Original Article

Increased Body Mass Index and Hypertension: An Unbreakable Bond

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Abstract

Background: Adherence with lifestyle recommendations is low among hypertensive patients. The main objective of this study was to assess the prevalence of diagnosed hypertension among the Greek urban population and to examine how lifestyle and sociodemographic characteristics differ between already known hypertensive and the rest of the population. **Methods:** In this cross-sectional survey, data were collected from 1,060 participants (mean age 47.1 ± 16.9 (mean ± 1[st]andard deviation), 52.7% females). Sociodemographic characteristics, health risk factors, and medical history were involved. Body mass index (BMI) (kg/m^2) was calculated, according to reported height and weight. Parametric tests and multiple logistic regression analysis were applied to identify whether socio-demographic characteristics and health risk factors differed between known hypertensive and the rest of the population. **Results:** Already known hypertensives were 179 (101 females-78 males). The prevalence of known hypertension was 16.9% (18.1% in females and 15.6% in males). In multivariate analysis, known hypertensives were more likely to have advanced age (P < 0,001, OR = 1.101, 95%CI 1.081–1.121) and increased BMI (P < 0,001, OR = 1.138, 95%CI 1.085–1.194). Moreover, they had a higher probability of suffering from other cardiovascular diseases or sharing other risk factors for cardiovascular diseases. **Conclusions:** Among Greek urban population, almost one to six adults knows to suffer from hypertension. In spite the recommendations, patients who were aware of their illness have increased BMI compared with the rest of the population.

Keywords: *Body mass index, cardiovascular diseases, hypertension, lifestyle, obesity, overweight*

Introduction

Hypertension constitutes a major worldwide health concern.[1] Affects 37–55% of the adult population in Europe.[2] The previous study from Greece exhibited a prevalence of hypertension of 31.1%. From hypertensive patients, 39.8% did not know that they had hypertension. Furthermore, only 32.8% of treated patients had their blood pressure adequately controlled.[3] The treatment of hypertension not only consists of drug therapy but also targeted lifestyle modifications such as weight reduction, smoking cessation, moderation of alcohol consumption, regular aerobic physical activity, salt restriction, etc.[4] These lifestyle changes contribute to blood pressure reduction in under treatment hypertensive patients and allow reduction of both the number and doses of antihypertensive drugs.[5] It is worth mentioning that weight loss appears to be the most effective modification to lifestyle for the blood pressure regulation,[6-8] suggesting that increased body mass index (BMI) is causally associated with high blood pressure.[9,10] After definite a diagnosis, the patients must modify their lifestyle and probably must receive medications. However, although hypertensive patients are informed about their disease, studies from several countries have reported that they did not change their lifestyle behavior.[11-13] Consequently arises the question, whether in Greece differences in lifestyle exist between known hypertensive patients and the rest of the population. The main objective of this study was to assess the proportion of diagnosed hypertensive patients in Greek urban population and to examine the extent of how lifestyle and socio-demographic characteristics differ between already known hypertensives and the rest of the population.

Methods

Data collection

This cross-sectional study was conducted in April of 2016 (1-20/04). The sampling procedure was conducted as follows: The research sample was taken from an up to date database of 100.549 households that

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has been constructed to support the application of 3–4 step stratified sampling, where the selection of primary sample units (PSUs) was likely proportional to their size. The above method allows random sampling when it is impossible to record all units of the population. Kapodistrian municipalities are designated as PSUs.

In detail, the sampling phases for the selection of 1,060 interviews are described below:

Phase 1: During Phase 1, the Greek territory was divided into 4 geographical strata and the number of PSU selected within each stratum is proportional to its population. For the present project, only the Attic layer was used, so the sampling method is 3-stage cluster sampling. In total, 36 of the 111 Kapodistrian municipalities (PSU) of the prefecture of Attica were selected, with the probability of being selected proportionally to their permanent population. The selection of the PSU was by re-election, i.e. the large Kapodistrian municipalities were elected more than once. In the areas within the geographical coverage of the 1st Health District of Attica, 25 Kapodistrian municipalities were selected.

Phase 2: Within each PSU, two inventory sectors (administrative entities) were selected by systematic random sampling. In this way, a total of 50 inventory areas were selected. The census areas are essentially sets of adjacent building blocks and have been created by ELSTAT (Greek Statistical Authority) in such a way that they have an average of 500 households each and are technically considered as secondary sampling units (SSU).

Phase 3: In each of the 50 selected SSU, the exact addresses of all households were recorded. Depending on the needs of each sample size, an equal number of households are selected within each SSU. In the case of 1.060 interviews, a random sample of 1.520 households (i.e. 1.520 households/50 SSU ≈ 30 households per SSU) was selected. From a total of 1.520 candidates, 1.060 agreed to participate (response rate 69.7%).

Phase 4: The researchers visited the 1.520 selected households and randomly selected the household member to respond to the questionnaire. People unable to communicate with the researchers, individuals younger than 18-year-old, and institutionalized people were excluded. Through this sampling procedure, it was ensured that the sample was representative of the general urban population.

Questionnaire

A researcher completed a structured questionnaire through a home-based personal interview for each participant. The questions included social and demographic characteristics (gender, age, educational level, marital status, and occupation), lifestyle factors (BMI, alcohol consumption- frequency of alcohol consumption, smoking habits- smoker or nonsmoker, and physical activity- hours per week of aerobic exercise), and medical and medication history. BMI (kg/m^2) was calculated, according to reported weight and height. Study participants were divided into groups according their BMI (<18.5 "underweight," 18.5 to 24.99 "normal weight," 25.0 to 29.99 "overweight," and >30.0 obese). All participants were informed about data confidentiality and anonymity before they responded to the questionnaire, and in all cases, an informed consent was obtained. The study was approved by the 1st Regional Health Authority of Greece.

Statistical analysis

Categorical variables are expressed as percentages and frequencies. Continuous variables are expressed as means ± 1 standard deviation (M ± 1SD). The Kolmogorov–Smirnov test was used for accessing the normality of evaluated continuous variables. A Chi-square test was applied, for categorical data to evaluate whether the socio-demographic and lifestyle characteristics differed between hypertensive patients and the rest of the population. With this term, we referred to those who did not mentioned to suffer from hypertension. To compare age and BMI between the two groups independent Student's t test was used. Results were considered statistically significant when $P < 0.05$. Variables that had a significant association with hypertension in the bivariate analysis were proceeded into the separate logistic regression analysis to identify the most important ones. By this method, the odds ratio (OR) and 95% confidence interval (CI) were designated. All analysis was performed by using SPSS v22.0.

Results

Study participants were predominantly females (559 females- 501 males). Already known hypertensives were 179 (101 females-78 males). The prevalence of known hypertension was 16.9% (18.1% in females and 15.6% in males). The known hypertensives were more likely to suffer from diabetes mellitus ($\chi^2 = 117.888$, $P < 0.001$), dyslipidaemia ($\chi^2 = 177.580$, $P < 0.001$), coronary heart disease ($\chi^2 = 47.223$, $P < 0.001$), heart failure ($\chi^2 = 88.102$, $P < 0.001$), stroke ($\chi^2 = 26.864$, $P < 0.001$), osteoarthritis ($\chi^2 = 56.580$, $P < 0.001$), back pain ($\chi^2 = 34.888$, $P < 0.001$), digestive system disorders ($\chi^2 = 22.784$, $P < 0.001$), and thyroid diseases ($\chi^2 = 7.731$, $P = 0.01$). The comparison of socio-demographic characteristics and health risk factors between known hypertensive and the rest of the population is shown in Table 1.

In multivariate analysis, known hypertensives with high probability have advanced age ($P < 0,001$, OR = 1.101, 95% CI 1.081–1.121) and increased BMI ($P < 0,001$, OR = 1.138, 95% CI 1.085–1.194).

The prevalence of hypertension across BMI groups is shown in Table 2.

Table 1: Comparison of socio-demographic characteristics and health risk factors between hypertensive and the rest of the population

Socio-demographic characteristics	Hypertensive *n*=179	Rest population *n*=881	Statistical significance
Gender			
Males	78 (43.6%)	423 (48.0%)	NS[a]
Females	101 (56.4%)	458 (52.0%)	
Age (year-old) (mean±1SD)	65.8 (±9.7)	43.3 (±15.5)	*P*<0.001[b], *t* (1058) = −18688
Marital status			
Married	133 (74.3%)	516 (58.6%)	*P*<0.001[a]
Unmarried	6 (3.4%)	291 (33.0%)	(χ^2=115.646)
Divorced	5 (2.8%)	43 (4.9%)	
Widowed	35 (19.6%)	31 (3.5%)	
Educational level			
Primary	23 (12.8%)	28 (3.2%)	*P*=0.000[a]
Secondary	135 (75.4%)	513 (58.2%)	(χ^2=68.290)
Technological education Institution	7 (3.9%)	163 (18.5%)	
University	14 (7.8%)	177 (20.1%)	
Smoking			
Yes	42 (23.5%)	319 (36.2%)	*P*=0.001[a]
No	137 (76.5%)	562 (63.8%)	(χ^2=10.761)
BMI (mean±1SD)	28.5 (±4.2)	25.4 (±3.9)	*P*<0.001b (*t* (1058) = −9664)
Physical activity			
None	162 (90.5%)	549 (62.3%)	*P*<0.001[a]
1-2 hours/week	6 (3.4%)	166 (18.8%)	(χ^2=54.241)
3-4 hours/week	8 (4.5%)	101 (11.5%)	
>4 hours/week	3 (1.7%)	65 (7.4%)	
Alcohol consumption			
Never	87 (48.6%)	195 (22.1%)	*P*<0.001[a]
<once a month	32 (17.9%)	278 (31.6%)	(χ^2=56.190)
2-4 times per month	29 (16.2%)	237 (26.9%)	
2-3 times per week	25 (14.0%)	129 (14.6%)	
>4 times per week	6 (3.4%)	42 (4.8%)	
Occupation			
Working	50 (27.9%)	551 (62.5%)	*P*<0.001[a]
Retired	91 (50.8%)	107 (12.1%)	(χ^2=169.416)
Unemployed	38 (21.2%)	142 (16.1%)	
Student	0 (0%)	81 (9.2%)	
Low income			
Yes	37 (20.7%)	226 (25.7%)	NS[a]
No	127 (70.9%)	571 (64.8%)	
Missing	15 (8.4%)	84 (9.5%)	

[a]Chi-square test, [b]Student's *t* test

Discussion

The results of the present study indicate that the prevalence of self-reported hypertension among a representative sample of the general urban population was 16.9% (18.1% in females and 15.6% in males). Previous studies that provided data regarding the prevalence of hypertension in Greek population have reported a prevalence of 25% for women and 37.5% for men (ATTICA study),[14] 38.9% for women and 40.2% for men (Greek EPIC study),[15] and 28.4% for women and 33.6% for men (The Hypertension Study in General Practice in Hellas).[3] In another local, small-scale, observational study, the prevalence of hypertension was estimated 27% in woman and 30% in men (Didima study).[16] In all these surveys, the calculated prevalence was according to blood pressure measurement.

Table 2: Prevalence of hypertension across BMI groups

BMI categories	Known hypertensives		Rest population	
	Number	Percentage[a]	Number	Percentage[b]
Underweight	0	(0%)	7	(100%)
Normal weight	27	(5.8%)	435	(94.2%)
Overweight	107	(23.7%)	345	(76.3%)
Obese	45	(32.4%)	94	(67.6)
Total	179		881	

[a]Percentage of patients with hypertension across BMI groups, [b]Percentage of the rest of the population across BMI groups

This large difference in the prevalence of hypertension among these and the present study is mainly because of the fact that in our study hypertension among the participants was self-reported. Moreover, our results are in line with the data of a telephone survey conducted among a nationwide sample of about 5,000 Greek adults (17.7% in females and 13.3% in males) in which the participants self-reported whether they are hypertensives.[17] The difference between these two and the above-mentioned studies indicate that a large group of hypertensive subjects is unaware of their condition.

Our results also suggest that already known hypertensive patients were also probable to have older age and increased BMI. In addition, there was a higher probability for them to suffer from other cardiovascular diseases or to share other risk factors for cardiovascular diseases. Age is not a modifiable factor for hypertension. However, increased BMI, like other lifestyle characteristics, is an amendable health risk factor for the prevention of hypertension. Moreover, for therapeutic purposes, weight loss reduces blood pressure in most hypertensive subjects.[8,18] In addition, as the prevalence of hypertension, diabetes mellitus, and dyslipidemia increase with higher BMI[19] and a raised risk of death from overall cardiovascular disease occurs in the group with BMI 25 or above;[20] weight loss constitutes the cornerstone not only for the prevention and treatment of hypertension but also for other risk factors and cardiovascular diseases. Nevertheless, the overall results of lifestyle modification to reduce obesity are poor and in most long-term trials of weight reduction, it was found that in most cases weight returns to baseline levels after several years.[21]

Although some studies demonstrating that the awareness of hypertension can affect people's lifestyle,[11,22] there are some other indicating no significant difference in lifestyle between those who are aware and those who are not aware of their illness.[23-25] In terms of BMI reduction, previous studies demonstrated that people who were aware of their hypertension, consumed less salt and smoked less frequently as compared with those who were not aware of their illness[11,22] and that except from salt and alcohol consumption and smoking habits, there is no significant difference between these two groups in terms of other lifestyle risk factors.[22,23] Although achieving hypertension control, Ho *et al*. have demonstrated that the majority of obese patients did not achieve clinically significant weight loss,[26] and the proportion of overweight and obese hypertensive patients who attempted to lose weight remain suboptimal.[27]

In our study, we do not know the baseline weight of already known hypertensive patients before the diagnosis of hypertension, so we do not know if they had made efforts to reduce their body weight. This is a limitation of our study. However, this shortage did not modify the fact that known hypertensives are more likely to have increased BMI. A second limitation is that unfortunately the questionnaire did not include questions about salt intake and dietary practices; hence, we do not know the compliance of known hypertensive patients with the recommendations. Finally, the third limitation of our study was the fact that both the height and weight of the participants were self-reported. Although women are more prone to underestimate their weight, men to overestimate their height and obese to underestimate both their weight and height,[28,29] regarding the misclassification into BMI classes the bias resulting from self-report, is in general small.[30] In our study, it is highlighted that known hypertensive patients in Greece were more likely to have increased BMI in spite the recommendations. As weight loss is expected to have a positive impact not only in blood pressure reduction but also in adjusting the other risk factors for cardiovascular diseases, preventive actions must be undertaken by the physicians.

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Conflicts of interest

There are no conflicts of interest.

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