Hypertension incidence in Turkey (HinT): a population-based study

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Objective **Hypertension incidence is an important determinant of hypertension prevalence and progression. Few studies have been published on hypertension incidence in developing countries despite the high prevalence observed. The aim of this study was to investigate the incidence of hypertension in Turkey.**

Methods **The study was designed as an epidemiological cohort study which included the population of the Prevalence, awareness, treatment and control of hypertension in Turkey (PatenT) Study which had 4910 volunteers. Blood pressure measurements were performed three times and a questionnaire was used to obtain data on the present status of hypertension with regards to distributions and alterations of risk factors.**

Results **In the present study, 4008 (81.6%) participants of the PatenT Study population were contacted after 4 years. After excluding 173 dead and 67 pregnant individuals, the study cohort comprised of 3768 individuals. The overall 4-year incidence rate of hypertension was 21.4%; it reached a maximum of 43.3% in individuals over 65 years of age. Age, initial blood pressure category, and body mass index were the best predictors of the hypertension incidence rate. Multivariate logistic regression analysis revealed that age, obesity, alcohol consumption, and living in rural areas were significant predictors of hypertension.**

Conclusion **Follow-up periods scheduled considering age, initial blood pressure category, and body mass index are important for the early determination of hypertension. As there are limited data regarding hypertension incidence in developing countries, the results of data collected in this study might serve as a model. *J Hypertens* 28:240–244 © 2010 Wolters Kluwer Health | Lippincott Williams & Wilkins.**

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Introduction

High blood pressure (BP) is a major public health challenge and the most important preventable risk factor for stroke, cardiovascular and renal disease. Global prevalence of hypertension and burden of disease attributable to high BP is significantly increasing [1]. The majority of the burden has been in developing countries and in relatively young age groups [2]. The rising epidemics of cardiovascular disease require increased awareness and surveillance [3], however; little information is available in these regions [2].

Turkey is a developing Mediterranean country and has a relatively high proportion (61.3%) of young population (<35 years) [4]. In 2003, the Prevalence, awareness, treatment and control of hypertension in Turkey (PatenT) study was conducted [5], and hypertension was found to be highly prevalent (31.8%).

Part of this work was presented at 10th National Congress of Hypertension and Renal Diseases in Antalya, TURKEY at 21–25 May 2009.

Incidence data are an important determinant of hypertension prevalence and provide significant information about risk factors for progression from normal to high BP. The present Hypertension incidence in Turkey (HinT) Study is the first study to use real life data for the determination of hypertension incidence. The aim of the study was to investigate the incidence of hypertension in Turkey in order to facilitate future public health efforts in primary prevention as well as secondary prevention in countries with emerging economies.

Methods

Study design and participants

This epidemiological cohort study was designed, directed and supported by the Turkish Society of Hypertension and Renal Diseases. Individuals were the participants of the PatenT Study, which included 4910 volunteers from 26 cities located in seven geographical provinces of Turkey. In the PatenT Study [5] a two-stage stratified

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sampling method was used to select a nationally representative sample of the adult population over 18 years of age. Sampling process was first stratified by province and then by urban/rural areas. A total of 4992 people (65% urban and 35% rural residents) were randomly selected. Strata were selected by a proportional sampling method according to postal-code lists. Rural areas were defined as towns and villages 80 km away from city centers. As pregnancy has a significant effect on BP readings [5], 82 pregnant women were excluded and the final sample size was 4910 individuals.

A new questionnaire, including the questions of the 2003 survey with the addition of present status of hypertension with respect to distributions and alterations of risk factors were administered. Weight and height measurements were performed, and blood and urine samples were obtained.

The study was conducted according to the Declaration of Helsinki and Good Clinical Practices. Written permission was obtained from the Ministry of Health. Verbal informed consents were obtained from all participants.

Blood pressure measurement

Three BP readings were taken with a standard mercury sphygmomanometer (Erkameter 3000 Mercurial Sphyg with Velcro Cuff; Erka, Bad Toelz, Germany) and appropriate-sized adult cuffs as described previously [5].

Participants with systolic BP at least 140 mmHg and/or diastolic BP at least 90 mmHg by measurement or who were using antihypertensive medication or were diagnosed as hypertensive by a physician were considered to be hypertensive. Normal BP has been categorized as optimal (systolic BP <120 mmHg and diastolic BP <80 mmHg), normal (systolic BP 120–129 mmHg and diastolic BP 80–84 mmHg), or high–normal (systolic BP 130–139 mmHg and diastolic BP 85–89 mmHg) [6].

Incidence rate calculation

Incidence rate is represented by the number of new events occurring in a population over a specific period of time divided by the average incidence population [7]. Incidence rate was calculated by dividing the number of hypertensive individuals in the 2007 survey who were normotensive in 2003, with the average incidence population. Average incidence population was calculated as the population at the end of the second year, that is, half of the 4-year population with respect to the initial normotensive population. End of the second year population was reached by subtracting half of the number of the predicted hypertensive individuals and individuals with unknown outcome from initial total incidence population. Individuals with unknown outcome comprised unreachable, dead and pregnant normotensive individuals.

$$\text{Incidence rate} = \frac{\text{New hypertensive individuals : number in 2007 survey}}{\text{AIP}}$$

$$\text{AIP} = \text{TIP} - \frac{\text{NHT} + \text{UNS} + \text{PNS} + \text{DNS}}{2}$$

AIP: Average incidence population
TIP: Total incidence population
NHT: Number of new hypertensive individuals
UNS: Number of unreachable normotensive individuals
PNS: Number of pregnant normotensive individuals
DNS: Number of dead normotensive individuals

Statistical analysis

All statistical analyses were performed by using SPSS 11.0 (SPSS Inc., Chicago, Illinois, USA) and STATA 9.0 (STATA Corporation, Houston, Texas, USA) software. Student t test was used to compare normally distributed numeric variables. Univariate and multivariate logistic regression analysis were used to assess significant predictors of hypertension. Statistical significance level was selected as $P<0.05$.

Results

A total of 4008 individuals out of 4910 individuals participated in the 2003 survey, were included and the attainment rate was 81.6%. After exclusion of 173 dead and 67 pregnant individuals, hypertensive individuals constituted 31.7% of the remaining 3768 participants. The ratios of hypertensive individuals were similar in the attained population and the total population of the 2003 survey. In the present study, 902 individuals could not be included due to several reasons; the most frequently encountered were absence in the former address (69%) and unwillingness to participate (12%). Among these 902 individuals, 260 (28.9%) were hypertensive and 642 (71.1%) were normotensive in 2003 (Table 1). No significant difference was present between the participants and the unattainable people, regarding demographic characteristics and BP recordings. The demographics and clinical features of participants in the 2007 survey ($n=3768$) are presented in Table 2.

Table 1 Characteristics of 2003 and 2007 populations

	2003 population	2007 population
Total population	4992	4008
Death	–	173
Pregnant	82	67
Unattainable population	–	902[a]
Study population	4910	3768
Normotensives	3327	2001
Hypertensives	1583	1767

[a] 642 were normotensive and 260 were hypertensive in 2003.

Table 2 Demographic and clinical features of participants in the 2007 survey

Variable	Population (%)
Sex	
Female	60.8
Male	39.2
Age (years)	
<35	26.4
35–64	59.9
≥65	13.7
Residence	
Urban area	62.7
Rural area	37.3
Blood pressure categories	
Optimal	21.4
Normal	23.0
High–normal	15.1
Stage 1 HT	23.1
Stage 2 HT	12.6
Stage 3 HT	4.9
BMI	
Nonobese (BMI < 30 kg/m^2)	66.4
Obese (BMI ≥ 30 kg/m^2)	33.6

BMI, body mass index; HT, hypertension.

More than half of the study population were women (60.8%) and 43.7% of them were in menopause. Hypertension was present in 73.8% of postmenopausal women and it was significantly higher than the ratio in menstruating women (29.1%, $P < 0.001$).

The total incidence population of the present study consisted of the 3327 normotensive participants from the 2003 survey. Data for 755 of these participants (22.7%) could not be used as 54 were dead, 59 were pregnant and 642 were unreachable. Among the individuals in the incidence cohort of the 2007 survey, 571 were hypertensive (438 by measurement, and 133 by medical history). The overall 4-year incidence rate of hypertension (observed incidence rate) was determined to be 21.4% (95% CI, 19.9–23.0) as shown below:

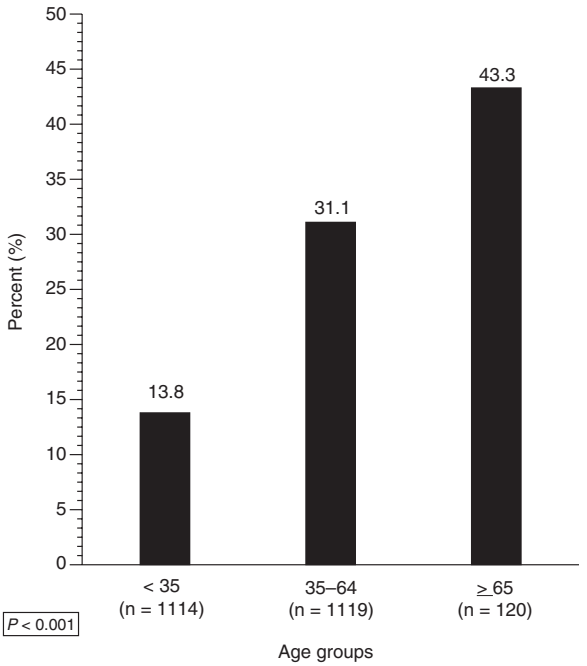
$$\text{AIP} = 3327 - \frac{571 + 642 + 59 + 54}{2}$$

$$\text{AIP} = 3327 - \frac{1326}{2} = 3327 - 663 = 2664$$

$$\text{Incidence rate} = \frac{571}{2664} = 0.214 = 21.4\%$$

The adjusted incidence rate, weighted according to sex, age, or residence status was 21.3% (95% CI, 19.7–23.0). The incidence rate of hypertension in men was (23.0%; 95% CI, 20.4–25.8) significantly higher than in women (19.2%; 95% CI, 17.2–21.4) with a difference of 3.8% (95% CI, 0.4–7.2, $P = 0.029$). The incidence rate increased with age, reaching a maximum of 43.3% in individuals over 65 years of age (Fig. 1). The rate was significantly higher in people living in rural areas (25.5%; 95% CI, 22.6–28.5) than in urban areas (19.0%; 95% CI, 17.1–21.1, $P < 0.001$).

Fig. 1



Incidence rate of hypertension according to age groups in the 2007 survey.

The most predictive parameters of hypertension incidence were initial BP category, age, and BMI. Among individuals in the three BP categories (optimal, normal, and high–normal), individuals with high–normal BP were more likely to have hypertension than individuals in the other categories. A great majority of individuals (40.7%) with high–normal BP in the 2003 survey were found to be hypertensive in 2007 (Table 3).

During the 4-year period, there was a significant increase in BMI values of the study population. The mean increase in BMI was 0.88 kg/m^2 (%95 CI, 0.77–0.98, $P < 0.001$). The mean BMI for women was significantly higher than for men in both 2003 (26.48 and 25.56, respectively) and 2007 surveys (28.8 and 27.92, respectively). Also, hypertensive individuals had a significantly higher mean BMI (28.26) than normotensive individuals

Table 3 Blood pressure variations between the 2003 and 2007 surveys

		2003 survey		
		Optimal	Normal	High–normal
2007 survey	Optimal	47.7%	26.3%	14.1%
	Normal	29.5%	34.8%	25.2%
	High–normal	10.5%	17.6%	19.9%
	Stage 1 HT	9.9%	16.2%	28.0%
	Stage 2 HT	1.7%	4.4%	10.3%
	Stage 3 HT	0.7%	0.7%	2.4%

Table 4 Results of univariate and multivariate logistic regression analyses for hypertension incidence

Variables[a]	Univariate (*P*)	Multivariate (*P*)	Odds ratio	95% CI
Age	<0.001	<0.001	1.036	1.028–1.044
Obesity	<0.001	<0.001	1.744	1.414–2.152
Cola intake	0.032	0.865	1.018	0.829–1.250
Living in rural areas	<0.001	0.003	1.377	1.116–1.698
Diabetes mellitus	<0.001	0.003	1.800	1.223–2.649
Employment status	<0.001	0.709	0.936	0.661–1.325

[a] The variables included in the logistic regression analysis are; age, sex, obesity, alcohol consumption, smoking, physical activity, coffee, tea and cola intake, living in rural areas, presence of diabetes mellitus, employment status.

(26.12; $P < 0.001$). The hypertension incidence of lean (BMI < 25), overweight (BMI 25–29) and obese individuals (BMI > 29) was calculated as 14.2% (95% CI, 12.3–16.2), 24.5% (95% CI, 21.7–27.4) and 37.8% (95% CI, 33.2–42.5), respectively.

Multivariate logistic regression analysis demonstrated that in the presence of diabetes mellitus and obesity, hypertension risk increased 1.8 fold ($P = 0.003$) and 1.7 fold ($P < 0.001$), respectively. In addition age, cola intake, and living in rural areas were also significant predictors of hypertension. All available data about potential risk factors have been included in the univariate logistic regression analysis; however, no relation was found between sex, smoking status, physical activity and hypertension incidence. In multivariate logistic regression analysis, significant predictors of hypertension were age, obesity, alcohol consumption, and living in rural areas (Table 4).

Discussion

The present HinT Study is the first to evaluate the incidence rate of hypertension in Turkey. The incidence rate was 21.3%, which is relatively high for a young population as in Turkey.

Relatively few studies have been published on hypertension incidence in the general population. Most of the published data are from developed countries. The Framingham Heart Study [8] is the most instructive study, providing data for both incidence and progression to hypertension from a large community-based sample in the United States. The recent analyses about global burden of hypertension, however, clearly indicate the ominous danger in the developing world. It is, therefore, crucial to collect data from these countries and the data collected in this study may constitute a model.

The duration of evaluation in incidence studies vary. In the present study, the PatenT Study population was evaluated 4 years after the first assessment, similar to the Framingham Heart Study. The Framingham Heart Study gives feasible suggestions about follow-up periods for determination of hypertension. Annual incidence rates in the Framingham Heart Study demonstrated a serious increase in hypertension for older individuals with high normal BP (15.7%) in 1 year [8]. The yearly evaluation of BP can thus provide important results and the absence of it may be a limitation of the HinT study.

In a small cohort study performed in the United States, the 7-year hypertension incidence was 25.3% [9]. Similarly, hypertension incidence in Canada was 25.7% over 7 years of follow-up [10]. It is noteworthy that the incidence rate of hypertension over a 4-year follow-up period in this study is similar to those performed over 7 years. To our knowledge, there are no incidence data in the literature from developing countries.

In the present study age, initial BP category, and BMI were the most predictive parameters of hypertension incidence rate. Although the hypertension incidence rate was 31.1% in people aged 35–64 years, it increased to 43.3% in the group aged at least 65 years. The increase with advancing age is consistent with previous studies [8,11–13]. A great number of participants with high–normal BP in this study showed progression (40.7%) to hypertension over a 4-year period. This rate is similar to the progression rate in the high–normal BP category in the Framingham Heart Study (37.3%) [8].

In the present study, the impact of BMI on hypertension incidence has also been shown. As BMI increases, hypertension incidence rate rises dramatically, up to 37.8% in obese individuals. BMI in the study population significantly increased during the 4-year period. The prevalence of obesity was found to be 30.4% in Turkey, and that is consistent with our findings (33.6%) [14]. Mean BMI in the hypertensive individuals (28.26 kg/m^2) was significantly higher than in normotensives (26.12 kg/m^2). Each one-unit increase in BMI was associated with a 3% increase in the risk of developing hypertension [11]. A weight gain of 5% over the 4 years of follow-up (equivalent to a gain of 4 kg in an average man, or 3 kg in a woman) was associated with a 21–30% increased risk of hypertension [8].

Current recommendations for BP follow-up in normotensive individuals vary widely across guidelines [6,15–17]. The Framingham Heart Study suggested that individuals with high–normal BP should be monitored once a year and those with normal BP every 2 years [8]. The second joint European Task Force on Prevention of Coronary disease has recommended a follow-up interval of up to 5 years [16], which would seem to be too long for the individuals who are obese, elderly or have high–normal BP.

Sex may be another risk factor for the progression of hypertension. In the present study, men had higher rates of hypertension incidence than women. This relation, however, was not present in univariate logistic regression

analysis and there have been contradictory results regarding sex and hypertension incidence in the literature [9,11,12].

In the present study, logistic regression analysis revealed that age, obesity, cola intake, residence in rural areas, and diabetes mellitus were risk factors for hypertension incidence. The effect of age [8,11–13] and weight gain [8,11] was determined in several studies. There is a close connection between diabetes mellitus and hypertension. Several longitudinal studies have shown a relationship between insulin resistance and hypertension incidence [18,19]. The reasons for detecting higher hypertension incidence in rural areas may be low educational level and low socioeconomic status [20]. Another factor leading to increased incidence may be high salt consumption, which is typical for developing countries like Turkey. Bread is an important component of diet in Turkey and average bread consumption leads to 7.28 g/day salt intake, which is more than the daily recommended amount [21]. In this study, a significant relation between cola consumption and hypertension incidence was found in univariate logistic regression analysis but it did not remain in the multivariate analysis. This may have occurred by chance or may be due to BMI increase in people consuming soft drinks. Sex, smoking status and physical activity were also included in the logistic regression analysis and no relation was found with hypertension incidence.

A relative limitation of the present study was the unattainable population. However, according to our experiences and data in the literature, in a country with high population movements like Turkey, an attainment rate of 81.6% is important.

In conclusion, a relatively high rate of hypertension incidence was found in Turkey. In order to detect hypertension in the early stages, the follow-up periods should be arranged considering the age, initial BP category, and BMI of the individuals. As BP measurements do not constitute a great burden on the national health economy compared with the burden of hypertensive diseases, the screening of normotensive individuals, especially those in the high–normal BP category and the elderly will enable early detection and treatment of hypertension. The results of the current study in an economically developing country present local findings that may reflect the hypertension incidence in similar countries globally.

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The sponsor, the Turkish Society of Hypertension and Renal Diseases', had assigned the study group and were involved in the study design.

There are no conflicts of interests.

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