Original Article

Prevalence of hypertension and associated cardiometabolic risk factors in urban Rishikesh, Uttarakhand

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Abstract

Background: Hypertension is one of the leading causes of premature death worldwide and is a major risk factor for cardiovascular disease and all-of them cause mortality. Out of the estimated 1.13 billion people who have hypertension, less than 1 in 5 people have it under control. **Aim and Objectives:** To study the prevalence of hypertension and associated risk factors in the urban population of Rishikesh and the association of hypertension with other determinants. **Methodology:** A community based cross-sectional study was conducted in an urban area of Rishikesh. The World Health Organization (WHO) steps instrument and protocol was used for the assessment of risk factors and measurements. i.e. anthropometry and blood pressure. Sample size was calculated to be 478. Data was entered and analyzed using SPSS Version 20.0. Appropriate statistical tests were done. A *P* value of < 0.05 was considered significant. **Results:** The prevalence of hypertension in urban Rishikesh is 32.4%. The prevalence in male and female is 34.5% and 31.3% respectively. Among hypertensives 45.8% had hypertriglyceridemia, 32.2% had low high-density lipoproteins (HDL), 52.25% had fasting blood glucose more than 100, and 55.4% were obese individuals. Multivariate logistic regression analysis identified that age, waist circumference, body mass index, triglycerides level, and physical activity were independently associated with hypertension. **Conclusions:** As the prevalence of hypertension and cardiometabolic risk factors were higher, necessary health interventions were required to reduce the morbidity/mortality of the disease.

Keywords: Cardiometabolic risk, hypertension, NCEP ATP 3 criteria, non communicable diseases, Uttarakhand

Introduction

Hypertension is one of the most important causes of the total disease burden and premature death worldwide.[1] According to many observational studies, hypertension is a chronic condition of concern because of its role in the causation of coronary heart disease (CHD), stroke, and other vascular diseases.[2,3] It is the most common cardiovascular disease (CVD) disorder which poses a major public health challenge to a population undergoing socioeconomic evolution. It is accounting for 20–50% of all deaths.[4] The various studies have shown the emergence of the epidemiological shift has often been linked with epidemics of non communicable diseases, which includes hypertension, ischemic heart diseases, CVD, type 2 diabetes mellitus, and other chronic diseases. The overall prevalence for hypertension in India is 29.8%. Significant differences in hypertension prevalence were noted between rural and urban parts 27.6% and 33.8%

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respectively. The prevalence for hypertension in urban north India is 34.5%.[5] According to the National family health survey 4 (NFHS) Uttarakhand fact sheet, the prevalence of hypertension is more widespread in urban men (20.0%) than women (11.1%) population and also it is higher in the case of urban subjects than the rural counterparts.[6] Urban environments tend to have a lack of physical activity, unhealthy food consumption, overcrowding, heavy use of motor transportation, and poor air quality, thus their prevalence is higher when compared with rural.[7] However, having this much higher disease prevalence, only about 25.6% of treated patients had their blood pressure under control, in a multicentre study from India on awareness, treatment, and the adequacy of control of hypertension.[8] As the prevalence and burden of disease is high, the Indian Government has launched the National Program for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS) for the prevention and control of disease at community level.[9] The true prevalence of hypertension in Uttarakhand, especially in urban areas, where a high prevalence of risk factors is expected, remains unexplored. Therefore, the current study was conducted in urban areas under the Municipal Corporation of Dehradun district to estimate the prevalence of hypertension and its associated risk factors in people 19–60 years of age. Through this study, appropriate recommendations can be given for the formulation of effective strategies from primary care level onwards to prevent and control hypertension.

Materials and Methods

A community-based cross-sectional study was conducted in year 2018-19 for a duration of one year in the age group of more than 19 to 60 years residing in the urban areas of Rishikesh. Assuming the prevalence of hypertension in urban north India to be 34.5%, sample size was calculated to be 226 by keeping a relative precision of 18%. Applying a design effect of 2.0, sample size was calculated to be 452. Considering a drop-out rate of 5%, the final sample size was calculated to be 476 and we have taken 478 subjects. Individuals in the age group 19 years to 60 years on the day of data collection, and who consent to participate in the study and residing for more than 6 months in the area were eligible for inclusion in the study. The diagnosed cases of cirrhosis of liver, chronic kidney disease, Cushing's syndrome, hypothyroidism, which cause increase in weight due to pathologic water retention, may lead to false readings of weight and anthropometric measurements were excluded from the study. Patients with type-1 diabetes mellitus, secondary hypertension, and those on drugs causing overweight/obesity like steroids, oral contraceptives, antidepressants etc., were also excluded. Pregnant females were also excluded due to physiologic gain in abdominal circumference and the alteration of various parameters during pregnancy.

Rishikesh is a Nagar Palika Parishad city in district Dehradun, Uttarakhand. Rishikesh city is divided into 20 wards with the population of 70,189 as per Census India, 2011.[10]Cluster sampling technique, which is a kind of two-stage sampling technique, was used to select the representative population of urban areas of Rishikesh. At first stage, a list of urban areas from the District Urban Development Authority office was taken, and then 10 clusters were selected. At second stage, 48 study participants from each of the selected clusters were randomly selected. If all the 48 study participants could not be found from a single cluster, then the contiguous cluster was taken until the desired number was completed. It was ensured to select only one study participant from each selected house. With a drop- out of 2, final analysis was done for 478 participants**.** Written informed consent was obtained from the study participants before including them in the study. A pre tested interview schedule was used for data collection regarding sociodemographic characteristics. The WHO steps instrument and protocol were used for the assessment of risk factors and measurements, i.e. anthropometry and blood pressure.

Informed written consent from the participants was obtained after informing them that the participation was voluntary, and there was no harm to the participant due to or during our study. Study was started after getting approval from the Ethics committee of the institution, (Ref no AIIMS/IEC/18/95) AIIMS Rishikesh. The confidentiality of the information obtained from the patient was maintained and the identity of the patient was not revealed. Descriptive statistics were used for getting percentages, proportion, mean (standard deviation (SD)), and median (interquartile range(IQR)). Chi-square test was used to examine the association between categorical variables, whereas *t*-test was used for comparing the means. Binary logistic regression analysis was performed simultaneously to evaluate the effects of age, gender, obesity, elevated fasting blood glucose (FBG), triglycerides (TG), decreased high density lipoprotein (HDL), physical activity, and stress on hypertension (dependent variable). A significance level of 5% was used for all of the statistical tests. The data was analyzed using SPSS Version 20.0.

Anthropometric measurements

Body weight (nearest 0.5 kg), height (nearest 0.1 cm), waist (nearest 0.2 cm), and hip circumferences (nearest 0.2 cm) were obtained using a standard tool. The body mass index (BMI, kg/m2) and waist–hip ratio (WHR) were subsequently computed.[11]

Blood pressure measurement

Blood pressure was measured for each participant using the auscultatory method with a standardized aneroid sphygmomanometer (Rossmax Swiss Gmbh). The participants were asked to sit quietly and rest for 15 minutes with their legs uncrossed. The participants were advised to have an empty bladder, not to have coffee before or during the measurements, and not to talk during the measurements. Three measurements of blood pressure were taken. During data analysis, the mean of the second and third readings were calculated. The participant was allowed to take rest for three minutes between each of the readings.

Biochemical analysis

Laboratory assessments included the measurements of HDL, TGL, and FBS obtained by venous blood samples in fasting state of 12 hrs, measured by fully automated chemistry analyzer.

The blood samples were collected in a red vacutainer for the measurement of fasting lipids (TGLs, and (HDL)) cholesterol and grey vacutainer were used for estimating fasting blood sugar. A total of 5 ml of blood samples was collected. All blood samples were properly labelled and transported to the laboratory at AIIMS, Rishikesh for analysis.

Definitions

Waist circumference

Waist circumference (WC) was measured at the end of normal expiration, 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.[12]

Waist hip ratio

Waist hip ratio (WHR) was calculated by dividing waist circumference (in cm) by hip circumference (cm). Hip circumference was measured 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.[12]

Socioeconomic status (SES)

Defined as per revised Kuppuswamy classification.[13]

Body mass index (BMI) [14]

BMI, formerly called the Quetelet index, is a 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 (kg/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 (≥ 30).

Hypertension

Hypertension is defined as systolic blood pressure (SBP) ≥140 mmHg or diastolic blood pressure (DBP) ≥90 mmHg as per Joint National Committee (JNC-7) or having a history of previously known disease. Pre HTN was defined as SBP between 120 and 139 mmHg or DBP between 80 and 89 mm Hg.[15]

Type 2 diabetes mellitus

Diagnosed either by the past history of known diabetes or fasting plasma glucose ≥126 mg/dl, and impaired fasting glucose (pre diabetes) was defined as fasting plasma glucose between 100 and 125 mg/dl.[16]

Hypertriglyceridemia

The Adult Treatment Panel III guidelines of the National Cholesterol Education Program (NCEP ATP 3) has suggested four discrete categories: normal fasting TG is <150 mg/dl, borderline high TG is 150–199 mg/dl, high TG is 200–499 mg/dl, and very high TG is >500 mg/dl.[17]

Current smoker

A person who has smoked at least 100 cigarettes in his lifetime and has continued to smoke every day or some days in the last 28 days.[18]

Current alcohol

Present consumer was defined as a person who has consumed alcohol everyday or some days in the last 30 days. Past consumer was defined as a person who used to consume alcohol but stopped taking alcohol 12 months ago.[19]

Stress assessment

Assessed by perceived stress scale, scores ranging from 0–13 would be considered low stress, 14–26 would be considered moderate stress, and scores ranging from 27–40 would be considered high perceived stress.[20]

Physical activity

The global physical activity questionnaire (GPAQ) was used. Metabolic equivalent tasks (MET) values were applied to vigorous and moderate intensity variables in the work and recreation settings. These have been calculated using an average of the typical types of activity undertaken. Applying MET values to activity levels allows us to calculate total physical activity.[21]

Results

The prevalence of hypertension (HTN) was 32.4% (155/478) among the study subjects. The prevalence in males and females were 34.5% and 31.3% respectively. Table 1 shows the socio demographic characteristics such as age, gender, education, occupation, and socioeconomic status of hypertensive and non hypertensive subjects. The majority (32.8%) of the study participants were in the age group of 31–40 years. Females constituted 65.5% of the total sample. Twenty nine percent of the participants were high school pass and another 24.9% had completed education till higher secondary certificate. A little more than half of the participants (56.3%) were unemployed, while only 9 participants were engaged in a professional or semi-professional type of occupation. The hypertension increases with age as shown in the Table 1. There was statistically significant association present between the 2 groups with respect to age. However, there was no statistically significant association between the groups with respect to their education status, occupation, and socioeconomic status of the study subject.

Almost all participants (99.2%) knew their blood pressure status and 82.4% had checked their blood pressure in the last 12 months. 18.4% of study participants reported having a history of raised blood pressure or hypertension and 18.2% of them were currently receiving medications and had received lifestyle modification advice either from doctor or healthcare worker.

In reference to the age group 19–30 years, in age group of 31–40, 41–50, and 51–60 years, odds of hypertension was 3.56, 9.18, and

Table 1: Sociodemographic variables and its association with hypertension

Variables	HTN present (*n*=155) No. (%)	HTN absent (*n*=323) No. (%)	OR (95%CI)	Chi-square value, *P*
Gender				
Males (ref) (*n*=165)	57 (34.5)	108 (65.4)	1.16 (0.78-1.73)	0.51, 0.47
Females (*n*=313)	98 (20.5)	215 (68.6)		
Age (in years)				
19-30* (*n*=87)	5 (5.7)	82(94.2)	1	113.1, 001
31-40 (*n*=157)	28(17.8)	129(82.1)	3.56 (1.32-9.59)	
41-50 (*n*=117)	42(35.8)	75(64.1)	9.18 (3.45, 24.44)	
51-60 (*n*=117)	80(68.7)	37(31.6)	35.46 (13.26-94.8)	
Education				
Illiterate* (*n*=57)	24 (42.1)	33 (57.8)	1	4.388, 0.62
Less than middle school (*n*=27)	9 (33.3)	18 (66.6)	1.35 (0.54-3.42)	
Middle school (*n*=89)	24 (26.9)	65 (73)	0.51 (0.25-1.03)	
High school (10th std) (*n*=137)	45 (32.8)	92 (67.1)	0.67 (0.36-1.27)	
Higher secondary certificate (12th std) (*n*=119)	39 (32.7)	80 (67.2)	0.67 (0.35-1.28)	
Graduate degree and above (*n*=49)	14 (28.5)	35 (71.1)	0.55 (0.24-1.24)	
Occupation				
Unemployed* (*n*=269)	85 (31.5)	184 (68.4)	1	12.4, 0.08
Unskilled worker (*n*=43)	9 (20.9)	34 (79)	0.57 (0.26-1.25)	
Semi-skilled worker (*n*=57)	21 (36.8)	36 (63.1)	1.26 (0.7-2.29)	
Skilled worker (*n*=68)	24 (35.2)	44 (64.7)	1.18 (0.67-2.07)	
Arithmetic skill jobs (*n*=32)	15 (46.8)	17 (53.1)	1.91 (0.91- 4)	
Semi-professional and professional (*n*=9)	1 (11.1)	8 (88.8)	0.27 (0.03-2.2)	
Socio Economic Status*				
Lower* (*n*=7)	4 (57.1)	3 (42.8)	1	6.11, 0.19
Upper Lower (*n*=155)	43 (27.7)	112 (72.2)	0.29 (0.06-1.34)	
Lower middle (*n*=261)	90 (34.4)	171 (65.5)	0.39 (0.09- 1.8)	
Upper middle (*n*=54)	17 (31.48)	37 (68.5)	0.34 (0.07-1.71)	
Upper (*n*=1)	1 (100)	0		

35.46 times respectively. Regarding occupation among semiskilled, skilled, and arithmetic skill job workers the odds of hypertension was 1.26, 1.18, and 1.96 times respectively. It was observed from the Table 2, there was a significant difference between the family history of cardiovascular diseases and hypertension with odds of 8.53. Among the subjects with the family history of obesity and cerebrovascular accidents, the odds of hypertension was 1.04 and 2.09 times.

Table 3 depicted that the mean (±SD) of age, SBP, DBP, BMI, WHR, WC, TG, and FBG were higher among the hypertensive subjects compared with the non hypertensives and there was a

significant difference present between the 2 groups ($P < 0.05$). There was no statistical significance for HDL among the groups.

Among hypertensives 45.8% had hypertriglyceridemia, 32.2% had low HDL, 52.25% had fasting blood glucose more than 100, and 55.4% were obese individuals.

Table 4 shows the association of cardiovascular risk factors among hypertensives and non hypertensive subjects. It can be observed from the table, that there was statistically significant association present with hypertension to TG (OR: 2.4), FBG (OR: 2.55), WC (OR: 3.06), obesity grade 1 (OR: 5.24) and grade 2 (OR: 9.8), WHR (OR: 2.56), stress (OR: 1.65) and alcohol intake (OR: 1.74) with *P* value < 0.05. However, no statistically significant association was observed between HDL, physical activity, smoking, and hypertension.

The binary logistic regression analysis showed that the odds of being hypertensive in the age group of 31–40, 41–50, and 51–60 years was 4.92, 11.0, and 24.0 times, respectively. With regard to the anthropometric risk factors, being overweight, obesity grade 1, obesity grade 2, and raised waist circumference are 1.6, 2.9, 2.05, and 2.13 times higher odds of being hypertensive. Raised triglycerides and physical activity with MET score <600 had 1.9 and 3.8 times the higher odds of hypertension. Smoking, alcohol, FBS, and WHR were not statistically associated with hypertension after doing regression analysis [Table 5].

Discussion

A number of research suggesting that cardiovascular disease and hypertension are rapidly increasing both in urban and rural areas of South Asia, yet there have been few population-based studies and prevalence estimates that vary place to place.[22,23]

This community based cross-sectional study identified a high prevalence of hypertension in the urban areas of Rishikesh of 32.4%. One third of the study subjects were hypertensives, which highlights the escalating burden of this silent killer.

The prevalence of hypertension in the present study (32.4%) are in accordance with the study conducted in urban Varanasi (32.5%), municipalities of Kathmandu (32.9%), and urban area of Aurangabad (30.5%), Maharashtra.[24-26]The prevalence of hypertension in our study is within the range of estimated prevalence of hypertension in urban India.[5] The prevalence was higher in comparison with the prevalence reported by Mahmood SE *et al.* in the urban area of Lucknow (10.5%) and Nagendra K *et al.* in Urban Shimoga (26.5%).[27,28] This high-level prevalence of hypertension, could be because it is uncommon in India to go for regular checkups. In the present study, the prevalence of hypertension was found to steadily increase with age. Similar observations were found in studies conducted by Vasan RS *et al.*, Kalavathy MC *et al.*, Kusuma YS *et al.*, and Nirmala A.[29-32] One of the possible reason for this is stiffening of the aorta and arteries walls and this contributes to the the high prevalence of hypertension in older age groups.

Men exhibit higher prevalence of hypertension than their women counterparts (male: 34.5% and female: 31.3%). Similarly, various studies came out with the higher percentage of hypertension in men than women.[33-36] This gender disparity could be partially due to biological sex difference and due to behavioral risk factors. The

Table 2: Association of hypertension with family history of diseases

Variables	HTN Present (*n*=155) No. (%)	HTN absent (*n*=323) No. (%)	OR (95% CI)	Chi square value, *P*
Hypertension (*n*=22)	5 (22.7)	17 (77.2)	0.6 (0.21-1.65)	0.99, 0.32
Diabetes mellitus (*n*=18)	3 (16.6)	15 (83.3)	0.4 (0.11-1.42)	2.12, 0.14
Obesity (*n*=3)	1 (33.3)	2 (66.6)	1.04 (0.09-11.5)	0.001, 0.97
Cardiovascular diseases (*n*=5)	4 (80)	1 (20)	8.53 (0.94-76.9)	5.219, **0.02**
Cerebrovascular accidents (*n*=2)	1 (50)	1 (50)	2.09 (0.13-33.6)	0.28, 0.596
Other diseases (*n*=14)	8 (57.1)	6 (42.8)	2.8 (0.9-8.4)	4.021,**0.04**

Table 3: Mean and SD of variables with hypertensive and non-hypertensive subjects

Variables	HTN Present (*n*=155) Mean±SD	HTN absent (*n*=323) Mean±SD	Mean difference (95% CI)	*t* statistics*,*P*
Age	50.41±9.56	30.2±10.3	20.2 (18.2-22.1)	12.4, **0.001**
Systolic BP	140.83±21.6	111.9±11.9	28.9 (25.8-31.9)	18.8, **0.001**
Diastolic BP	83.96±9.81	74.2±7.47	9.7 (8.1-11.2)	11.9, **0.001**
Body mass index	26.36±5.27	23.95±4.7	2.4 (1.4-3.3)	5.0, **0.001**
Waist hip ratio	0.96±0.6	0.92±0.07	0.03 (0.02-0.04)	5.18, **0.001**
Waist circumference (cm)	92±11	85±12	7.7 (5.5-9.8)	7.02, **0.001**
Triglycerides(g/dl)	190.45±144.36	150.65±125.16	39.8 (14.5-65.08)	3.09, 0.002
Fasting blood glucose (g/dl)	122.14±62.70	100.82±36.42	21.3 (12.3-30.2)	4.6, **0.001**
High density lipoproteins (g/dl)	41.6±9.48	41.8±9.4	0.2 (1.6-2.0)	0.21, 0.82

*t- independent *t* test

Table 4: Association of other cardiac risk factors with hypertension

Variables	HTN Present (*n*=155) No. (%)	HTN absent (*n*=323) No. (%)	OR (95% CI)	Chi square value, *P*
Triglycerides (g/dl)				
<150 (*n*=190)	84 (44.2)	106 (55.7)	2.422 (1.63-3.58)	19.9,**0.001**
≥150 (*n*=288)	71 (24.6)	217(75.3)		
High density lipoproteins (g/dl)				
≤40 male ≤50 female (*n*=339)	105 (30.9)	234(69)	0.799 (0.52-1.211)	1.12,0.28
>40 male >50 female (*n*=139)	50 (35.9)	89(64)		
Fasting blood glucose (g/dl)				
<100 (*n*=159)	74 (46.5)	85 (53.4)	2.55 (1.71-3.87)	21.6,**0.001**
≥100 (*n*=319)	81 (25.3)	238 (74.6)		
Waist circumference (cm)				
≥90 male ≥80 female (*n*=307)	124 (40.3)	183 (59.6)	3.06 (1.94-4.8)	24.8,**0.001**
<90 male <80 female (*n*=171)	31 (18.1)	140 (81.8)		
Body Mass Index (kg/m^2)				
Underweight (*n*=54)	5 (9.2)	49 (90.7)	1	23.7,**0.001**
Normal (*n*=128)	44 (34.3)	84 (65.6)	5.13 (1.91-13.8)	
Overweight (*n*=77)	20 (25.9)	57 (74)	3.44 (1.2-9.84)	
Obese grade 1 (*n*=155)	54 (34.8)	101 (65.1)	5.24 (1.97-13.93)	
Obese grade 2 (*n*=64)	32 (50)	32 (50)	9.8 (3.46-27.8)	
Waist hip ratio				
≥ 0.95 male ≥ 0.80 female (*n*=369)	135 (36.5)	234 (63.4)	2.56 (1.51-4.35)	12.77,**0.001**
<0.80 male < 0.80 female (*n*=109)	20 (18.3)	89 (81.6)		
Physical activity (MET score)*				
< 600 (*n*=17)	3 (17.6)	14 (82.3)	0.43 (0.12-1.53)	1.75,0.18
≥ 600 (*n*=461)	152 (32.9)	309 (67)		
Stress level**				
Moderate Stress (*n*=210)	81 (38.5)	129 (61.4)	1.65 (1.12-2.42)	6.45,**0.01**
Low Stress (*n*=268)	74 (27.6)	194 (72.3)		
Smoking status				
Yes (*n*=43)	16 (37.2)	27 (62.7)	1.26 (0.65-2.41)	0.49,0.48
No (*n*= 435)	139 (31.9)	296 (68)		
Alcohol consumption status				
Yes (*n*=57)	25 (43.8)	32 (56.1)	1.74 (0.996-3.069)	3.8, **0.04**
No (*n*=421)	130 (30.8)	291 (69.1)		

*Global physical activity questionnaire, MET- metabolic equivalent task. **perceived stress scale

higher education level was negatively associated with hypertension in our study. Tabrizi JS *et al.* and Singh S *et al.* study also supported our finding.[24,37] Higher education imparts better knowledge and information about hypertension, and so the disease is lesser among them.

Hypertension was significantly higher among individuals who were alcohol user than those who did not. Hypertension was more prevalent in alcohol users (OR: 1.74) as compared to non users. Similar to our study, Manimunda SP *et al.* and Khan RJ *et al.* reported that alcohol is an independent risk factor for hypertension.[38,39]

The different anthropometric measurements like BMI, waist circumference, and waist hip ratio were taken into account to measure overweight, obesity, and central or abdominal obesity. This study showed that overweight and obesity were major modifiable risk factors to develop hypertension. Overweight, obesity grade 1, and obesity grade 2 subjects had odds of 3.4, 5.2, and 9.8 times higher risk of hypertension in this study. Similar trends were observed by Erem C *et al.*, Abebe SM *et al.*, Tabrizi JS *et al.*, Singh R *et al.* and Costa *et al.*[37,40-44]. The reason behind is that weight gain increases cardiac output and increases peripheral resistance of arterioles. Similarly, hypertension was more prevalent among those with raised triglycerides levels. The findings were consisted with study done by Khan RJ in Nepal.[36]

In multivariate analysis, raised triglycerides, rise in age, waist circumference, obesity, and physical activity were the independent risk factors of hypertension as reported by other authors as well.[45]

Table 5: Multivariate analysis for risk factors of hypertension

Variables	β coefficient	Odds ratio (95% confidence interval)	*P*
Age			
19-30* (*n*=87)	Reference		
31-40 (*n*=157)	1.59	4.92 (2.6-9.01)	**0.001**
41-50 (*n*=117)	2.4	11.0 (5.9-20.5)	**0.001**
51-60 (*n*=117)	3.17	24.0 (8.6-66.7)	**0.001**
Waist circumference (cm)			
<90 male <80 female (*n*=171)	Reference		
≥90 male ≥80 female (*n*=307)	0.75	2.13 (1.05-4.32)	**0.03**
Body Mass Index (kg/m^2)			
Underweight (*n*=54)	Reference		
Normal (*n*=128)	1.38	4.0 (0.99- 16.1)	0.05
Overweight (*n*=77)	0.4	1.6 (0.7-3.7)	0.25
Obese grade 1 (*n*=155)	1.08	2.9 (1.2-6.8)	**0.01**
Obese grade 2 (*n*=64)	0.72	2.05 (1.03-4.09)	**0.04**
Waist hip ratio			
<0.80 male < 0.80 female (*n*=109)	Reference		
≥ 0.95 male ≥ 0.80 female (*n*=369)	1.37	0.25 (0.33-1.9)	0.18
Triglycerides (g/dl)			
<150 (*n*=190)	Reference		
≥150 (*n*=288)	0.68	1.9 (1.2-3.2)	**0.006**
Fasting blood glucose (g/dl)			
<100 (*n*=159)	Reference		
≥100 (*n*=319)	0.194	1.2 (0.73-2.0)	0.44
Physical activity (MET score)			
< 600 (*n*=17)	Reference		
≥ 600 (*n*=461)	1.34	3.8 (0.89-16.4)	**0.07**
Stress based on perceived stress scale			
Moderate Stress (*n*=210)	0.22	0.8 (0.5-1.2)	0.35
Low Stress (*n*=268)	Reference		
Smoking status			
Yes (*n*=43)	0.185	1.2 (0.45-3.15)	0.70
No (*n*= 435)	Reference		
Alcohol consumption status			
Yes (*n*=57)	0.63	0.52 (0.23-1.2)	0.13
No (*n*=421)	Reference		

Conclusions and Recommendations

The prevalence of hypertension was found to be higher in the people of Rishikesh. Health interventions required to prevent or reduce the morbidity/mortality need to be addressed in adult population starting from their childhood. In people with hypertension, intervention strategies for the control of hypertension and other co morbidities like hyperglycemia and dyslipidemia would lead to reductions in the subsequent cardiovascular mortality. Moreover, approaches like weight reduction will be useful strategies for increasing insulin sensitivity. The implementation of these strategies is important in the elderly population as they are at an increased risk of developing hypertension and related disorders due to age associated physiology.

Limitation

Among the study participants, the females (65.5%) were higher than the males (34.5%). It is because of the higher proportion of males in the study population were working class and so they were not available during the time of data collection. However, each selected participant was approached 3 times for inclusion within study at 3 separate days.

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Conflicts of interest

There are no conflicts of interest.

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