Original Article

Prevalence of hypertension, diabetes, and associated risk factors among geriatric population living in a high-altitude region of rural Uttarakhand, India

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Abstract

Background: Hypertension (HTN) and diabetes mellitus (DM) both are rapidly emerging as public health problems among geriatric population in developing countries. HTN can lead to stroke, myocardial infarction, congestive heart failure, and chronic kidney diseases among geriatric population. DM increases the risk of coronary heart disease, cerebrovascular disease, peripheral vascular disease, retinopathy, nephropathy, and neuropathy among geriatric population. **Methodology:** A community-based, cross-sectional study was conducted during 2015–2016 in District Nainital, Uttarakhand. A list of all villages with their population in the district was developed. From this list, 30 villages were identified using population proportionate to size sampling method. From each village, 30 geriatric subjects were selected. A total of 1003 geriatric subjects age 60 years and above were included in the study. Data were collected on sociodemographic profile, blood pressure, fasting blood glucose, anthropometry, and lipid profile from all the enrolled subjects. The prevalence of HTN and DM was assessed. Univariate and multivariate analyses were done to identify risk factors associated with HTN and DM. **Results:** The prevalence of HTN and DM was found to be 54.5% and 14.6%, respectively. For HTN, advancing age, high educational level and body mass index (BMI) (≥25 kg/m^2) and for DM higher education level and BMI (≥25 kg/m^2) were found to be significant risk factors. **Conclusion:** A high prevalence of HTN and DM was found in geriatric population residing in rural area of Uttarakhand.

Keywords: Diabetes, geriatric, high-altitude, hypertension

Introduction

Hypertension (HTN) and diabetes mellitus (DM) both are rapidly emerging as public health problems in developing countries.[1,2] HTN and DM are high in geriatric population across all geographical area and sociodemographic groups in India.[3,4] HTN and DM affect 1 billion[5] and 422 million[6] people worldwide, respectively. Prevalence of HTN among geriatric population was found to be 67.2% in Delhi and 63.6% in Assam.[7,8] Prevalence of DM among geriatric population was found to be 24.0% in Delhi.[7] Earlier studies have reported that the prevalence of HTN and DM was higher among elderly compared with middle age or young adults.[9,10] HTN can lead to cardiovascular disease, stroke, myocardial infarction, congestive heart failure, and chronic kidney diseases.[11] Likewise, DM

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increases the risk of coronary heart disease, cerebrovascular disease, peripheral vascular disease, retinopathy, nephropathy, and neuropathy.[12] According to World Health Organization (WHO), HTN is one of the most important causes of premature death globally.[13] Epidemiology of HTN and DM varies in India because it is a diverse country and people follow different lifestyle practices in different states. There is a lack of scientific evidence on the prevalence and risk factors associated with HTN and DM among geriatric population living at high-altitude region of India. Hence, this study was conducted.

Methodology

A community-based, cross-sectional study was conducted during 2015–2016 in district Nainital, Uttarakhand state, India. The district is situated at an altitude of 2084 m. A total of 1003 geriatric population were enrolled from 30 clusters (villages) identified using population proportionate to size sampling methodology. After reaching the village, the village president member was contacted. From the selected village, one lane was selected randomly. From the selected lane, one household was selected randomly. The survey was initiated from the selected first household and contiguously covered all the required number of subjects from that cluster. Thirty geriatric subjects in the age group of 60 years and above were selected from each cluster by house-to-house visit. The geriatric subjects were identified with the help of village-level health and nutrition functionaries such as anganwadi workers. However, they did not participate in data collection. 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.

An oral questionnaire was administered to obtain information on sociodemographic profile such as age, gender, caste, religion, financial dependency, educational qualification, occupation, family monthly income, type of house, type of family, marital status, and living arrangement. Information on alcohol use, tobacco consumption, Mini Nutritional Assessment (MNA), physical activity, and Barthel scale was obtained through oral questionnaire. Estimation of blood pressure (BP), fasting blood glucose, and lipid profile was undertaken using standard procedure.

BP was measured using digital Omron HEM-7080[14] BP apparatus in the sitting position. Participants were asked to restrict alcoholic or caffeinated beverages and smoking at least 30 min prior to measurements. Before starting BP measurements, the participants were advised to relax in a sitting position for at least 5 min. The participant's left arm was placed on the table. The respondent's arm was positioned so that it is resting at the level of the heart. Two readings of BP were taken at 5 min intervals on the same arm. The mean of the two measures was taken as final reading. Medical records of the subjects were checked and subjects taking hypertensive drug were considered as hypertensive.

Subjects were classified as hypertensive when systolic blood pressure (SBP) was ≥140 mm Hg or diastolic blood pressure (DBP) was ≥90 mm Hg according to Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure.[15] Subjects with elevated BP were referred to a medical practitioner for treatment.

Fasting blood sugar was measured using Accu-Chek Active glucometer with measuring range of 10–600 mg/dL.[16] One day before the investigation, participants were instructed to remain fasting for blood glucose estimation. Each participant was asked to clean and rub his or her hands against each other to stimulate blood flow. Third (middle) or fourth (ring) finger of each subject was selected for collecting the blood. The finger tip was cleaned and punctured with a sterilized disposable lancet and a full drop of blood was allowed to form on finger. The first drop of the free flowing of blood was wiped off using a sterile swab. The second drop of blood was used to fill up the blood glucose strip for estimation of fasting blood glucose.

Medical records of the subjects were checked and subjects taking antidiabetic drug were considered as diabetic. Diagnosis of DM was done based on WHO criteria. Geriatric subjects having fasting blood glucose ≥126 mg/dL were considered as diabetic.[17] Subjects with elevated fasting blood glucose were referred to a medical practitioner for treatment.

Estimation of total serum cholesterol (TC) and triglyceride (TG) was done using Dried Blood Spot methodology.[18-20] Biochemical estimation of TC was done by cholesterol oxidase method, whereas TGs were estimated by glycerophosphate oxidase–peroxidase method using enzymatic kits from Randox Laboratories, Ltd. (UK).

The cutoff for TG (mg/dL) was used as normal <150 (normal), 150–199 (borderline high), and 200–499 (high). Similarly, TC (mg/dL) cutoff used was <200 (desirable), 200–239 (borderline high), and ≥240 (high). These cutoffs have been recommended by the third report of the National Cholesterol Education Program Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults (Adult treatment panel III).[21]

Weight: Weight (kg) was measured with an electronic weighing scale SECA model-813 to the nearest 100 g. Elderly subjects were asked to be barefoot and wear light clothing. They were asked to stand straight on a firm horizontal flat surface of scale, and weight on the screen was recorded. *Height:* Height (cm) was measured using SECA-213 portable stadiometer to the nearest 0.1 cm. The individual was asked to stand upright without shoes with his or her back against the vertical backboard, heels together, and eyes directed forward. Body mass index (BMI) was calculated using the following formula: BMI (kg/m^2) = weight (kg)/height (m^2). The cutoff of BMI (kg/m^2) used was <18.5 (underweight), 18.5–24.9 (normal), 25–29.9 (overweight and pre-obese), and ≥30 (obese) as per

WHO classification.[22] High BMI level (≥25 kg/m^2) included overweight and obesity category. The research was approved by the ethical committee of All India Institute of Medical Sciences, New Delhi.

Statistical analysis

Statistical Package for Social Sciences (SPSS) version 20.0 was used for conducting statistical analysis of data (IBM SPSS statistics for Windows, version 20; IBM Corp, Armonk, NY, USA). Chi-square test was applied to analyze the association of various parameters with HTN and DM among the geriatric population. Stepwise logistic regression analysis was applied to assess the independent contribution of different factors to the presence of HTN and DM.

Results

A total of 1003 geriatric subjects were approached for the study. BP and fasting blood sugar could be done for 994 and 1002 geriatric subjects; respectively.

The sociodemographic details of the geriatric subjects are depicted in Table 1. The mean age of the males was 69.5 ± 7.4 years and for female was 67.8 ± 7.2 years. Overall, 52.5% subjects were illiterate. In all, 576 (57.4%) subjects were economically dependent on other family members [Table 1].

In this study, 542 subjects were found to be diagnosed with HTN. Of these, 383 were detected during the present survey and 159 were earlier known cases on the basis of their medical records. Similarly, 146 geriatric subjects were found to be diagnosed with diabetes. Of these, 77 were earlier known cases on the basis of their medical records and 69 were detected during the present survey [Table 2].

A total of 8.6% (86/994) geriatric subjects had both HTN and DM. This concomitant prevalence of HTN and DM was higher in female (58.1%) compared with male (41.9%).

The overall prevalence of HTN was 54.5%; males (20.3%) and females (34.2%). The overall prevalence of DM was 14.6%; males (5.2%) and females (9.4%) [Tables 3 and 4].

Risk factors of hypertension

Age, education, income, tobacco consumption, MNA, physical activity, and BMI were found to be significantly associated with HTN ($P < 0.05$). The prevalence of HTN was found to be higher (58.5%) in subjects who were doing irregular physical activity than those who were doing regular physical activity (41.5%) [Table 4].

In stepwise multivariate analysis, age (70–≥80 years), education of high school and above, satisfactory MNA, and BMI ≥25 kg/m^2 were observed to be significant and independent risk factors of HTN [Table 4].

Subjects with age 80 years and above were found to be two times at higher risk of developing HTN [adjusted odds ratio (AOR) = 2.18, 95% confidence interval (CI) =1.3–3.4] when compared with age group 60–<70 years. Geriatric subjects having satisfactory nutritional status were found to be at more risk of developing HTN (AOR = 2.41, 95% CI = 1.4–4.0) in comparison to subjects having poor nutritional status. The odds of becoming hypertensive increased with education of high school and above (AOR = 1.99, 95% CI = 1.2–3.1) and BMI ≥25 kg/m^2 (AOR = 1.77, 95% CI = 1.2–2.5) [Table 4].

Risk factors of diabetes

In this study, education, income, socioeconomic status, MNA, BMI, and total cholesterol were found to be significantly associated with DM ($P < 0.05$). The majority of geriatric subjects who had high cholesterol value (74%) were diabetic compared with subjects who had cholesterol in normal range (52.5%) [Table 5].

In multivariate logistic regression analysis, education of high school and above and BMI ≥25 kg/m^{2}were found to be significant and independent risk factors of developing DM. Living alone and high cholesterol level were found as an independent but not significant risk factors of DM [Table 5].

The risk for developing DM was found to be 2.19 times higher in subjects who received education of high school and above (95% CI = 1.4–3.5) and almost two times higher risk among subjects having BMI ≥25 kg/m^2 (AOR = 1.87, 95% CI = 1.3-2.7) [Table 5].

Discussion

In India, HTN and DM are the major causes of morbidity and mortality in geriatric population and are the risk factors of many other diseases including heart attack, stroke, kidney failure, leg amputation, vision loss, blood vessels, and peripheral nerve damage.

We found that 54.5% of subjects were suffering from HTN; of these, 383 of 542 (70.6%) were not aware about their status of HTN. Earlier studies have found the rate of undiagnosed HTN among geriatric population of Surat,[23] Uttarakhand,[24] Maharashtra,[25] and Kerala[26] to be 52.0%, 40.94%, 36.1%, and 34.6%, respectively.

Similarly, we found that 14.6 subjects were suffering from DM; of these, 69 of 146 (47.2%) were not aware about their presence of DM. Earlier study conducted in the state of Uttar Pradesh[27] reported 35.8% of prevalence of undiagnosed DM.

The prevalence of HTN reported in this study (54.5%) is comparatively higher than reported in earlier studies in Uttarakhand state which documented prevalence of 45.1%,[28] 41.2,[29] and 38.8%.[24] Earlier studies reported lower prevalence

Table 1: Distribution of elderly subjects according to sociodemographic profile (*n*=1003)

Sociodemographic profile	Male (*n*=363), *n* (%)	Female (*n*=640), *n* (%)	Total (*n*=1003), *n* (%)
Age (years)			
60-<70	197 (54.3)	397 (62.0)	594 (59.2)
70-<80	120 (33.0)	177 (27.7)	297 (29.6)
≥80	46 (12.7)	66 (10.3)	112 (11.2)
Caste			
SC	61 (16.8)	94 (14.7)	155 (15.5)
ST	12 (3.3)	10 (1.6)	22 (2.2)
OBC	6 (1.6)	10 (1.6)	6 (1.6)
Others	284 (78.2)	526 (82.2)	810 (80.7)
Religion			
Hindu	357 (98.3)	629 (98.3)	986 (98.3)
Muslim	3 (0.8)	1 (0.2)	4 (0.4)
Sikh	Nil	4 (0.6)	4 (0.4)
Christian	3 (0.8)	6 (0.9)	9 (0.9)
Economic dependency			
Yes	123 (33.9)	453 (70.8)	576 (57.4)
No	240 (66.1)	187 (29.2)	427 (42.6)
Education			
Illiterate	81 (22.3)	446 (68.7)	527 (52.5)
Primary school certificate	120 (33.1)	124 (19.4)	244 (24.3)
Middle school certificate	62 (17.1)	36 (5.6)	98 (9.8)
High school certificate	49 (13.5)	22 (3.4)	71 (7.1)
Intermediate or posthigh school diploma	28 (7.7)	6 (0.9)	34 (3.4)
Graduate and postgraduate	11 (3.0)	1 (0.2)	12 (1.2)
Professional and honors	12 (3.3)	5 (0.8)	17 (1.7)
Occupation			
Unemployed	54 (14.9)	481 (75.1)	535 (53.3)
Unskilled worker	133 (36.6)	104 (16.2)	237 (23.6)
Clerical, shop owner, farmer	13 (3.6)	2 (0.3)	15 (1.5)
Professional	163 (44.9)	53 (8.3)	216 (21.6)
Family income per month (Rs.)			
≤1865	93 (25.6)	138 (21.6)	231 (23.0)
1866-5546	125 (34.4)	286 (44.7)	411 (41.0)
5547-9248	46 (12.7)	103 (16.1)	149 (14.8)
9249-13,873	39 (10.7)	41 (6.4)	80 (8.0)
13,874-18,497	30 (8.3)	30 (4.7)	60 (6.0)
18,498-36,996	23 (6.3)	33 (5.1)	56 (5.6)
≥36,997	7 (1.9)	9 (1.4)	16 (1.6)
Type of house			
Kuccha	43 (11.8)	79 (12.3)	122 (12.2)
Semi-Pucca	73 (20.1)	105 (16.4)	178 (17.7)
Pucca	247 (68.1)	456 (71.2)	703 (70.1)
Type of family			
Nuclear	124 (34.1)	164 (25.6)	288 (28.7)
Joint	223 (61.4)	445 (69.5)	668 (66.6)
Extended	16 (4.4)	31 (4.8)	47 (4.7)
Marital status			
Married	328 (90.4)	265 (41.4)	593 (59.1)
Widowed	32 (8.8)	373 (58.3)	405 (40.4)
Divorced/separated	1 (0.3)	2 (0.3)	3 (0.3)
Never married	2 (0.5)	Nil	2 (0.2)
Living arrangement			
Alone	12 (3.3)	33 (5.2)	45 (4.5)
With spouse	40 (11.0)	48 (7.5)	88 (8.8)
With spouse and married children	196 (53.9)	191 (29.8)	387 (38.6)
With spouse and unmarried children	53 (14.6)	31 (4.8)	84 (8.4)
With married children only	62 (17.1)	337 (52.7)	399 (39.7)

SC: Scheduled caste; ST: Scheduled tribe; OBC: Other backward classes

Table 2: Distribution of elderly subjects according to prevalence of HTN and diabetes mellitus

Based on medical records (*n*=159), *n* (%)		Based on survey findings (*n*=383), *n* (%)		Total HTN (*n*=542), *n* (%)		Based on medical records (*n*=77), *n* (%)		Based on survey findings (*n*=69), *n* (%)		Total diabetic (*n*=146), *n* (%)	
Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
42 (20.8)	117 (34.4)	160 (79.2)	223 (65.6)	202 (37.3)	340 (62.7)	28 (53.9)	49 (52.1)	24 (46.1)	45 (47.9)	52 (35.6)	94 (64.4)

HTN: Hypertension

Table 3: Profile of HTN and impaired fasting glucose among geriatric subjects

Indicator	Male, *n* (%)	Female, *n* (%)	Total, *n* (%)
SBP (mmHg) (*n*=994)			
Normal (<120)	63 (17.6)	109 (17.1)	172 (17.3)
Pre-HTN (120-139)	107 (30.0)	213 (33.5)	320 (32.2)
Stage I HTN (140-159)	91 (25.4)	157 (24.7)	248 (25.0)
Stage II HTN (≥160)	97 (27.0)	157 (24.7)	254 (25.5)
DBP (mmHg) (*n*=994)			
Normal (<80)	126 (35.2)	217 (34.1)	343 (34.5)
Pre-HTN (80-89)	102 (28.5)	192 (30.2)	294 (29.6)
Stage I HTN (90-99)	80 (22.3)	141 (22.2)	221 (22.2)
Stage II HTN (≥100)	50 (14.0)	86 (13.5)	136 (13.7)
SBP and DBP (mmHg) (*n*=994)			
Normal (<120 or <80)	57 (15.9)	92 (14.5)	149 (15.0)
Pre-HTN (120-139 or 80-89)	99 (27.7)	204 (32.1)	303 (30.5)
Stage I HTN (140-159 or 90-99)	98 (27.4)	162 (25.5)	260 (26.1)
Stage II HTN (≥160 or ≥100)	104 (29.0)	178 (27.9)	282 (28.4)
Blood glucose level (mg/dL) (*n*=1002)			
Normal (<110)	270 (74.6)	482 (75.3)	752 (75.0)
Impaired fasting glucose (110-<126)	40 (11.0)	64 (10.0)	104 (10.4)
Diabetes (≥126)	52 (14.4)	94 (14.7)	146 (14.6)
Elderly subjects with HTN and DM (86/994)	36 (41.9)	50 (58.1)	-

HTN: Hypertension; SBP: Systolic blood pressure; DBP: Diastolic blood pressure; DM: Diabetes mellitus

of HTN in Maharashtra (46.3%),[25] Andhra Pradesh (32%),[30] Bangalore (31.5%).[31]

We found higher proportion of HTN in females (34.2%) as against their male counterparts (20.3%). Similar findings have been documented among geriatric population by other researchers in rural India (male 47.3%; female 53.3%),[32] Raipur city (male 42.3%; female 55.5%),[33] Wardha district (male 10.4%; female 10.0%),[25] high-altitude region of Ladakh (male 63.8%; female 67.0%),[34] and Punjab (male 38.5%; female 54.4%).[35]

In this study, the prevalence of DM was 14.6%, which was lower than the earlier studies done in Kerala (28.2%),[36] Kashmir (27.3%),[37] Andhra Pradesh (24%),[30] and Delhi (13%).[38] However, a study conducted in Uttarakhand among geriatric population has documented lower prevalence of DM (8.7%)[39] in comparison to this study. With regard to prevalence of DM by sex, we found that females have higher percentage (9.4%) in comparison to male subjects (5.2%). Similar findings have been reported by earlier researchers in India.[10,40] National Family Health Survey-4 has documented a prevalence of impaired fasting glucose of 8.8% among male and 6.1% among female adult population.[41]

HTN in conjunction with DM was found in a total of 8.6% geriatric subjects (in both male and females) in this study which was lower than reported in an earlier study conducted in Karnataka (9.02%).[42] Prevalence of HTN and DM varies in our study compared to earlier studies which might be due to variation in age, genetic background, lifestyle, environmental, methodological, diagnostic criteria, and geographical differences all over the country.

Risk factors associated with HTN were analyzed. We found that with advancing age, the risk of HTN increases and this difference was found to be significant. In the rural community-based, cross-sectional study, risk of HTN was found to be higher among population over age 80 years in comparison to population age 70–80 years of age.[43] Earlier studies reported significant association of HTN with advancing age.[33,44] Vascular stiffening among geriatric leads to increased SBP and SBP, increased pulse pressure, and increased pulse wave velocity which has an important role in the causation of HTN.[45-49] We observed that with increasing educational level, the odds of HTN increased. A similar finding was showed in an earlier study in Uttarakhand among geriatric population.[24] The prevalence of HTN was found to increase with BMI (≥25 mg/m^2). Higher BMI has been found to be an important predictor of HTN by other researchers also.[8,31,50,51] Similarly, a study done in rural India among geriatric population reported that higher BMI had twice the risk of having HTN among both males (OR = 1.9; CI = 1.4–2.5) and females (OR = 2.2; CI = 1.7–2.8).[31] We observed HTN higher among geriatric population with irregular physical activity, though this difference was not found significant. An earlier study found a significant positive association of HTN with physical activity.[33]

In this study, it was found that higher educational status and BMI are strongly associated with DM. Higher education influences the lifestyle pattern. Studies have documented that lifestyle modification is one of the most effective tools for primary prevention of diabetes in Asian Indians.[52] This study showed BMI as an independent significant risk factor for the development of diabetes. A study conducted by Bhalerao *et al.* had reported that BMI is a significant predictor of development of diabetes.[10] DM was found to be more associated with those having high blood cholesterol. A similar finding was observed by Bharti *et al.* which documented that subjects with hypercholesterolemia level are more likely to develop DM.[53]

Table 4: Factors associated with HTN: Results of bivariate and stepwise multivariate logistic regression analysis (*n*=994)

HTN variable	Yes (*n*=542), *n* (%)	No (*n*=452), *n* (%)	*P*	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Age (years)					
60-<70	297 (54.8)	291 (64.4)	0.004	1.0	1.0
70-<80	173 (31.9)	123 (27.2)		1.37 (1.0-1.8)	1.51 (1.1-2.0)
≥80	72 (13.3)	38 (8.4)		1.85 (1.2-2.8)	2.18 (1.3-3.4)
Gender					
Male	202 (37.3)	156 (34.5)	0.367	1.0	-
Female	340 (62.7)	296 (64.5)		0.88 (0.7-1.1)	
Economic dependency					
No	230 (42.4)	194 (42.9)	0.878	1.0	-
Yes	312 (57.6)	258 (57.1)		1.02 (0.8-1.3)	
Education					
Illiterate	267 (49.3)	256 (56.6)	0.003	1.0	1.0
Primary school C	130 (24.0)	111 (24.7)		1.12 (0.8-1.5)	1.17 (0.8-1.6)
Middle school C	53 (9.8)	44 (9.7)		1.15 (0.7-1.8)	1.14 (0.7-1.8)
High school certificate and above	92 (16.9)	41 (9.0)		2.15 (1.4-3.2)	1.99 (1.2-3.1)
Income (Rs.)					
≤1865	118 (21.8)	112 (24.8)	0.018	1.0	-
1866-5546	208 (38.4)	200 (44.2)		0.98 (0.7-1.4)	
5547-9248	80 (14.8)	66 (14.6)		1.15 (0.7-1.7)	
9249-13,873	51 (9.4)	28 (6.2)		1.72 (1.0-2.9)	
13,874 and above	85 (15.7)	46 (10.2)		1.75 (1.1-2.7)	
Socioeconomic status					
Lower	388 (71.6)	334 (73.9)	0.639	1.0	-
Middle	144 (26.6)	112 (24.8)		1.11 (0.8-1.5)	
Upper	10 (1.8)	6 (1.3)		1.43 (0.5-3.9)	
Marital status					
Married	323 (59.6)	264 (58.4)	0.705	1.0	-
Single/divorced/separated	219 (40.4)	188 (41.6)		0.95 (0.7-1.2)	
Living arrangement					
Living with someone	519 (95.8)	430 (95.1)		1.0	-
Alone	23 (4.2)	22 (4.9)	0.638	0.86 (0.5-1.6)	
Alcohol use					
No	490 (90.4)	405 (89.6)	0.673	1.0	-
Yes	52 (9.6)	47 (10.4)		0.91 (0.6-1.4)	
Tobacco use (smoke or smokeless)					
No	398 (73.4)	301 (66.6)	0.019	1.0	-
Yes	144 (26.6)	151 (33.4)		0.72 (0.5-0.9)	
MNA (*n*=833)					
Malnutrition	57 (10.7)	83 (19.0)	0.000	1.0	1.0
At risk of malnutrition	326 (61.2)	287 (65.5)		1.65 (1.1-2.4)	1.67 (1.1-2.4)
Satisfactory	150 (28.1)	68 (15.5)		3.21 (2.0-4.9)	2.41 (1.4-4.0)
Two or more serving of fruits and vegetable per day					
Yes	404 (74.5)	328 (72.6)	0.482	1.0	-
No	138 (25.5)	124 (27.4)		0.90 (0.7-1.2)	
Physical activity					
Regular	225 (41.5)	232 (51.3)	0.002	1.0	1.0
Irregular	317 (58.5)	220 (48.7)		1.48 (1.2-1.9)	1.44 (1.0-1.8)
Barthel scale					
Independent	358 (66.0)	291 (64.4)	0.582	1.0	-
Dependent	184 (34.0)	161 (35.6)		0.92 (0.7-1.2)	
BMI (kg/m^2)					
<25	381 (71.6)	371 (84.3)	0.000	1.0	1.0
≥25	151 (28.4)	69 (15.7)		2.13 (1.5-2.9)	1.77 (1.2-2.5)
Total TG (mg/dL)					

Contd...

Table 4: Contd...

HTN variable	Yes (*n*=542), *n* (%)	No (*n*=452), *n* (%)	*P*	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Normal (<150)	349 (65.8)	293 (65.6)	0.910	1.0	-
Borderline (150-199)	146 (27.6)	127 (28.4)		0.96 (0.7-1.2)	
High (200-499)	35 (6.6)	27 (6.0)		1.08 (0.6-1.8)	
TC (mg/dL)					
Desirable (<200)	378 (71.3)	341 (76.3)	0.068	1.0	-
Borderline high (200-239)	135 (25.5)	100 (22.4)		1.21 (0.9-1.6)	
High (≥240)	17 (3.2)	6 (1.3)		2.55 (0.99-6.5)	

HTN: Hypertension; OR: Odds ratio; CI: Confidence interval; MNA: Mini Nutritional Assessment; BMI: Body mass index; TG: Triglyceride; TC: Total cholesterol

Table 5: Factors associated with diabetes: Results of bivariate and stepwise multivariate logistic regression analysis (*n*=1002)

Diabetic variables	Yes (*n*=146), *n* (%)	No (*n*=856), *n* (%)	*P*	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Age (years)					
60-<70	96 (65.8)	498 (58.2)	0.157	1.0	-
70-<80	39 (26.7)	257 (30.0)		0.79 (0.5-1.1)	
≥80	11 (7.5)	101 (11.8)		0.56 (0.3-1.0)	
Gender					
Male	52 (35.6)	310 (36.2)	0.889	1.0	-
Female	94 (64.4)	546 (63.8)		1.03 (0.7-1.5)	
Economic dependency					
No	61 (41.8)	366 (42.8)	0.826	1.0	-
Yes	85 (58.2)	490 (57.2)		1.04 (0.7-1.5)	
Education					
Illiterate	69 (47.3)	458 (53.5)	0.000	1.0	1.0
Primary school C	26 (17.8)	217 (25.3)		0.79 (0.5-1.3)	0.79 (0.5-1.3)
Middle school C	16 (11.0)	82 (9.6)		1.29 (0.7-2.3)	1.20 (0.7-2.2)
High school certificate and above	35 (23.9)	99 (11.6)		2.34 (1.5-3.7)	2.19 (1.4-3.5)
Income (Rs.)					
≤1865	25 (17.1)	205 (24.0)	0.070	1.0	-
1866-5546	57 (39.0)	354 (41.4)		1.32 (0.8-2.2)	
5547-9248	23 (15.8)	126 (14.7)		1.49 (0.8-2.7)	
9249-13,873	19 (13.0)	61 (7.1)		2.55 (1.3-4.9)	
13,874 and above	22 (15.1	110 (12.8)		1.64 (0.9-3.0)	
Socioeconomic status					
Lower	102 (69.9)	626 (73.1)	0.048	1.0	-
Middle	38 (26.0)	219 (25.6)		1.06 (0.7-1.6)	
Upper	6 (4.1)	11 (1.3)		3.34 (1.2-9.2)	
Marital status					
Married	89 (61.0)	503 (58.8)	0.618	1.0	-
Single/divorced/separated	57 (39.0)	353 (41.2)		1.0 (0.6-1.3)	
Living arrangement					
Living with someone	136 (93.1)	821 (95.9)	0.137	1.0	1.0
Alone	10 (6.9)	35 (4.1)		1.72 (0.8-3.7)	2.00 (0.9-4.2)
Alcohol use					
No	130 (89.0)	773 (90.3)	0.637	1.0	-
Yes	16 (11.0)	83 (9.7)		1.14 (0.6-2.0)	
Tobacco use (smoke or smokeless)					
No	109 (74.7)	595 (69.5)	0.208	1.0	-
Yes	27 (25.3)	261 (30.5)		0.77 (0.5-1.1)	
MNA (*n*=833)					
Malnutrition	15 (10.3)	125 (15.0)	0.031	1.0	-
At risk of malnutrition	87 (59.6)	533 (64.0)		1.36 (0.7-2.4)	
Satisfactory	44 (30.1)	175 (21.0)		2.09 (1.1-3.9)	

Contd...

Table 5: Contd...

Diabetic variables	Yes (*n*=146), *n* (%)	No (*n*=856), *n* (%)	*P*	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Two or more serving of fruits and vegetable per day					
Yes	103 (70.6)	636 (74.3)	0.341	1.0	-
No	43 (29.4)	220 (25.7)		1.2 (0.8-1.7)	
Physical activity					
Regular	63 (43.1)	400 (46.7)	0.423	1.0	-
Irregular	83 (56.9)	456 (53.3)		1.15 (0.8-1.6)	
Barthel scale					
Independent	99 (67.8)	557 (65.1)	0.520	1.0	-
Dependent	47 (32.2)	299 (34.9)		0.88 (0.6-1.2)	
BMI (kg/m^2)					
≤25	95 (65.1)	663 (79.5)	0.000	1.0	1.0
≥25	51 (34.9)	171 (20.5)		2.08 (1.4-3.0)	1.87 (1.3-2.7)
Total TG (mg/dL)					
Normal (<150)	94 (64.8)	553 (66.0)	0.779	1.0	-
Borderline (150-199)	43 (29.7)	230 (27.4)		1.08 (0.7-1.6)	
High (200-499)	8 (5.5)	56 (6.6)		0.84 (0.4-1.8)	
TC (mg/dL)					
Desirable (<200)	95 (65.5)	630 (75.1)	0.034	1.0	1.0
Borderline high (200-239)	44 (30.3)	192 (22.9)		1.51 (1.0-2.2)	1.5 (1.0-2.3)
High (≥240)	6 (4.2)	17 (2.0)		2.34 (0.9-6.1)	2.05 (0.7-5.5)

OR: Odds ratio; CI: Confidence interval; MNA: Mini Nutritional Assessment; BMI: Body mass index; TG: Triglyceride; TC: Total cholesterol

The strengths of this resent study include a large population-based sample, representative sampling methodology, and use of standardized data collection protocols, and the study highlights the burden of undiagnosed HTN and DM among geriatric population. This study had a very high response rate (99.1%).

Conclusion

A high prevalence of HTN and DM was found in geriatric population residing in rural area of Uttarakhand. About 70% of the geriatric subjects were unaware of the presence of HTN and 47.2% were unaware of the presence of DM in Uttarakhand. Hence, routine screening of the presence of BP and impaired fasting blood glucose is required to identify people with undiagnosed HTN and DM so that early treatment can be started to control and prevent complications related to HTN and DM.

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Conflicts of interest

There are no conflicts of interest.

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