.087
18.5-24.9 (Average)	24(6.9)	324(93.1)	348	
≥25.0 (Overweight)	25(9.1)	251(90.9)	276	
Total	49(7.3)	620(92.7)	669	

**Table-5:** Association between Physical activity Body Mass Index of patients having both Diabetes Mellitus and Hypertension

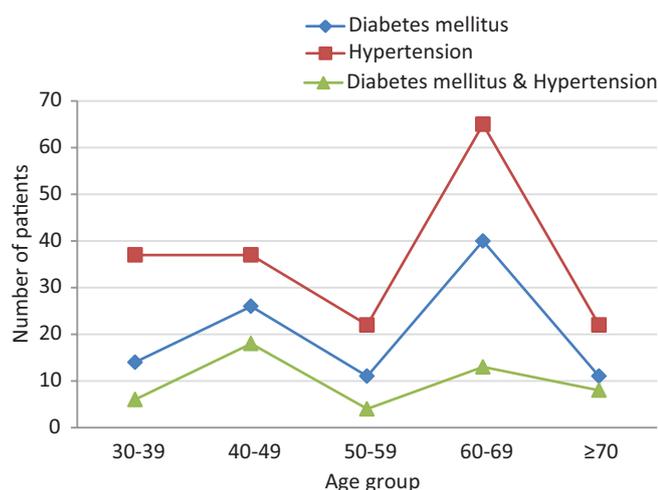
Variables	Patients having both Diabetes Mellitus and Hypertension		Mean difference (95% CI)	P value*
	Present (Mean±SD)	Absent (Mean±SD)		
Age	48.2±11.3	42.5±9.6	5.7(3.4-8.3)	0.001
Systolic Blood Pressure	138.1±22.2	112.2±10.8	25.9(23.8-29.1)	0.001
Diastolic Blood Pressure	84.5±8.5	75.8±8.3	8.7 (7.2-10.9)	0.001
Body mass index	27.5±6.1	24.8±3.8	2.7 (1.8-4.1)	0.001
Waist hip ratio	0.92±0.5	0.90±0.1	0.02(0.01-0.05)	0.001
Waist circumference (cm)	89±10	84±13	5.0 (3.4-7.9)	0.001

\*t- independent t test

**Table-6:** Mean and SD of variables with patients having both Diabetes Mellitus and Hypertension

Variables	β coefficient	Odds ratio (95% confidence interval)	P value
Age group			
30-39	Reference		
40-49	1.3	5.1 (3.6-8.9)	<0.05
50-59	3.1	12.1 (6.1-25.2)	<0.05
60-69	3.3	23.9 (6.5-26.8)	<0.05
≥70	3.2	25.1 (10.1-28.2)	<0.05
Waist circumference (cm)			
<90 male	Reference		
<80 female			
≥90 male	1.2	3.2 (1.8-4.5)	<0.05
≥80 female			
Body Mass Index (kg/m <sup>2</sup> )			
<18.5 (Underweight)	Reference		
18.5-24.9 (Average)	2.12	3.8 (1.0- 9.9)	<0.05
≥25.0 (Overweight)	0.8	1.5 (0.9-4.1)	<0.05
Waist hip ratio			
<0.80 male	Reference		
< 0.80 female			
≥ 0.95 male	2.1	1.1(0.8-1.8)	>0.05
≥ 0.80 female			

**Table-7:** Multivariate analysis for risk factors of patients having both Diabetes Mellitus and Hypertension



**Figure-1:** Frequency distribution of patients diagnosed with Diabetes mellitus, Hypertension and both with respect to age group.

with both positive diabetes mellitus and hypertension were female. Age group 30-39 years and 50-59 years were showing minimum number of patients. In which percentage of male patients were higher as compare to female patients. Age group 70 and above years, there were no any male found, all of them were female patients. There was highly significant association between age and gender of individuals having both diabetes mellitus and hypertension. (table 4)

Figure 1 shows that the number of patients identified with diabetes mellitus, hypertension and both with respect to age group. As clearly shown in figure 1 that majority of individuals were suffering with DM. Line of both diabetes mellitus & hypertension and hypertension was approximately coincide at the age group 70 and above years. At the age group 60-69 years most of the individual were suffering with hypertension as compare to other two groups. Followed by number of patients suffering with DM and minimum number of patients positive in both diabetes mellitus & hypertension, in all the age groups. All the three categories were showing minimum number of patients in the age group 50-59 years. (figure 1)

Table 5 shows 165 individuals were sedentary worker, 222 were moderate worker and 282 were vigorous worker. The prevalence of those patients having both Diabetes Mellitus and Hypertension among moderate worker was found to be high as (10.8%) and vigorous workers (2.9%). It can be seen that as the physical activity increases prevalence decreases in patients having both Diabetes Mellitus and Hypertension. Majority of the study subjects were belongs to average category. In which only 6.9% subjects suffering with both Diabetes Mellitus and Hypertension. Maximum number of Patients having both Diabetes Mellitus and Hypertension was found in Overweight category followed by average category of BMI. Whereas, no any individual was in underweight category. (table 5)

Table 6 depicted that the mean ( $\pm$ SD) of age, SBP, DBP, BMI, WHR and WC, were higher among the patients having both Diabetes Mellitus and Hypertension subjects compared with the patients not having both Diabetes Mellitus and

Hypertension and there was a significant difference present between the 2 groups ( $P < 0.05$ ).

The binary logistic regression analysis showed that the odds of being disease in the age group of 40-49, 50-59, 60-69 and above 70 years was 5.1, 12.1, 23.9 and 25.1 times, respectively. With regard to the anthropometric risk factors, being overweight, raised waist circumference and waist hip ratio are 1.5, 3.2 and 1.1 times higher odds of being disease. Waist hip ratio are not statistically associated with disease after doing regression analysis. (table 7)

## DISCUSSION

Diabetes and hypertension are among the most common non-communicable diseases affecting our population. India has become the Diabetes Capital of the World with more than 62 million individuals (as of 2014) diagnosed with diabetes.<sup>18</sup> According to National Family Health Survey-4 (2015-2016) the prevalence of hypertension among adults was 22.4% (men-13.6% and women-8.8%).<sup>19</sup> While prevalence is approximately 27.4% in the present study. In which majority of female enduring hypertension, i.e., 19.1%. Whereas, only 8.2% of total were male hypertensive patients. Hypertensive patients were highest in the age group 60-69 years. Prevalence of diabetes has increased exponentially throughout the world from 108 million in 1980 to 422 million in 2014. Throughout the world, the diabetic prevalence among adults over 18 years of age has increased rapidly from 4.7% in 1980 to 8.5% in 2014. The middle and low-income countries are worst affected by diabetes owing to its rapid rise in prevalence in the recent past.<sup>20</sup> Giri et al., revealed in their study that 17.1% adult population diagnosis of hypertension whereas 26% population were detected having high blood pressure.<sup>21</sup> Prevalence of 26% with 40.3% for 45 to 54 years age, 42% for 55 to 64 years and 56.8% for 65 to 74 years against that in the Nepalese population of 14.2% in 40 to 49 years age, 25.9% in 50 to 59 years and 34% in 60 to 74 years.<sup>22</sup> In the present study, approximately fifty percent of total diabetes mellitus patient were belonging to age above 60 years. Prevalence of diabetes in the present study is 15.2%. In which nearly both gender having equal percentages of diabetes mellitus, i.e., 7.03% female and 8.2% of total were male diabetes mellitus patients. This study is compared with similar studies in the neighboring countries.<sup>23-27</sup> Population prevalence of diabetes in urban Bhutanese was 8.2% (Male: 8.6%, Female: 7.7%) against that in urban Indians aged 20 years and more of 12.1%, Nepalese urbanites 15.7 to 16.6% and Dhaka of 11.2%, which is observed to be lesser than in the neighboring countries.<sup>28-30</sup> Diabetes mellitus and hypertension are inter-related diseases that strongly predispose an individual to atherosclerotic cardiovascular disease.<sup>9,10</sup> Hypertension is about twice as frequent in individuals with diabetes as in those without.<sup>10</sup> The prevalence of coexisting hypertension and diabetes appears to be increasing in industrialized nations because populations are aging and both hypertension and non-insulin dependent diabetes mellitus incidence increases with age.<sup>9,10</sup> Present study shows similar findings, forty-nine individuals who were positive with both diabetes mellitus

and hypertension. Majority of patients were belonging to age group 40-49 years. Age group 70 and above years, there were no any male found, all of them were female patients. For all these reasons, hypertension and diabetes should be recognized and treated early and aggressively. Mohan et al.,<sup>31</sup> had also found sedentary life style as an important risk factor for development of diabetes. Furthermore, in present study proportion of those patients having both Diabetes Mellitus and Hypertension among moderate worker was found to be high as and vigorous workers. Whereas, Valliyot et al.,<sup>32</sup> also stated that those who were involved in more physical activity were less prone for Diabetes Mellitus. Pandya et al.,<sup>33</sup> showed that prevalence of obesity is more in diabetic's individuals. Further in his study, increased waist circumference was also found in diabetic's individuals. Jayawardena<sup>34</sup> concluded in his study that higher BMI and high waist hip ratio had increased risk of diabetes mellitus. In multivariate analysis, higher in age, waist circumference and obesity were the independent risk factors of hypertension as reported by present study and other study supported.<sup>35</sup> In present study majority of patients having both diabetes mellitus and hypertension was found in overweight class.

## CONCLUSIONS

To reduce the disease burden due to diabetes and hypertension, primary prevention measures such as health education regarding adoption of healthy lifestyle should be instituted. Interventions such as screening and early initiation of treatment should also be made for controlling the diseases and preventing its complications. Since the prevalence of both hypertension and diabetes increases after forty years of age, screening program should be instigated for early finding of these two diseases. Early initiation of handling for both the diseases could guide to their useful control and prevention of future complications. Diabetic patients should be advised about proper self-care.

**Ethical approval:** The study was approved by the Institutional Ethics Committee

## REFERENCES

- Whiting DR, Guariguata L, Weil C, Shaw J. IDF diabetes atlas: Global estimates of the prevalence of diabetes for 2011 and 2030. *Diabetes Res Clin Pract* 2011;94:311-21.
- Wild S, Roglic G, Green A, Sicree R, King H. Global prevalence of diabetes. Estimates for the year 2000 and projections for 2030. *Diabetes Care* 2004;27:1047-53.
- Zimmer P, Alberti KG, Shaw J. Global and societal implications of the diabetes epidemic. *Nature* 2001;414:782-7.
- Shaw JE, Sicree RA, Zimmet PZ. Global estimates of the prevalence of diabetes for 2010 and 2030. *Diabetes Res Clin Pract* 2010;87:4-14.
- American Diabetes Association. Type 2 diabetes in children and adolescents. *Diabetes Care* 2000;23:381-9.
- Goldberg RB, Capuzzi D. Lipid disorders in type 1 and type 2 diabetes. *Clin Lab Med* 2001;21:147-72.
- Wingard DL, Barrett-Connor E. Heart disease and diabetes. In: *Diabetes in America*. 2nd ed. Bethesda:

- National Diabetes Data Group, National Institutes of Health; 1995. p. 429-48.
- Haffner SM, Lehto S, Ronnema T, Pyorala K, Laakso M. Mortality from coronary heart disease in subjects with type 2 diabetes and in nondiabetic subjects with and without prior myocardial infarction. *N Engl J Med* 1998;339:229-34.
- Epstein M, Sowers JR. Diabetes mellitus and hypertension. *Hypertension* 1992;19:403-18.
- The National High Blood Pressure Education Program Working Group. National High Blood Pressure Education Program Working Group report on hypertension in diabetes. *Hypertension* 1994;23:145-58.
- Chen G, McAlister FA, Walker RL, Hemmelgarn BR, Campbell NR. Cardiovascular outcomes in framingham participants with diabetes: The importance of blood pressure. *Hypertension* 2011;57:891-7
- Anjana MR, Pradeepa R, Deepa M, Datta M, Sudha V, Unnikrishnan R et al. The Indian Council of Medical Research-India Diabetes (ICMR-INDIAB) Study: Methodological Details. *J Diabetes Sci Technol* 2011; 5: 906-914.
- World Health Organization. Waist circumference and waist-hip ratio: Report of a WHO expert consultation, Geneva, 8-11 December 2008. World Health Organization. Available from: <https://apps.who.int/iris/handle/10665/44583>.
- World Health Organization. Social determinants of health, 2017. Available from: [http://www.who.int/social\\_determinants/en/](http://www.who.int/social_determinants/en/).
- WHO EC. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet* (London, England) 2004;363:157.
- Joint National Committee on the Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. The seventh report of the joint national committee on the prevention, detection, evaluation, and treatment of high blood pressure: The JNC 7 report. *JAMA* 2003;289:2560-72.
- American Diabetic Association. Diagnosis and classification of DM. *Diabetes Care* 2004;27:S5-10
- Joshi SR, Parikh RM. India - Diabetes Capital of the World: Now Heading Towards Hypertension, *JAPI, Editorial*. 2007;55:323-4.
- Hariharan S, Umadevi R, Stephen T, Pradeep S. Burden of diabetes and hypertension among people attending health camps in an urban area of Kancheepuram district. *Int J Community Med Public Health* 2018;5:140-3
- Global status report on non communicable diseases 2014. Geneva, World Health Organization, 2012.
- Giri BR, Sharma KP, Chapagai RN, Palzom D. Diabetes and hypertension in urban bhutanese men and women. *Indian J Community Med* 2013;38:138-43.
- Shrestha UK, Singh DL, Bhattarai MD. The prevalence of hypertension and diabetes defined by fasting and 2h plasma glucose criteria in urban Nepal, *Diabetes UK. Diabet Med* 2006;23:1130-5
- Verma NP, Madhu SV. Prevalence of known diabetes in urban east Delhi. 17th International Diabetes Federation

- Congress, Mexico city. *Diabetes ResClinPract* 2000;50 Suppl 1: S1-474.
24. Iyer RS, Iyer RR, Upasani SV, Baitule MN. Diabetes Mellitus in Dombivli.an urban population study. 17th International Diabetes Federation Congress, Mexico City. *J Assoc Physicians India* 2001;49:713-6.
  25. Ramaiya KL, Kodali VR, Alberti KG. Epidemiology of Diabetes in Asian of Indian sub continent. *Diabetes Metab Rev*1990;6:125-46.
  26. Ramachandran A, Snehalatha C, Latha E, Manoharan M, Vijay V. Impact of urbanization on the life style and on the prevalence of diabetes in native Asian Indian population. *Diabetes Res ClinPract* 1999;44:207-13.
  27. Ramachandran A, Snehalatha C, Latha E, Vijay V, Viswanathan M. Prevalence of NIDDM in urban population in India. *Diabetologia*1997;40:232-7.
  28. Shrestha UK, Singh DL, Bhattarai MD. The prevalence of hypertension and diabetes defined by fasting and 2-h plasma glucose criteria in urban Nepal, *Diabetes UK. Diabet Med* 2006;23:1130-5.
  29. Sayeed MA, Mahtab H, Khanam PA, Latif ZA, Banu A, Khan AK. Prevalence of diabetes and impaired fasting glucose in urban population of Bangladesh. *Bangladesh Med Res Council Bull* 2007;33:1-12.
  30. Ramachandran A, Snehalatha C, Kapur A, Vijay V, Mohan V, Das AK, et al. For the Diabetes Epidemiology Study Group in India (DESI). High prevalence of diabetes and impaired glucose tolerance in India: National Urban Diabetes Survey. *Diabetologia* 2001;44:1094-101.
  31. Mohan V, Mathur P, Deepa R, Deepa M, Shukla DK, Menon GR, et al. Urban rural differences in prevalence of self-reported diabetes in India - the WHO-ICMR Indian NCD risk factor surveillance. *Diabetes Res ClinPract* 2008; 80: 159-68.
  32. Valliyot B, Sreedharan J, Valliyot SB, Muttappallymyalil J. Demographic parameters associated with Type 2 Diabetes Mellitus in North Kerala, India. *American Journal of Research Communication* 2014; 2: 39-48.
  33. Pandya H, Lakhani JD, Patel N. Obesity is becoming synonym for diabetes in rural areas of India also – an alarming situation. *Int J Biol Med Res* 2011; 2: 556-60.
  34. Jayawardena R, Ranasinghe P, Byrne NM, Soares MJ, Katulanda P, Hills AP. Prevalence and trends of the diabetes epidemic in South Asia: a systematic review and meta-analysis. *BMC Public Health* 2012; 12:380:1-11
  35. El Bcheraoui C, Memish ZA, Tuffaha M, Daoud F, Robinson M, Jaber S, et al. Hypertension and its associated risk factors in the Kingdom of Saudi Arabia, 2013: A national survey. *IntJHypertens* 2014;2014:564679.

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