

COEXISTENCE OF DIABETES MELLITUS AND HYPERTENSION AND ITS CORRELATES AMONG ADULTS IN RURAL INDIA: A COMMUNITY-BASED STUDY

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ABSTRACT

Background: A tremendous increase in the co-occurrence of Hypertension (HTN) and Diabetes mellitus (DM) all over the world including India is seen, which is nowadays considered as a major public health problem. These two multifactorial disorders are the gateway to the cardiovascular diseases. The coexistence of DM and HTN worsens clinical outcomes.

Aim and Objectives: To determine burden of coexistence of HTN and DM and factors affecting them in adult population of Dehradun.

Methodology: A cross sectional survey was conducted covering all households in the randomly selected 30 villages of district Dehradun, Uttarakhand by house-to-house visit. A pre-validated, structured questionnaire was used for collecting data on sociodemographic profile, addiction, physical activity, stress, sleep. Blood pressure, random blood sugar and anthropometric measurements were done. Appropriate statistical tests were applied.

Result: Out of total 1946 participants, 56.2% women and 43.8% men also 39.1% (749) were found Hypertensive, 16.1% (313) Diabetics and 8.9% (173) had Coexistence of both. Maximum number of participants suffering from Hypertension, Diabetes and Co-existence of both belonged to the age group >60 years and were males. The odds of getting coexistence is more among those > 40 years (OR: 4.137), males (OR: 1.636), those with high WC (OR: 1.647) and high BMI (OR: 1.478).

Conclusion: The prevalence of diabetes, hypertension and coexistence of both was quite high in the present study. Interventions to be taken at an earliest to reduce the incidence of complications and its associated mortality.

Keywords: Diabetes Mellitus, Hypertension, Co-existence, Correlates

INTRODUCTION

Non-communicable diseases such as heart disease, cancer, diabetes, hypertension and chronic lung diseases are rapidly increasing worldwide. They have gradually overtaken infectious disease as the leading cause of morbidity and mortality worldwide as well as India [1]. India is in the midst of a rapid epidemiological transition: the estimated proportion of disability-adjusted life-years (DALYs) attributable to NCDs in India has risen from 31% of total DALYs in 1990 to 55% in 2016 [2]. An increasing prevalence of Diabetes Mellitus (DM) and Hypertension (HTN) is thought to be both an important driver and consequence of this transition. These both are the, most common non communicable diseases which have emerged as public health issues as they are the gateway of cardiovascular diseases including coronary artery disease, heart disease and strokes [3]. In the year 1995 the global prevalence of DM was 4% and predicted to rise 5.4% by the year 2025 [4,5]. Also, worldwide total number of hypertensive populations predicted to be 1.5 billion by the year 2025 from 1.0 billion in the year 2011 [4,5].

Hypertension is commonly found in patients with diabetes and vice versa. Out of the total population suffering from diabetes, half of them is hypertensive and about 5% to 25% of population with hypertension

are suffering from diabetes [6]. The coexistence of DM and HTN have been reported in various studies. The prevalence of such coexistence varies from 40% to 60% among patients with type2 DM depending on ethnic, racial and social group [5,7]. In most of the cases HTN may precede the onset of DM. In some cases, HTN and DM may be present together at the time of initial diagnosis [8]. As reported from Hypertensive Diabetes Study (HDS)-1 39% of the patients were hypertensive at the time of diagnosis of DM [9]. In a large prospective cohort study among adults reported that the development of type2 DM was almost 2.5 times more in hypertensive patients than normotensive counterpart [10]. Thus, the global burden for coexistence of diabetic and hypertension become the threat to world health care services.

People with coexistence of DM and HTN are more prone to develop atherosclerosis, retinopathy and nephropathy. Coronary artery disease and left ventricular hypertrophy are more common in diabetic hypertensive patients than the patients suffering from either DM or HTN [3,11]. Indeed, when hypertension coexists with diabetes, the risk of CVD is increased by 75%, which further contributes to the overall morbidity and mortality of an already high-risk population [3,12]. This coexistence is a major risk factors to the development and progression of macrovascular and microvascular complications in people with diabetes compared to the general population [3,13]. From the public health point of view such Epidemiologic studies have an important clinical impact and should form a scientific basis for clinical and public health practice. As primary health care is the first point of contact of the individuals, family, and the community with the health system at the national level so an integrated approach is needed at primary health care level for addressing the burden of HTN and DM. As a result, the present study was undertaken to assess the burden of coexistence of HTN and DM in and factors affecting them in adult population of Dehradun.

MATERIALS & METHODS

Study Setting

Uttarakhand is one of the hilly states of the India with more than 70% rural population. Multistage sampling technique was used to calculate desired sample. State has 13 districts; out which district Dehradun was selected. Dehradun has six blocks; present study was conducted in Doiwala block of district Dehradun. As per census 2011 there are 44 villages in Doiwala block. Out of which 30 villages were selected randomly for the study.

Study Procedure

A community based cross sectional survey was conducted covering all the households in the randomly selected villages by house-to-house visit. Study was conducted from April 2018 to November 2019. Sample size was calculated based on estimate of prevalence of controlled hypertension for rural Indians as 10.7% based on meta-analysis of prevalence, awareness and control of Hypertension [14]. Considering absolute precision of 2 percent at 5percent level of significance and 2 design effect, Sample size came out to be 1900. But a total of sample 1946 was taken for analysis. The objectives and procedure of data collection were explained to each subject. An informed written consent was obtained from each subject prior to data collection.

Inclusion Criteria:

Persons who were above 19 years of age both male and female and willing to participate in the study after obtaining informed consent.

Exclusion Criteria:

Pregnant women and those who did not give consent to participate in the study.

Study tool and it's administration-

A pre-validated, structured questionnaire was used for capturing data. Questionnaire included information on Sociodemographic profile (age, sex, education, occupation and type of family), addiction (alcohol and smoking), physical activity, sleep pattern and level of stress. Measurements included anthropometric measurements such as weight, height, waist circumference, hip circumference to calculate Body Mass Index (BMI) and Waist Hip Ratio (WHR). Asian criteria for obesity was used at cut-off point of BMI ≥ 24.9 kg/m² [15] and abdominal obesity was defined as WC ≥ 90 cm. for male and ≥ 80 cm for female and WHR $\geq .95$ for male and $\geq .85$ for females [16]. Also, participants were asked about their status of Hypertension and Diabetes. Blood pressure and random blood sugar level was measured. Questionnaire was administered to participants in Hindi language by 10 field research investigators. Each of them was briefed and trained in the methodology for asking questions. A training manual was developed and provided to each field research Investigator as ready reckoner. To help reduce inter-observer variability,

three supervisors (medical and nursing faculty) of Institute, assisted in data collection. Furthermore, every 10th questionnaire was checked by supervisors.

Definitions

Hypertensive: Hypertension was defined as having SBP of 140mmHg or greater &/or DBP of 90mm Hg or greater or both or treatment with antihypertensives [17].

Diabetes: Diabetes was defined as having impaired blood glucose level of ≥ 140 mg/dL if patients reported not fasting as per the recommendations of the International Diabetes Federation and WHO) [18].

Coexistence of Hypertension and Diabetes: Those having SBP of 140mmHg or greater &/or DBP of 90mm Hg or greater or both or treatment with antihypertensives and impaired blood glucose level of ≥ 140 mg/dl or higher.

Blood Pressure Measurement

Blood pressure was measured using digital Omron HEM-7080 [19] digital Blood pressure instrument in sitting position in right arm to nearest of 1 mm Hg. Participants were asked to sit quietly and rest for 5 minutes then two readings were taken. Participants were asked to rest for three minutes between each of the reading. During data analysis mean of two readings were calculated. JNC VII guidelines were followed for defining hypertension.

Blood Glucose Measurement

Fasting blood sugar was measured using Accu-Chek Active glucometer with measuring range of 10–600 mg/dL [20]. American Diabetes Association (ADA) guidelines for defining Diabetes according to American Diabetic Association guidelines.

Sleep Pattern Measurement

Epsworth sleepiness scale (ESS) was used to collect information on sleep pattern [21].

Stress level Measurement

Perceived stress scale was used to collect information on level of stress [22].

Statistical Analysis

Data was collected and analysed using SPSS 25. Data management tools were utilized to avoid duplication and entry error. Data was analysed using descriptive statistics. Categorical variables were documented in terms of frequency and proportion and continuous variables in terms of mean with standard deviation and median with interquartile range. Inferential statistics were used to compare proportion or mean in two or more different groups. Chi-square tests was applied among groups to compare their differences. Odds ratios (OR) and 95% confidence intervals (CI) was calculated based on logistic regression models. The p value ≤ 0.05 was the cut off point for statistical significance.

Ethical Consideration

Ethical approval for the study was obtained from Research and Ethics committee of Institute. All the patients were provided reports of Blood pressure and diabetes and were appropriately referred to medicine OPD of AIIMS, Rishikesh, if needing consultation.

RESULTS

Total 1946 participants were included in the study with 56.2% women and 43.8% men. 72.4% of the study participants were above 40years of age and majority of them were living in nuclear families (58.5%). 30% of them were illiterate or educated up to primary level, while 14% of them were postgraduates. About one third of them were employed in formal sector and approximately half of them were student, homemaker and retired. Approximately 10% were self-employed.

Table 1 depicts out of total 1946 screened, 39.1% (749) were found Hypertensive, 16.1% (313) were found to be Diabetics and 8.9% (173) had Coexistence of both Hypertension and Diabetes. Maximum number of participants suffering from Hypertension, Diabetes and Co-existence of both conditions belong to the age group of >60 years. Majority of the males are suffering from hypertension (46.4%), diabetes (16.5%) and co-existence of both conditions (10.3%) but this difference is not statistically significant. There is a significant statistical association between increasing age and occurrence of diabetes and hypertension. In our study it was found that majority of the participants were living in three generation family irrespective of their comorbidity status. About 42.3% hypertensive, 19.3% diabetic and 8.9% participants suffering from both conditions were found to be illiterate. Majority of the hypertensive participants (69%) were retired whereas the number of participants suffering from diabetes (25.1%) and co-existence of both conditions (18.9%) were higher in unemployed group.

Table 2 reveals those subjects suffering from co-morbidities have high waist circumference (11.5%), high WHR (10.6%), high BMI (12.1%). It was found that addiction of either alcohol (12.9%) or smoking

(13.0%) was significantly higher in participants suffering from any of the given co-morbidities. Also decreased sleep (12.2%) was significantly higher in subjects with coexistence.

Table3 depicts Univariate simple linear binary logistic regression analysis of correlates of coexistence of hypertension and diabetes. All the factors found to be statistically significant ($p < 0.05$) on chi square test were evaluated using logistic regression analysis. On univariate analysis factors such as men, increasing age, high BMI, high WC analysed were found to be significantly associated with coexistence. Study participants belonging to age group > 40 years were associated with 4.137 times greater risk having coexistence of both than those of age ≤ 40 years. Similarly, the odds of getting coexistence is more among males (OR: 1.636), those with high WC (OR: 1.647) and high BMI (OR: 1.478).

DISCUSSION

A total of 1946 subjects were included in the present study out of which 56.2% are women and 43.8% men. Similar study was done by **Saxena et al (2011) (23)** in Dehradun, Uttarakhand reported that out of total 707 study participants 43.3% were males and 56.7% females. Out of the total study participants screened prevalence of Hypertension was found to be 39.1% diabetes 16.1%. **Kapil et al (2018) (24)** conducted study in Nainital, Uttarakhand reported a little higher prevalence of HTN (54.5%) but almost similar prevalence of diabetes (14.6%). On the contrary study done by **Saxena et al (2011) (23)** in Dehradun Uttarakhand reported almost very low prevalence of hypertension (6.7%), prehypertension (25.2%), diabetes (3.7%) and pre diabetes (2.8%). Also study done by **Saxena et al (2012) (25)** in Rishikesh Uttarakhand among elderly reported prevalence of hypertension (30.8%) and diabetes (8%). Prevalence of co-existence of Hypertension and Diabetes was found to be 8.9% in the present study. But a lower prevalence of coexistence was seen in study conducted by **Hariharan et al (2018) (26)** who conducted study in Anakaputhur area of Kancheepuram district reported prevalence of coexistence to be 5.7%.

In the present study prevalence of HTN was in males (46.4%) and females (32.4%) and prevalence of DM was in males (16.5%) and females (15.7%). This prevalence was much higher than the prevalence shown by **Kapil et al (2018) (24)** in Nainital, Uttarakhand reported that the prevalence of HTN was in males (20.3%) and females (34.2%) and prevalence of DM was in males (5.2%) and females (9.4%).

In the present study prevalence of Hypertension was statistically more in the age > 60 years (61.7%), males (46.4%), those who consumed alcohol (54.1%), smoking (55.7%), had decreased sleep (45.8%), high BMI (47.1%), high WC (45.0%) and high WHR (41.1%). Similar results were shown by **Kapil et al (2018) (24)** in Nainital, Uttarakhand reported that age, education, income, tobacco consumption, MNA, physical activity, and BMI were found to be significantly associated with HTN ($P < 0.05$).

Similarly in the present study prevalence of diabetes was significantly more in age > 60 years (22.9%), males (16.5%), those who were illiterate or were educated up to primary level (42.3%), those who were retired (69.0%), had high WC (19.5%), high WHR (18.7%), high BMI (20.8%), bad sleep habits (19.1%) and high level of stress (25.0%). Similar results were shown by **Kapil et al (2018)** in Nainital, Uttarakhand reported that education, income, socioeconomic status, MNA, BMI, and total cholesterol were found to be significantly associated with DM ($P < 0.05$).

It is seen in the present study that prevalence of coexistence was statistically more in the subjects belonging to age group > 60 years (15.4%) and males (10.3%). But **Radhakrishnan et al (2015) (27)** in Tamil Nadu reported that coexistence was more in age group 40 – 60 years and in males. Also, in the present study coexistence was significantly associated with high BMI (12.1%), high Waist Hip Ratio (10.6%) and high Waist Circumference (11.5%) and similar results shown by **Balogun et al (2011) (28)** in Nigeria reported that the those with coexistence of hypertension and diabetes significantly had higher BMI ($p = 0.04$), higher hip/waist ratio ($p = 0.01$) and higher waist circumference ($p = 0.04$). **Tiptaradol et al (2012) (29)** in Thai also reported similar results factors associated with coexistence of diabetes and hypertension included; age ≥ 60 years (adjust odds ratio 1.38, 95%CI 1.14, 1.73), having education less than 6 years (1.83, 95%CI 1.03, 3.38) and abdominal obesity (2.49, 95%CI 2.00, 3.10).

In the present study, study participants belonging to age group > 40 years were associated with 4.137 times greater risk having coexistence of both than those of age ≤ 40 years. Similarly, the odds of getting coexistence are more among males (OR: 1.636), those with high WC (OR: 1.647) and high BMI (OR: 1.478). Similar study was done by **Tiptaradol et al (2012) (29)** which depicted that the factors associated with the coexistence of both conditions included: age ≥ 60 years (OR: 1.38) living in urban area (OR: 1.15), having education less than 6 years (OR: 1.83) and abdominal obesity (OR: 2.49).

CONCLUSION

A high prevalence of HTN, DM and coexistence of both was found in adult population residing in rural area of Uttarakhand. This coexistence was higher as the age increased, among men and those who were retired and unemployed. Coexistence was also significantly higher in those having obesity, central obesity, addicted to smoking and alcohol and having poor sleep habit. Both DM and HTN often comes hand in hand with each other. Preventing HTN, DM and their coexistence is a great challenge in developing country like India.

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