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Prevalence of prehypertension and hypertension and associated risk factors among Turkish adults: Trabzon Hypertension Study

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ABSTRACT

Background To estimate the prevalence, awareness and control of prehypertension (preHT) and hypertension (HT) as defined by JNC-7 criteria in the Trabzon Region and its associations with demographic factors (age, sex, obesity, marital status, reproductive history in women and level of education), socioeconomic factors (household income and occupation), family history of selected medical conditions (diabetes, hypertension, obesity and cardiovascular disease), lifestyle factors (smoking habits, physical activity and alcohol consumption) in the adult population.

Methods In this cross-sectional survey, a sample of households was systematically selected from the central province of Trabzon and its nine towns. A total of 4809 adult subjects (2601 women and 2208 men) were included in the study. Demographic and socioeconomic factors, family history of selected medical conditions, and lifestyle factors were obtained for all participants. Systolic blood pressure (BP) and diastolic BP levels were measured for all subjects. The persons included in the questionnaire were invited to the local medical centers for blood examination between 08:00-10:00 following 12 hours of fasting. The levels of serum glucose (FBG), total cholesterol (Total-C), high density cholesterol (HDL-C), low density cholesterol (LDL-C) and triglycerides were measured with autoanalyzer. Definition and classification of HT was performed according to guidelines from the US JNC-7 report. Prevalence, awareness, treatment and control of HT were assessed.

Results The prevalences of HT and preHT were 44.0% (46.1% in women and 41.6% in men) and 14.5% (12.6% in women and 16.8% in men), respectively. Overall, only 41% of the hypertensive individuals had been previously diagnosed. Furthermore, 54.5% of the hypertensive subjects were being treated with antihypertensive drugs (AHD), but only 24.3% of treated subjects had their BP adequately controlled. Among all hypertensive subjects (known and newly diagnosed), only 5.43% had their BP under control. The prevalence of HT increased with age, being highest in the 60- to 69-year-old age group (84.4%) but lower again in the 70+ age group. Interestingly, the prevalence was 16.9% in the 20-to 29-year old age group. HT was associated positively with marital status, parity, cessation of cigarette smoking, and negatively with level of education, alcohol consumption, current cigarette use, and physical activity. Multinomial logistic regression analysis revealed that HT were significantly associated with age, male gender, BMI, low education level, nonsmoking, positive family history of selected medical conditions, occupation, and parity.

Conclusions The Trabzon Hypertension Study data indicated that HT is very common and is an important health problem in the adult population of Trabzon. Patients who are unaware of their status and treated uncontrolled hypertensives are at high risk of early cardiovascular morbidity and mortality. To control preHT and HT, effective public health education and urgent precautions are needed. The precautions include serious health education, a well-balanced diet and increasing physical activity.

Keywords associated risk factors, awareness and control, hypertension, prehypertension, prevalence, Trabzon, Turkish population

Introduction

Hypertension (HT) is an important public health problem worldwide and is the most widely recognized modifiable risk factor for cardiovascular disease (CVD), cerebrovascular disease (stroke) and end-stage renal disease.[1]

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Worldwide prevalence estimates for HT may be as much as 1 billion individuals, and ~7.1 million deaths per year may be attributable to it.[2] The prevalence of HT varies widely among different populations, with rates as low as 3.4% in rural Indian men and as high as 72.5% in Polish women.[1] Differences in genetic background, environmental factors (especially diet and physical activity) and variations in study protocols all influence the prevalence of HT in adults.[3] In economically developed countries, the prevalence of HT ranged between ~20 and 50%. Although HT is well recognized as a major cause of morbidity and mortality in the economically developed world, the importance of HT in economically developing countries is less well established.[1]

Recently, the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High BP (JNC-7) defined a new set of guidelines for the prevention and management of HT. According to the JNC-7, normal BP is defined as a systolic BP (SBP) less than 120 mmHg and a diastolic BP (DBP) less than 80 mmHg; an SBP of 120–139 mmHg or a DBP of 80–90 mmHg is defined as prehypertension (preHT).[4] PreHT is not a disease category; however, prehypertensive subjects are known to be at high risk for developing HT, and even slightly elevated BP increases cardiovascular risk.[5]

HT is also a common and consistent health problem in developing countries, and its prevalence is currently rising steadily.[1] In Turkey, there have been only a few studies regarding the epidemiology of HT.[3,6–8] However, whether preHT status is associated with demographic factors or with metabolic profiles in the Turkish population is still unknown.

The aim of this study is to assess the prevalence of preHT and HT according to the new JNC guidelines in the Trabzon Region and to examine its associations with a number of risk factors in a large sample of the Turkish adult population. Further, to evaluate more accurately the current status of HT screening and management in Trabzon, we have included assessments of awareness, treatment and control of HT.

Methods

BP measurement and classification

SBP and DBP were measured after the subject had rested for 15 min, using a standardized aneroid sphygmomanometer and cuffs of appropriate sizes (23 × 12.5 cm) by well-trained personnel. The subject's arm was placed at heart level in a sitting position. Measurements were taken thrice and the mean was taken for all cases. If readings varied by >10 mmHg, an additional reading was performed. Participants were advised to avoid cigarette smoking, alcohol, caffeinated beverages and exercise for at least 30 min before their BP measurement. The Korotkoff phase I (appearance) and phase V (disappearance) were recorded for the SBP and DBP, respectively. The classification of normotensives, prehypertensives and hypertensives was based on the classification of BP from the JNC-7.[4] Normal BP was defined as not being on antihypertensive medication and having an SBP of less than 120 mmHg and DBP of less than 80 mmHg. PreHT was defined as not being on antihypertensive medication and having an SBP of 120–139 mmHg or DBP of 80–89 mmHg. HT was defined based on the JNC-7 cut-off point of 140 mmHg and above for SBP and/or 90 mmHg and above for DBP, and also if the subject was on antihypertensive medication. Stage 1 HT was defined as an SBP of 140–159 mmHg or DBP of 90–99 mmHg and Stage 2 HT SBP ≥160 mmHg or DBP ≥100 mmHg.

Awareness, treatment and control of HT

Subjects with HT were classified into categories of HT awareness, treatment and control as follows:

(i) 'Awareness' was defined as a positive response to the question, 'Did a doctor ever tell you that you have (had) high BP?'.
(ii) 'Treatment' was defined as the use of any antihypertensive medication.
(iii) 'Controlled Treated HT" was defined as receiving antihypertensive therapy and having a BP (SBP/DBP) <140/90 mmHg.

Definition of metabolic syndrome

Metabolic syndrome (MetS) was defined according to the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III, ATP III) criteria.[9]

Statistical analysis

Data normality was assessed by the Kolmogorov–Smirnov test. Comparisons among HT groups (normal, preHT and HT) were done with ANOVA (Bonferroni test as *post hoc*) for normally categorical data and Kruskal–Wallis test (Mann–Whitney *U*-test with Bonferroni correction as *post hoc*) for other data. Comparisons, among groups for quantitative data and prevalence of HT were done with the $\chi 2$ test. For associated risk factors of HT, logistic regression analysis was done. In this analysis, HT and preHT were taken as dependent variables. Univariate logistic regression analysis was modelled and parameters that have $P < 0.20$ were included in the model. Therefore, age groups, sex, level of education, cigarette use, alcohol consumption, family history of selected medical

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Table 1 Clinical and laboratory characteristics of the study participants by classification of BP

Parameter	*Normal* Mean ± SD	*Prehypertension* Mean ± SD	*Hypertension* Mean ± SD	*Total* Mean ± SD	*P value*
Men	$n = 918$	$n = 372$	$n = 918$	$n = 2208$	
Age (year)	34.96 ± 11.49	37.42 ± 13.03	47.43 ± 14.71	40.56 ± 14.41	<0.0001
BMI (kg m^{-2})	25.20 ± 3.53	26.15 ± 3.70	28.03 ± 3.90	26.53 ± 3.93	<0.0001
Waist girth (cm)	83.64 ± 12.89	89.20 ± 12.44	99.38 ± 13.38	93.2 ± 11.9	<0.0001
Waist–hip ratio	0.88 ± 0.01	0.89 ± 0.01	0.93 ± 0.01	0.90 ± 0.01	<0.0001
SBP (mmHg)	113.35 ± 7.72	128.94 ± 4.16	143.12 ± 18.34	128.35 ± 18.76	<0.0001
DBP (mmH)	73.08 ± 7.35	78.20 ± 5.55	91.08 ± 11.42	81.43 ± 12.30	<0.0001
FBG (mg dl^{-1})	83.74 ± 17.02	86.26 ± 28.26	95.18 ± 37.87	88.92 ± 29.65	<0.0001
Total-C (mg dl^{-1})	180.94 ± 42.71	188.44 ± 45.95	197.92 ± 42.91	189.26 ± 44.02	<0.0001
TG (mg dl^{-1})	134.67 ± 98.85	158.49 ± 130.98	166.87 ± 115.25	152.07 ± 112.64	<0.0001
HDL-C (mg dl^{-1})	45.40 ± 9.45	45.37 ± 10.39	45.19 ± 9.77	45.31 ± 9.75	=0.889
LDL-C (mg dl^{-1})	123.13 ± 38.41	126.67 ± 39.92	136.49 ± 38.88	129.28 ± 39.33	<0.0001
Women	$n = 1074$	$n = 327$	$n = 1200$	$n = 2601$	
Age (year)	32.58 ± 9.86	37.80 ± 12.87	48.92 ± 14.22	40.70 ± 14.66	<0.0001
BMI (kg m^{-2})	25.72 ± 5.05	27.77 ± 4.73	31.89 ± 5.98	28.82 ± 6.19	<0.0001
Waist girth (cm)	83.64 ± 12.89	89.20 ± 12.44	99.38 ± 13.38	91.60 ± 15.01	<0.0001
Waist–hip ratio	0.82 ± 0.01	0.84 ± 0.01	0.87 ± 0.01	0.84 ± 0.01	<0.0001
SBP (mmHg)	111.35 ± 8.81	128.78 ± 3.78	145.41 ± 21.98	129.95 ± 22.58	<0.0001
DBP (mmH)	71.90 ± 7.99	78.30 ± 5.75	92.40 ± 13.61	82.16 ± 14.48	<0.0001
FBG (mg dl^{-1})	82.52 ± 12.90	85.62 ± 23.11	95.68 ± 36.46	88.98 ± 28.08	<0.0001
Total-C (mg dl^{-1})	175.95 ± 36.58	188.72 ± 40.61	204.33 ± 43.68	190.65 ± 42.60	<0.0001
TG (mg dl^{-1})	100.42 ± 80.74	117.82 ± 73.43	148.37 ± 103.37	124.73 ± 93.82	<0.0001
HDL-C (mg dl^{-1})	55.90 ± 11.06	55.48 ± 11.18	52.86 ± 11.03	54.44 ± 11.15	<0.0001
LDL-C (mg dl^{-1})	112.53 ± 33.37	123.35 ± 35.95	138.64 ± 38.87	125.94 ± 38.31	<0.0001

FBG, fasting serum glucose; TG, triglycerides.

[a]Variance analysis.

conditions, classification of BMI, occupation, household income (US $ per month), marital status, status of physical activity and parity (for women only) were included in the models. Demographic, socioeconomic and lifestyle factors and family history of selected medical conditions were taken as independent variables. Results are shown as arithmetic mean ± standard deviation for continuous data, and percentage for categorical. Polychotomous logistic regression analysis was employed using the multinomial logit model to determine the risk factors for HT and preHT. A linear trend test for the ORs (95% CI) was also conducted, using each of the categorical variables in the model. $P < 0.05$ was considered significant.

Results

Prevalence of preHT and HT

The clinical and metabolic characteristics of subjects with preHT and HT and without preHT and HT included in the study are given in Table 1. All values (except for HDL-C) were significantly increased in preHT and HT groups compared with the normal subjects, although HDL-C levels were decreased. The difference in HDL-C levels was due to women with HT.

The prevalence of HT is shown in Table 2. The overall prevalence of HT was 44%; 46.1% in women and 41.6% in men. Prevalence of HT was higher in women than that in men ($P < 0.001$). There were some differences in the prevalence of HT in both men and women among towns ($X^2 = 59.1$, $P < 0.0001$ for women; $X^2 = 29.1$, $P < 0.0001$ for men; $X^2 = 64.9$, $P < 0.0001$ for all subjects) (data not shown). The overall prevalence of preHT was 14.5%; 12.6% in women and 16.8% in men. Approximately 58.5% of Turkish adults were found to have preHT or HT.

Prevalence of HT increased steadily with age both for men and women ($P < 0.0001$), with the highest prevalence in the 60 to 69-year-old age group (84.4%), and the

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Table 2 The prevalence of preHT and HT in all subjects by gender and age groups ($\chi^2 = 827.0$, df = 20, $P < 0.0001$ for women; $\chi^2 = 461.8$, df = 20, $P < 0.0001$ for men; $\chi^2 = 1227.7$, df = 20, $P < 0.0001$ for all subjects)

	Age groups (years)													
	20–29		*30–39*		*40–49*		*50–59*		*60–69*		*70 +*		*Total*	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Men	607	27.5	542	24.5	510	23.1	283	12.8	160	7.2	106	4.8	2208	100.0
Normal	361	59.5	272	50.2	192	37.6	61	21.6	16	10.0	16	15.1	918	41.6
Pre HT	130	21.4	96	17.7	77	15.1	42	14.8	18	11.3	9	8.5	372	16.8
HT	116	19.1	174	32.1	241	47.3	180	63.6	126	78.8	81	76.4	918	41.6
Stage 1	96	15.8	117	21.6	144	28.2	84	29.7	54	33.8	27	25.5	522	23.6
Stage 2	18	3.0	51	9.4	75	14.7	79	27.9	63	39.4	41	38.7	327	14.8
History of HT	2	0.3	6	1.1	22	4.3	17	6.0	9	5.6	13	12.3	69	3.1
Women	699	26.9	665	25.5	589	22.6	296	11.3	205	7.9	147	5.6	2601	100.0
Normal	500	71.5	345	51.9	172	29.2	39	13.2	11	5.4	8	5.4	1075	41.3
Pre HT	94	13.4	101	15.2	82	13.9	25	8.4	12	5.9	12	8.2	326	12.6
HT	105	15.0	219	32.9	335	56.9	232	78.4	182	88.8	127	86.4	1200	46.1
Stage 1	73	10.4	115	17.3	151	25.6	101	34.1	53	25.9	49	33.3	542	20.8
Stage 2	19	2.7	82	12.3	136	23.1	101	34.1	94	45.9	66	44.9	498	19.1
History of HT	13	1.9	22	3.3	48	8.1	30	10.2	35	17.1	12	8.2	160	6.2
Total	1306	27.1	1207	25.0	1099	22.8	579	12.0	365	7.5	253	5.2	4809	100.0
Normal	861	65.9	617	51.1	364	33.1	100	17.3	27	7.4	24	9.5	1993	41.5
Pre HT	224	17.2	197	16.3	159	14.5	67	11.6	30	8.2	21	8.3	698	14.5
HT	221	16.9	393	32.6	576	52.4	412	71.2	308	84.4	208	82.2	2118	44.0
Stage 1	169	12.9	232	19.2	295	26.8	185	32.0	107	29.3	76	30.0	1064	22.1
Stage 2	37	2.8	133	11.0	211	19.2	180	31.1	157	43.0	107	42.3	825	17.2
History of HT	15	1.1	28	2.3	70	6.4	47	8.1	44	12.1	25	9.9	229	4.8

prevalence declined slightly thereafter. The prevalence of HT among women increased markedly from the 20- to 29-year-old age group (15.0%) to the 60- to 69-year-old age group (88.8%, $P < 0.0001$). Among men, there was a steady increase in the prevalence of HT from the 20- to 29-year-old age group (19.1%) to the 60- to 69-year-old age group (78.8%) (Table 2).

The prevalence of preHT decreased steadily until the 60- to 69-year-old age group, and then stopped changing. However, especially, the prevalence of preHT more prominently and continuously decreased with age in men.

Prevalence of MetS in the prehypertensive and hypertensive groups

The crude prevalence of MetS according to NCEP ATP III criteria in the normotensive, prehypertensive and hypertensive groups was investigated. When stratified by BP groups, 47.2% (54.1% for women and 38.2% for men) of the hypertensive group had the MetS compared with 28% (30% for women and 26.3% for men) in the prehypertensive group and 4.9% (6.2% for women and 3.4% for men) in the normotensive group. Prevalence of MS increased with increasing BP ($\chi^2 = 603.698$, $P < 0.0001$ for women; $\chi^2 = 333.400$, $P < 0.0001$ for men; $\chi^2 = 934.206$, $P < 0.0001$ for all subjects).

Awareness, treatment and control of HT

Table 3 shows our findings concerning awareness, treatment and control of HT according to gender and age groups. Among 2118 subjects with HT, only 869 subjects (41%) were aware of their condition, and 1249 (59%) were not aware of their HT. Women were more aware than men (49.3 versus 30.3%, $P < 0.05$). Prevalence of awareness increased steadily with increasing age in both men and women, but men were less aware than women in each age group. Prevalence of awareness exceeded 65% in subjects

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Table 3 Awareness, treatment, treated/control and control (in all hypertensives) of HT in the study sample by age and gender

	Age groups (years)						
	20–29 n (%)	*30–39 n (%)*	*40–49 n (%)*	*50–59 n (%)*	*60–69 n (%)*	*70 + n (%)*	*Total n (%)*
Men							
Awareness[a]	7 (6.0)	22 (12.6)	64 (26.6)	73 (40.6)	60 (47.6)	52 (64.2)	278 (30.3)
Unawareness	109 (94.0)	152 (87.4)	177 (73.4)	107 (59.4)	66 (52.4)	29 (35.8)	640 (69.7)
Treatment[b]	4 (57.1)	7 (31.8)	28 (43.8)	41 (56.2)	39 (65.0)	34 (65.4)	153 (55.0)
Treated/Control[c]	1 (25.0)	2 (28.6)	7 (25.0)	9 (22.0)	7 (17.9)	7 (20.6)	33 (21.6)
Control[d]	1 (0.86)	2 (1.15)	7 (2.90)	9 (5.0)	7 (5.56)	7 (8.64)	33 (3.59)
Women							
Awareness[a]	17 (16.2)	67 (30.6)	141 (42.1)	134 (57.8)	141 (77.5)	91 (77.7)	591 (49.3)
Unawareness	88 (83.8)	152 (69.4)	194 (57.9)	98 (42.2)	41 (22.5)	36 (28.3)	609 (50.8)
Treatment[b]	2 (11.8)	17 (25.4)	83 (59.3)	84 (62.7)	84 (59.6)	50 (54.9)	320 (54.2)
Treated/Control[c]	1 (50.0)	1 (5.9)	28 (33.7)	24 (28.6)	21 (25.0)	7 (14.0)	82 (25.6)
Control[d]	1 (0.95)	1 (0.46)	28 (8.36)	24 (10.34)	21 (11.54)	7 (5.51)	82 (6.83)
All subjects							
Awareness[a]	24 (10.9)	89 (22.6)	205 (35.6)	207 (50.2)	201 (65.3)	143 (68.8)	869 (41.0)
Unawareness	197 (89.1)	304 (77.4)	371 (64.4)	205 (49.8)	107 (34.7)	65 (31.3)	1249 (59.0)
Treatment[b]	6 (25.0)	24 (27.0)	111 (54.4)	125 (60.4)	123 (61.2)	84 (58.7)	473 (54.5)
Treated/Control[c]	2 (33.3)	3 (12.5)	35 (31.5)	33 (26.4)	28 (22.8)	14 (16.7)	115 (24.3)
Control[d]	2 (0.90)	3 (0.76)	35 (6.08)	33 (8.01)	28 (9.09)	14 (6.73)	115 (5.43)

Awareness was defined as a positive response to question, 'Did a doctor ever tell you that you have (had) high BP?'

Treatment was defined as the use of any antihypertensive medication. Treated/Control was defined as receiving antihypertensive therapy among previously diagnosed hypertensive subjects and having a BP (SBP/DBP) < 140/90 mmHg. Control was defined as a BP < 140/90 mmHg among all hypertensive (known and unknown) subjects.

[a] $\chi^2 = 173.505$, $P < 0.0001$ for women; $\chi^2 = 130.597$, $P < 0.0001$ for men; $\chi^2 = 300.324$, $P < 0.0001$ for all subjects.

[b] $\chi^2 = 41{,}773$, $P < 0.0001$ for women; $\chi^2 = 12{,}794$, $P < 0.05$ for men; $\chi^2 = 43{,}193$, $P < 0.0001$ for all subjects.

[c] $\chi^2 = 10{,}910$, $P > 0.05$ for women; $\chi^2 = 0.751$, $P > 0.05$ for men; $\chi^2 = 8{,}354$, $P > 0.05$ for all subjects.

[d] $\chi^2 = 32.09$, $P < 0.0001$ for women; $\chi^2 = 14.21$, $P < 0.05$ for men; $\chi^2 = 40.01$, $P < 0.0001$ for all subjects.

aged 60 years and over. Of those aware of their HT, 54.5% (473 of 869) were receiving antihypertensive treatment and the percentage of individuals with controlled HT in these patients was 24.3% (115 of 473). Moreover, control of previously diagnosed HT was poor. Among 869 previously diagnosed hypertensive individuals, the percentage of individuals with controlled HT was 13.2% (115 of 869). Among all hypertensive (known and unknown) subjects ($n = 2118$), the percentage of controlled HT was 5.43% (115 of 2118). The rate of control in these subjects increased with age both for men and women ($P < 0.001$), with the highest prevalence in the 60- to 69-year-old age group (9.09%).

HT and associated risk factors

Table 4 shows univariate relationships of HT with various associated factors. Prevalence of HT steadily increased with degree of obesity, whereas prevalence of preHT decreased with degree of obesity. The highest HT prevalence was found in the morbid obese subjects (89.2%). Among subjects, 13.7% of the normotensives versus 21.9% of the prehypertensives and 42.4% of the hypertensives were categorized as obese, and 35.7% of the normotensives versus 41.1% of the prehypertensives and 35.9% of the hypertensives were overweight according to the WHO criteria.

When level of education is considered, an inverse relationship is observed between level of education and prevalence of HT ($P < 0.0001$). Prevalence was highest in illiterate people and lowest in people who graduated from universities or colleges. As education level increases the prevalence of HT decreases.

As for occupation, association with HT was shown in subjects ($P < 0.0001$). Prevalence of HT is highest in the groups of housewives and agricultural workers and lowest in the unemployed group.

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Table 4 Prevalences of preHT and HT in adult Turkish subjects by body mass index (BMI), occupation, level of education, marital status, cigarette smoking, alcohol consumption, degree of physical activity, household income and family history of obesity, diabetes and hypertension and parity

	Normal n (%)	*PreHT n (%)*	*HT n (%)*	*Total n (%)*
BMI (kg m^{-2}) ($\chi^2 = 766.044$, $P < 0.0001$)				
<25	998 (62.1)	255 (15.9)	353 (22.0)	1606 (33.4)
25–29	712 (40.5)	287 (16.3)	760 (43.2)	1759 (36.6)
30–39.9	273 (20.6)	153 (11.6)	898 (67.8)	1324 (27.5)
≥40	9 (7.5)	4 (3.3)	107 (89.2)	120 (2.5)
Level of education ($\chi^2 = 518.312$, $P < 0.0001$)				
Illiterate	118 (15.6)	76 (10.0)	563 (74.4)	757 (15.8)
Primary	674 (37.6)	246 (13.7)	874 (48.7)	1794 (37.3)
Secondary	230 (44.6)	93 (18.0)	193 (37.4)	516 (10.7)
High school	575 (53.1)	193 (17.8)	315 (29.1)	1083 (22.5)
University	395 (59.9)	91 (13.8)	173 (26.3)	659 (13.7)
Occupation ($\chi^2 = 63.847$, $P < 0.0001$)				
Worker	511 (47.3)	160 (14.8)	410 (37.9)	1081 (22.5)
Agriculturel worker	19 (23.2)	14 (17.1)	49 (59.8)	82 (1.7)
Tradesman	243 (42.3)	83 (14.4)	249 (43.3)	575 (12)
Unemployed	64 (47.8)	33 (24.6)	37 (27.6)	134 (2.8)
Housewife	773 (36.1)	275 (12.8)	1094 (51.1)	2142 (44.5)
Official	382 (48.1)	134 (16.9)	279 (35.1)	795 (16.5)
Marital status ($\chi^2 = 354.808$, $P < 0.0001$)				
Unmarried	530 (64.2)	136 (16.5)	160 (19.4)	826 (17.2)
Married	1433 (38.3)	537 (14.4)	1767 (47.3)	3737 (77.7)
Widowed	29 (11.8)	26 (10.6)	191 (77.6)	246 (5.1)
Cigarette use ($\chi^2 = 63.847$, $P < 0.0001$)				
Current smoker	683 (48.0)	235 (16.5)	506 (35.5)	1424 (29.6)
Nonsmoker	1128 (39.3)	382 (13.3)	1357 (47.3)	2867 (59.6)
Former smoker (ex-smoker)	181 (34.9)	82 (15.8)	255 (49.2)	518 (10.8)
Alcohol consumption ($\chi^2 = 117.618$, $P < 0.0001$)				
Drinker	166 (46.5)	56 (15.7)	135 (37.8)	357 (7.4)
Nondrinker	1772 (41.3)	615 (14.3)	1905 (44.4)	4292 (89.3)
Former drinker	54 (33.8)	28 (17.5)	78 (48.8)	160 (3.3)
Physical activity ($\chi^2 = 34.387$, $P < 0.0001$)				
Never	813 (38.5)	294 (13.9)	1007 (47.6)	2114 (43.9)
Mild	855 (43.1)	274 (13.8)	856 (43.1)	1985 (41.3)
Moderate-heavy	324 (45.6)	131 (18.5)	255 (35.9)	710 (14.8)
Household income (US $ per month) (χ^2: 34.02, $P < 0.0001$)				
1–250	241 (35.7)	93 (13.8)	342 (50.6)	676 (14.1)
250–500	968 (40.3)	339 (14.1)	1095 (45.6)	2402 (50.0)
500–750	578 (44.0)	207 (15.7)	530 (40.3)	1315 (27.3)
>750	205 (49.3)	60 (14.4)	151 (36.3)	416 (8.6)
Family history of diabetes, hypertension, obesity, and CHD (χ^2: 1.812, $P = 0.404$)				
No		197 (15.0)	556 (42.5)	1309 (27.2)
Yes		502 (14.3)	1562 (44.6)	3500 (72.8)
Parity (Number of births) ($\chi^2 = 473.948$, $P < 0.0001$)				
Unmarried	250 (72.3)	42 (12.1)	54 (15.6)	346 (13.3)
Nulliparous	94 (49.7)	26 (13.8)	69 (36.5)	189 (7.3)
1	148 (58.7)	41 (16.3)	63 (25.0)	252 (9.7)
2	264 (48.9)	81 (15.0)	195 (36.1)	540 (20.8)
3	172 (35.3)	68 (14.0)	247 (50.7)	487 (18.7)
4	77 (25.4)	31 (10.2)	195 (64.4)	303 (11.6)
5+	69 (14.3)	38 (7.9)	377 (77.9)	484 (18.6)
Total	1074 (100)	327 (100)	1200 (100)	2601 (100)

CHD, coronary heart disease.

We found a significant association between HT and marital status ($P < 0.0001$). Prevalence of HT was highest in widows and widowers and lowest in unmarried people.

We observed an association between cigarette use and the prevalence of HT ($P < 0.0001$). In particular, there was a significant correlation between nonsmoking, cessation of cigarette smoking and prevalence of HT. The percentages of current smokers, nonsmokers and ex-smokers were higher in the HT group than those in the preHT group. Interestingly, prevalence of HT was highest in the nonsmokers and ex-smokers (former smokers) and lowest in the smokers. Also, interestingly, there was an inverse association between alcohol consumption and prevalence of HT ($P < 0.0001$). Prevalence of HT was highest in the nondrinkers and ex-drinkers (former drinkers) and lowest in drinkers.

We observed an inverse association between physical activity and prevalence of HT ($P < 0.0001$). Prevalence of HT was increased with decreased physical activity.

There was a negative significant association between household income and prevalence of HT ($P < 0.0001$). Prevalence of HT decreases, as income level increases.

No significant association was found between the HT and family history of obesity, hypertension, hyperlipidemia, diabetes or CVD.

Among women, a linear association was observed between parity (the number of births) and the prevalence of HT ($P < 0.0001$). The prevalence was increased with the parity.

As a result of multinomial (linear logistic regression) analysis, odd ratios for each of the demographic factors, socioeconomic factors, lifestyle factors and family history of

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Table 5 Odds ratios (OR) and 95% confidence interval (CI) for preHT and HT for demographic, socioeconomic, lifestyle factors, and family history of selected medical conditions, comparing to normal group, using polychotomous logistic regression analysis with the multinomial logit model

Parameter	*Prehypertension*			*Hypertension*		
	OR	*95% CI*	*p*	*OR*	*95% CI*	*P*
Age groups						
20–29	1			1		
30–39	1.01	0.78–1.30	0.953	1.67	1.32–2.11	<0.0005
40–49	1.22	0.92–1.63	0.175	3.35	2.61–4.29	<0.0005
50–59	1.78	1.20–2.64	0.004	8.37	6.10–11.48	<0.0005
60–69	2.73	1.51–4.94	0.001	20.77	12.96–33.27	<0.0005
70+	2.02	1.02–3.97	0.043	16.54	9.86–27.74	<0.0005
Sex						
Female	1			1		
Male	1.88	1.37–2.58	<0.0005	1.77	1.34–2.34	<0.0005
Level of education						
Illiterate	1			1		
Primary	0.76	0.53–1.10	0.135	0.74	0.56–0.97	0.027
Secondary	0.89	0.58–1.36	0.585	0.65	0.46–0.92	0.015
High school	0.77	0.51–1.17	0.215	0.61	0.44–0.85	0.003
University	0.50	0.30–0.81	0.005	0.51	0.34–0.75	0.001
Cigarette use						
Nonsmoker	1			1		
Former Smoker	0.98	0.72–1.35	0.919	0.75	0.58–0.97	0.028
Current Smoker	0.98	0.79–1.20	0.822	0.80	0.67–0.95	0.013
Alcohol consumption						
Nondrinker	1			1		
Former Drinker	1.21	0.74–1.97	0.452	1.08	0.71–1.64	0.712
Drinker	0.91	0.65–1.28	0.588	1.15	0.86–1.52	0.346
Family history of selected medical conditions						
No	1			1		
Yes	1.12	0.92–1.37	0.260	1.46	1.23–1.73	<0.0005
BMI (kg m^{-2})						
<25	1			1		
25–29.9	1.41	1.14–1.73	0.001	2.06	1.71–2.47	<0.0005
30–39.9	1.89	1.45–2.47	<0.0005	4.94	3.99–6.12	<0.0005
≥40	1.58	0.48–5.24	0.455	17.27	8.38–35.61	<0.0005
Occupation						
Worker	1			1		
Agricultural worker	1.78	0.85–3.71	0.127	1.44	0.76–2.72	0.259
Tradesman	1.05	0.76–1.44	0.776	1.32	1.02–1.71	0.034
Unemployed	1.81	1.13–2.89	0.013	1.05	0.64–1.71	0.848
Housewife	1.64	1.13–2.36	0.008	1.47	1.08–2.02	0.015
Official	1.49	1.09–2.03	0.012	1.19	0.91–1.56	0.210
Household income (US $ per month)						
1–250	1			1		
250–500	0.90	0.68–1.20	0.478	0.84	0.67–1.05	0.130
500–750	1.02	0.75–1.39	0.889	0.96	0.75–1.24	0.774
>750	0.97	0.64–1.47	0.885	0.90	0.63–1.27	0.545

Continued

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Table 5 *Continued*

Parameter	*Prehypertension*			*Hypertension*		
	OR	*95% CI*	*p*	*OR*	*95% CI*	*P*
Marital status						
Unmarried	1			1		
Married	0.97	0.73–1.28	0.825	0.85	0.65–1.10	0.220
Widowed	1.80	0.95–3.40	0.073	1.54	0.90–2.62	0.115
Physical activity						
Never	1			1		
Mild	0.90	0.74–1.10	0.303	0.93	0.79–1.09	0.362
Moderate-heavy	1.18	0.90–1.54	0.233	1.11	0.88–1.40	0.397
Parity (for women only)						
Unmarried or Nulliparous	1			1		
1	1.21	0.67–2.17	0.529	1.01	0.59–1.72	0.982
2	1.15	0.68–1.95	0.603	1.53	0.97–2.41	0.068
3	1.07	0.62–1.86	0.806	1.42	0.90–2.26	0.135
4+	0.91	0.52–1.60	0.753	1.75	1.11–2.76	0.017

selected medical conditions are presented in Table 5. In the analysis, HT was significantly associated with the factors: age, male sex, BMI, education level, nonsmoking, family history of selected medical conditions, occupation (housewives and tradesmen) and parity. PreHT was associated with the factors: age, male sex, BMI, education level (only for universities), and occupation (especially housewives).

A clear trend towards increased risk of HT was noted with increments in age and BMI, male gender and family history of selected medical conditions.

In Spearman's correlation analysis, HT was positively correlated with age, BMI, WC, WHR, FBG (only for SBP), total-C, TG (only for SBP) and LDL-C ($P < 0.001$). PreHT was positively correlated with age, BMI, WC, hip girth WHR, FBG, total-C, LDL-C and TG ($P < 0.0001$).

Discussion

Main findings

The prevalence of HT was found to be 44%. The combined prevalence of both preHT and HT was excessively high (58.5%). According to the logistic regression analysis, age, sex, level of education, BMI and a family history of selected medical conditions were found to be associated with the prevalence of pre HT and HT. Only 41% of subjects were aware of their HT, 54.5% of them were receiving antihypertensive treatment, and 24.3% receiving antihypertensive agents were under control. Therefore, only 5.43% of all the hypertensive subjects were under control.

What is known already

HT is a common health problem in developing countries, and its prevalence is currently rising steadily.[1] The prevalence of HT varies widely among different populations and is somewhat dependent on factors such as race, lifestyle and degree of urbanization.[10] These differences may reflect the effects of dynamic interactions among genetic, demographic, sociocultural and economic factors. Moreover, the results may be variable in different regions of a country.[3,11] The prevalence in the worldwide adult population varies from 5.2 to 70.7%.[1] In various reports about prevalence of HT in Turkey between 1995 and 2003, the prevalence was found to be between 29.6 and 35.5% (the highest prevalence was 36.7% for women and 37.3% for men).[3,7,8,11] In a previous study performed by us from 1996 to 1997, we reported that the prevalence of SBP and DBP in adults ($n = 2646$) in the central province of Trabzon city was 12.0 and 8.2%, respectively.[6] That study was actually about the prevalence of diabetes. Then, in an other study performed by us from February 2001 to September 2002, we also reported that the prevalence of HT in adults ($n = 5016$) in the central province of Trabzon city and its nine towns was 33.9%; 34.6% in women and 33.2% in men.[12] That study was about the prevalence of obesity.

In the literature, HT is more prevalent among men than women,[13–17] although the prevalence is more among women than men in other studies.[18–22] In the other rare studies, the prevalence of HT was similar among men and women.[11,23] The variation may be explained by differential

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distribution in risk factors (e.g. genetic predisposition, dietary factors, lack of physical activity) between women and men across populations. The male gender is an independent risk factor for HT and CVD.[17]

Age is strongly associated with HT. In many studies, it was reported that the prevalence of HT increased with age.[3,7,8,11,14,19,20,24]

The level of awareness, treatment and control of HT varies considerably among countries and regions.[1] In economically developed countries, there were relatively high levels of awareness and treatment, with approximately one-half to two-third of hypertensives aware of their diagnosis and one-third to one-half receiving treatment.[1] The levels of awareness, treatment and control of HT are especially low in some economically developing countries.[1,3,7]

What this study adds

This paper reports one of the largest population-based studies of preHT and HT ever conducted, in which the prevalence of PreHT and HT, and associated risk factors were analysed for the first time in the Trabzon Region.

Using the new JNC guidelines (JNC-7 report) in the present study, the prevalence of HT was found to be 44%. The combined prevalence of both preHT and HT was high (58.5%). The estimated prevalence of HT was comparable, being moderately high by international standards. Compared with surveys in other countries, prevalence of HT in Trabzon city is higher than in Italy,[25] France,[18] Sweden,[25] USA,[26] Canada,[13] Mexico,[14] Korea,[19] South Africa,[24] China,[27] Pakistan,[20] India,[15] Jamaica,[21] and Greece,[28] but is lower than in Germany[25] and Finland,[25] and similar to the prevalence in Spain[29] and England.[25]

Thus, the prevalence of HT tends to be higher in Western countries than in Asian countries.[1] However, over the past decade, the prevalence of HT has either remained stable or has decreased in economically developed countries, and has shown a tendency to increase in economically developing countries.[1] Furthermore, in comparison with 2001–2002, in the present study, prevalence of HT from 2003 to 2005 represented an increase of 23% (25% for women and 20% for men) in the Trabzon city. Changes in lifestyle and dietary habits, economic development and an increase in life expectancy may help to explain the rapid increase in the prevalence and absolute number of subjects with HT in developing countries (e.g. Turkey).

Another important finding of the present study is that the combined prevalence of both preHT and HT in Turkish adults is excessively high (58.5%). To our knowledge, this is the second Turkish study to employ the new category of preHT, in accordance with the definitions established by the JNC-7 report.[11]

In the present study, the prevalence of HT in women was higher than in men (46.1 versus 41.6%) (especially after age 40). This finding was similar to the previous studies in Turkey.[3,7,8] However, the odds ratio (OR) for the HT and preHT groups was significantly increased in the male gender in multivariate logistic regression analysis.

In the present study, prevalence increased dramatically with age in both sexes, from ~16.9% among people in their 20s to over 80% among people older than 60 years. The highest prevalence of HT was in the 60- to 69-year-old age group for women (88.8 %) and men (78.8%). The positive associations between ageing and hypertension, diabetes and obesity were illustrated in a Turkish adult population.[6,12]

Our study has revealed that the MetS is more common among preHT and HT groups than among normotensive groups. Subjects with MetS were at increased risk of development of CVD.[30] Therefore, the results of the present study suggest that subjects with preHT have a higher risk of CVD. Accordingly, some studies have reported that subjects with preHT have an increased risk of CVD, including coronary atherosclerosis, compared with those with normal BP, supporting the recommendations of the JNC-7 report for physicians to target actively the lifestyle modifications and multiple risk reductions in preHT patients.[31]

In the present study, the most striking finding related to the awareness of HT was the very high percentage of subjects (59.0%), who had never had their BP checked. The highest unawareness rate was observed in the 20- to 29-year-old age group (89.1%). The rate of awareness of 41% is lower than in the USA[26] (68.9%), Canada[13] (58.0%) and Greece[28] (60.8%), similar to that in Spain[29] (45.5%), but higher than in Korea[32] (25.2%).

Among the individuals aware of their hypertensive status, 45% of males and 45.8% of females were not taking antihypertensive drugs (AHDs) in the present study. The rate of treatment of known hypertensive patients by AHD was quite low (54.5%). This rate is higher than in Bulgaria[16] (36%), Mexico[14] (46%) and Korea[19] (22.9%), similar to that in South Africa[24] (55% among women) and San Marino[33] (58.6%), but lower than in the USA[26] (84%). In our study, the rate of use of AHD increased with age, as in previous studies.[3,8,16]

Control of HT by AHD therapy (treated/control group) was quite low (24%) in the present study. Hypertension control rates vary within countries according to age, race, socio-economic status and quality of health care.[34] Our results are concordant with the results of previous studies in

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Turkey.[3,7,8] Also, the control rate among hypertensives taking AHDs is higher than in Bulgaria[16] and Mexico,[14] similar to that in San Marino,[33] but lower than in USA[26] and Canada.[13]

The control rate of HT among all hypertensive (known and unknown) subjects was very low (5.43%) in the present study. The control rate of HT in Trabzon was much lower than in some countries.[26,28,33] The low control rate is not only related to low awareness, but also to inadequate AHD therapy.[3]

Several studies have also found that obesity is a principal risk factor for the development of HT.[35] Overweight or obesity was significantly associated with high BP.[6] In our study, only 16.7% of HT and 36.5% of preHT were of normal weight. This study demonsrated that obesity was also a serious public health problem in Trabzon. Of the study population, 66.6% were either overweight or obese. A serious educational effort about obesity and its risks should be made for the population. A goal should be established of securing balanced nutrition for the community and increasing physical activity.[12]

In our study, HT had a strong inverse association with the level of education. The results are in line with previous studies conducted in Turkey and other countries.[11,17,19,36] Low education was a risk factor for features of HT in the present study. High prevalence of HT in the group with a low education level might result from the fact that the risk factors such stress, working conditions and nutritional habits were more common; or that people in this group had difficulties in reaching health-care services.[11]

Many studies have reported that low socio-economic status is associated with a higher prevalence of HT[15,20,22] and a higher mortality rate from CVD.[37] We observed an association between occupation and employment situation. Prevalence of HT was significantly increased in housewives and agriculture workers. However, OR for the HT was significantly increased in housewives and tradesmen. Doing domestic duties without fixed hours or renumeration, including a constant access to food, and lack of physical activity may contribute to the appearance of obesity and HT in these women. Interestingly, in the present study, we found a high prevalence of HT in agriculture workers. This condition may be explained by the fact that the total working time of agriculturel workers in 1 year is very short, approximately 1–2 months per year, due to the geographical and physical structure and climatic conditions of Trabzon city.

Current smoking is a significant independent risk factor for preHT and HT in both women and men.[17,31] In other studies, significant association between HT and smoking has not been observed.[19,22] Cigarette smoking is known to impair insulin action and may lead to insulin resistance. It may also cause high BP by increasing sympathetic activity.[38] In the present study, we found an association between smoking and HT (Tables 4 and 5). HT was significantly less frequent in current smokers than in ex-smokers and nonsmokers. The risk of preHT and HT was significantly decreased in current smokers and former smokers in multinomial logistic regression analysis. It is important to point out that our data, similar to other studies, have shown the interesting phenomenon that smokers have lower BP than nonsmokers, and did not refute the fact that smoking is one of the main risk factors of HT.

The ORs for HT were significantly increased in subjects with a family history of obesity, diabetes, hypertension and atherosclerotic heart disease compared with those without family history in the present study. In the literature, subjects with family history of obesity, diabetes, hypertension and atherosclerotic heart disease have a greater prevalence of HT compared with those without such family history.[15,17] Our results were concordant with the previous studies in the literature.

In the present study, we found that preHT and HT were positively correlated with WC, WHR, FBG, total-C, triglycerides and LDL-C. We did not find a correlation between preHT and HT and HDL-C. There is a strong correlation between body fat and BP. The prevalence of HT is greater in subjects with central obesity, as reflected by a high WC and WHR than in those with peripherial, gluteal fat and low WHR.[15] Shanthirani *et al.*[15] reported serum total-C, triglycerides, LDL-C and glucose intolerance to be associated with HT. Our results were concordant with the previous studies in the literature.[15,18]

Limitations of this study

A major limitation of the study is that it was performed only in urban areas. In addition, nutritional habits could not be included.

Conclusions

The present study, which first examined the clustering of various risk factors, showed that the prevalence of HT in Turkish adult subjects living in Trabzon was very high. HT is a public health problem that becomes important from the 20s. In the present study, the prevalence of HT in the 20- to 29-year-old age group was 16.9%. Therefore, we recommend that the BP of younger adults should be measured by midwives/nurses/physicians who make periodical house visits in Turkey as a public health measure. Also, subjects living in Trabzon may have a tendency toward HT. Despite

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the high prevalence of HT, more than one-half of the hypertensive subjects are unaware of their medical status. Only 5.4% of all hypertensives had their BP controlled. Our results emphasize the urgent need for a public health strategy for the prevention, detection and treatment of HT and preHT. Moreover, regular physical activity and weight reduction through education and awareness among people is the key to reduce the burden of HT, preHT and CVD.

Supplementary data

Supplementary data are available at the *Journal of Public Health* online.

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