

Prevalence, awareness, treatment and control of hypertension in Greek employees. The Cardiovascular risk in Greek (CARING) Employees Study*

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ABSTRACT

Objective. Previous studies investigating the epidemiology of hypertension in Greece gave variable estimates of the levels of prevalence, awareness, treatment and control of hypertension in the general population. Aim of this study was to add epidemiological data regarding the burden of hypertension in Greece, examining a sample of employees in industrial and commercial units in the wide area of Naoussa, in Northern Greece. *Methods.* A total of 503 employees (338 men and 165 women), 18-65 years old, participated in this cross-sectional survey. Each employee was evaluated in two visits and three blood pressure (BP) measurements were obtained in each visit. Analysis was performed using only the average BP of the second visit, according to the 140/90 mmHg hypertension threshold. *Results.* Prevalence of hypertension was 34.9% for men and 22.4% for women ($p < 0.01$). The levels of awareness, treatment and control of hypertension were 23.7%, 14.4% and 4.4% for men and 32.4%, 24.3% and 16.2% for women respectively. Control of hypertension differed significantly between men and women. Control of hypertension among treated hypertensives was 29.4% for men and 66.7% for women ($p = 0.103$). *Conclusions.* This study suggests that hypertension is a high-prevalent cardiovascular risk factor in young and middle-aged employees in Greece. The disappointing levels of awareness, treatment and control of hypertension highlight the important role of primary health care and industrial medicine in developing more effective strategies targeting on prevention and treatment of hypertension in this population in future.

INTRODUCTION

Hypertension is considered one of the most important risk factors for coronary artery disease, congestive heart failure, stroke, end-stage renal disease and peripheral vascular disease^{1,2}. Epidemiological studies suggest that each 10 mmHg rise in systolic and each 5 mmHg rise in diastolic blood pressure (SBP, DBP) is associated with an about 40% increase in the risk of death from stroke and with an about 30% increase in the risk of death from ischemic

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cardiac disease³. Blood pressure (BP) reduction through pharmacological interventions and achievement of adequate hypertension control, on the other hand, have well-documented benefits on cardiovascular morbidity and mortality⁴⁻⁶.

Although modern strategies targeting on primary and secondary prevention of hypertension have been developed, the reported rates of hypertension prevalence in national surveys from different countries in both Europe and Northern America do not exhibit the expected lowering trend^{7,8}. In addition, control of hypertension is achieved only in a small percentage of hypertensive patients, despite the important progress observed during the last years in the field of antihypertensive treatment⁹. In this context, effective management of hypertension still remains a major public health challenge in both sites of the Atlantic.

A number of previous epidemiological studies sought to investigate the levels of prevalence, awareness, treatment and control of hypertension in the Greek population¹⁰⁻¹⁶. Although all the available data consistently indicate that hypertension represents one of the most important cardiovascular risk factors in Greece, individual studies in the field gave variable estimates of the levels of hypertension prevalence and control in the general population. In this regard, some of these studies were mainly focused on the elderly^{10,14} and consequently, their findings do not reflect the burden of hypertension in the active part of the Greek population. Other studies, although attempted to include a more representative sample of the adult Greek population, are possibly limited by methodological issues regarding mainly the accuracy of BP determination (only one visit, less than three BP measurements in each visit)^{12,16}; thus, their results may overestimate the true prevalence and underestimate the true control of hypertension in the general population. In this context, as the overall picture of the burden hypertension in Greece remains somehow unclear, additional well-designed studies are required to fully elucidate the epidemiological features of hypertension in the Greek population.

The Cardiovascular Risk IN Greek (CARING) Employees Study is a population-based health and nutrition survey aiming to investigate the burden of several established and emerging cardiovascular risk factors in the active young and middle-aged population of Greece. In the present paper, we report the results of our survey with regards to the

levels of prevalence, awareness, treatment and control of hypertension in the study population.

MATERIAL AND METHODS

Study population

The *CARDIOVASCULAR RISK IN GREEK (CARING) EMPLOYEES STUDY* was a population-based health and nutrition survey that was carried out in employees of industrial and commercial units in the wide area of the city of Naoussa, in Northern Greece. We invited to participate in our study all relevant companies of this region with a work force at least 20 workers and we invited the total of employees in these units to participate in this cross-sectional study. A total 512 subjects from the original target population of 550 employees volunteered to undertake the protocol procedures (response rate, 93%). Among them, 503 participants (338 men and 165 women), 18-65 years old, with complete data set were finally included in the present analysis. All the examinations were conducted according to the Declaration of Helsinki (1989 amendment) and the study protocol was approved by the Ethics Committee of Faculty of Medicine, Aristotle University of Thessaloniki.

Subject evaluation

Study participants were evaluated in two separate visits with a 1-week interval between them. All protocol procedures were carried out in spaces of the offices of each factory or commercial company provided by the administration. The study was performed between March and October 2008, in Spring or Autumn, in order to avoid the effect of seasonal variation on BP measurements. Sociodemographic characteristics (age, sex, educational level), detailed medical history and information on lifestyle habits (smoking habits, physical exercise) were recorded in a standardised manner using an appropriately constructed questionnaire for the present study. Anthropometric characteristics were also obtained following standardised procedures with subjects wearing light clothing and no shoes. Every participant had his height and body weight measured in order to estimate the body mass index (BMI) as body weight (in kg) divided by height squared (in m²). Waist circumference in the narrowest part of the torso and hip circumference in the widest part of the buttocks was measured to estimate

the waist-to-hip ratio (W/H ratio).

Well-trained physicians measured BP, according to the European Society of Hypertension (ESH) guidelines^{17,18}. BP measurements were obtained with the use of the electronic sphygmomanometer OMRON M6 Comfort (HEM-7000-E) and bladder Omron ComfortCuff of appropriate size. After the end of the interview, participants remained at rest in the sitting posture for at least 10 min and then, BP was measured in both arms. If there was a difference in BP between the two arms, the measurements in the arm with the highest BP levels were taken into account. In each visit three BP measurements were obtained with at least 1-min interval between them. Participants who did not complete the protocol procedures in the second visit were finally excluded from the study, whereas all analyses were carried out with the use of the average of the three BP measurements obtained only in the second visit. No interventions in the antihypertensive medication were permitted during the study in participants currently receiving antihypertensive treatment.

Definitions

Hypertension was defined as SBP \geq 140 mmHg or DBP \geq 90 mmHg, or current treatment

with antihypertensive drugs, according to the ESH guidelines¹⁹. Awareness of hypertension reflects knowledge of the subject about being hypertensive based on a previous diagnosis. Treatment of hypertension was defined as current use of antihypertensive medication and control as treated hypertension with SBP <140 mmHg and DBP <90 mmHg. Patients who reported a positive history of hypertension and had BP below 140/90 mmHg without receiving antihypertensive treatment were classified as normotensives.

Statistical analysis

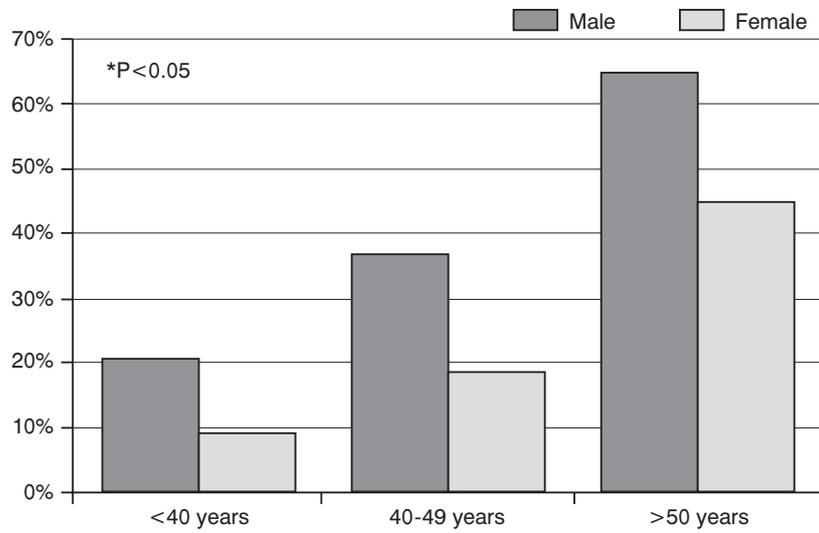
Analysis was performed using the Statistical Package for Social Sciences (SPSS) 17 for Windows Vista (SPSS Inc., Chicago, IL, USA). Continuous variables are presented as mean \pm standard deviation (mean \pm SD). Qualitative variables are presented as absolute and relative frequencies. Student's t-test for independent samples and one-way analysis of variance (ANOVA) were used to estimate differences between mean values. Chi-square test with the Yates correction, where appropriate, was used to compare frequencies. All analyses were performed separately for men and women. Probability values of $p < 0.05$ or lower were considered statistically significant.

Table 1. Baseline characteristics of the study population

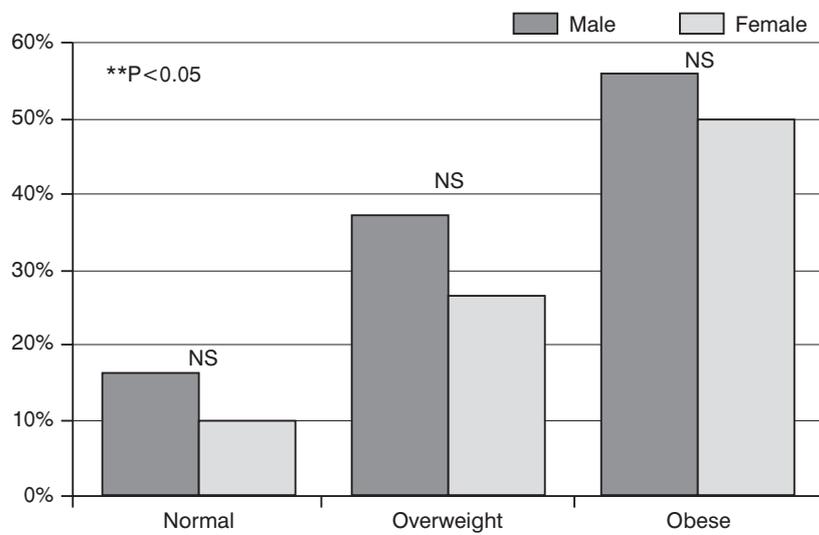
| | Male (n=338) | Female (n=165) | p*-value |
|--------------------------------|--------------|----------------|----------|
| Mean age (years) | 41.31 (8.13) | 43.83 (8.96) | <0.01 |
| Age group (years) | | | <0.05 |
| <40 | 39.1% | 27.2% | |
| 40-49 | 43.2% | 46.9% | |
| >50 | 17.6% | 25.9% | |
| Mean BMI (kg/m ²) | 27.34 (3.60) | 26.15 (5.52) | <0.05 |
| BMI group (kg/m ²) | | | <0.001 |
| <25 | 27.4% | 47.9% | |
| 25-30 | 52.1% | 35.9% | |
| >30 | 20.6% | 16.2% | |
| Waist circumference (cm) | 97.0 (9.6) | 86.1 (12.5) | <0.001 |
| W/H Ratio | 0.93 (0.06) | 0.82 (0.07) | <0.001 |
| Mean systolic BP (mmHg) | 130.0 (16.2) | 118.9 (17.5) | <0.001 |
| Mean diastolic BP (mmHg) | 82.8 (10.9) | 78.7 (11.5) | <0.001 |
| Family history of hypertension | 58.0% | 60.4% | 0.681 |
| Educational level | | | <0.001 |
| Basic | 19.8% | 43.8% | |
| High school / college | 61.8% | 33.1% | |
| University | 18.4% | 23.1% | |

Abbreviations: BMI - body mass index; BP - blood pressure; W/H - Waist-to-hip.

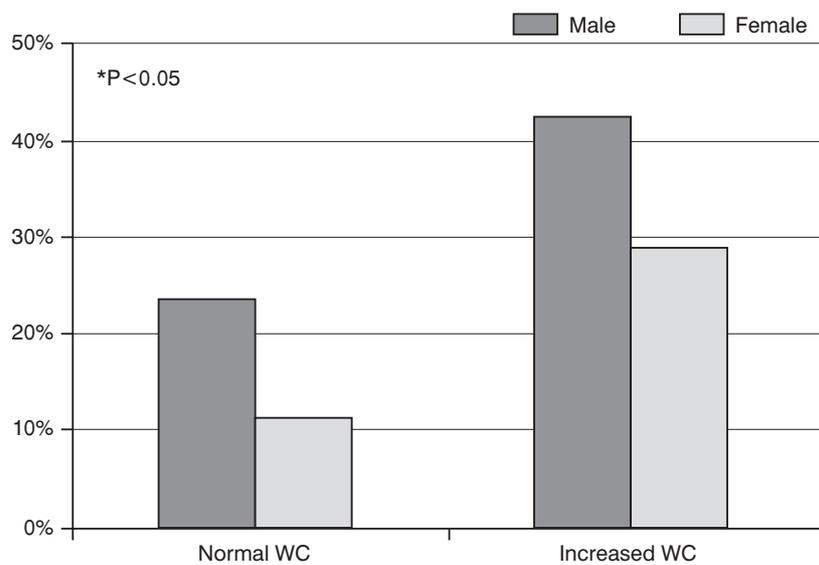
*Comparisons between men and women



1a



1b



1c

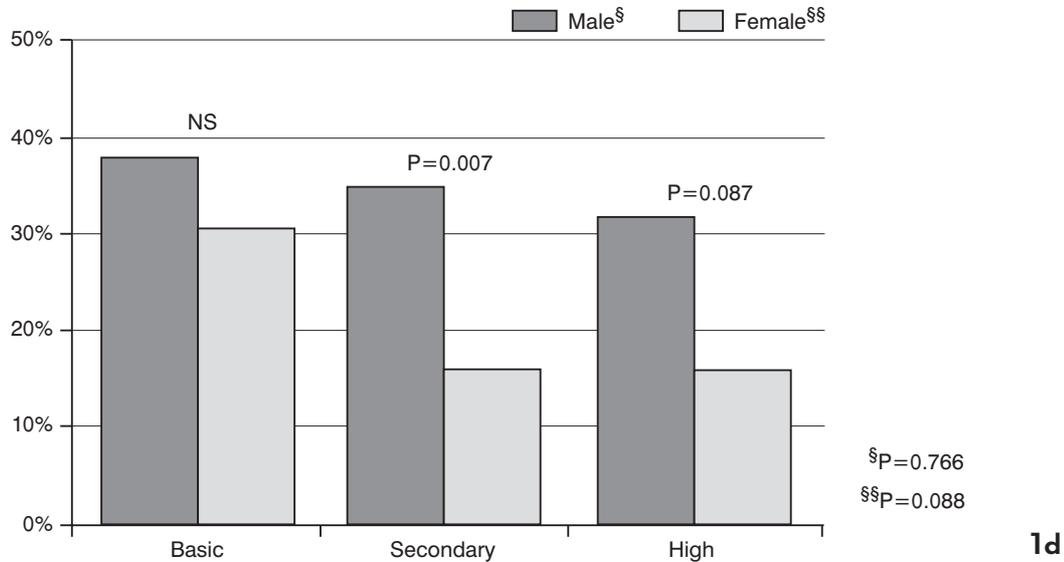


Fig. 1. Prevalence of hypertension in male and female employees by: 1a) age group, 1b) body mass index, 1c) waist circumference, 1d) educational level.

Basic education ≤ 6 years, secondary 6-12 years (high school, college), high >12 years (university). Abbreviations: NS – not significant; WC – waist circumference (normal if <94 cm in male and <80 cm in female employees)

* $p < 0.05$ for all comparisons. ** $p < 0.05$ for comparisons between different BMI groups: normal ($BMI < 25$ kg/m²), overweight ($25-30$ kg/m²) and obese ($BMI > 30$ kg/m²). Differences between genders in each group not statistically significant.

RESULTS

A total of 503 employees (338 men and 165 women) with complete data set were included in the analysis. Demographic characteristics of study participants are depicted in Table 1. There were significant differences between men and women in age, BMI, waist circumference, W/H ratio, mean SBP and DBP levels as well as in distribution of educational level.

According to the definition of SBP ≥ 140 mmHg or DBP ≥ 90 mmHg, or current treatment with antihypertensive agents, hypertension was detected in 118 out of 338 men (34.9%) and in 37 out of 165 women employees (22.4%). Prevalence of hypertension was significantly higher in men as compared to women ($p < 0.01$) (Table 2). As shown in Figure 1, significant differences in the rates of hypertension prevalence were observed between the age group of ≥ 50 , 40-49 and ≤ 40 years in both men and women employees. In addition, prevalence of hypertension was significantly higher among obese and overweight as compared to lean employees, as well as among those with increased waist circumference as compared to those with normal waist circumference. All these differences in prevalence of hypertension were consistent in both genders. In

contrast, no association between hypertension status and educational level was evident in the present analysis (Fig. 1).

As shown in Table 2, among 118 hypertensive men employees only 28 and among 37 hypertensive women only 12 were aware of their condition (awareness rate: 23.7% for men and 32.4% for women respectively, $p = 0.291$). A total of 17 hypertensive men and 9 hypertensive women were currently receiving antihypertensive treatment (treatment of hypertension rate: 14.4% for men and 24.3% for women, $p = 0.385$). With regards to hypertension

Table 2. Prevalence, awareness, treatment and control of hypertension in men and women employees

| | Men (n=338) | Women (n=165) | p*-Value |
|--|----------------|------------------|----------|
| Prevalence | 118 [34.9%] | 37 [22.4%] | <0.01 |
| Awareness | 28 [23.7%] | 12 [32.4%] | 0.291 |
| Treatment | 17 [14.4%] | 9 [24.3%] | 0.159 |
| Control | 5 [4.4%] | 6 [16.2%] | <0.05 |
| Subjects under control among subjects receiving antihypertensive treatment | 5/17 [29.4%] | 6/9 [66.7%] | 0.103 |

* Comparisons between men and women

Table 3. Systolic and diastolic blood pressure levels in normotensive, treated and untreated hypertensive employees.

| | Men (n=338) | | Women (n=165) | |
|-------------------------|-------------|------------|---------------|---------------|
| | SBP | DBP | SBP | DBP |
| Normotensives | 121.9±9.7 | 77.1±6.9 | 112.6±10.7 | 74.6±7.9 |
| Treated hypertensives | 142.2±17.1* | 92.2±11.9* | 132.2±26.7* | 85.1±17.4* |
| Untreated hypertensives | 145.7±14.7* | 93.6±8.5* | 143.3±15.9* | 95.4±6.9*, ** |

*Difference from Normotensives, $p < 0.001$. ** Difference from Treated Hypertensives, $p < 0.001$

control, only 5 out of 118 hypertensive men (4.4%) and 6 out of 37 hypertensive women (16.2%) had their BP levels adequately controlled. The levels of hypertension control differed significantly between men and women ($p < 0.05$). The percentage of hypertension control among treated hypertensives was 29.4% for men and 66.7% for women employees (Table 2).

The mean SBP and DBP levels for normotensive, treated and untreated hypertensive employees are presented in Table 3. In both males and females, normotensive subjects had lower SBP and DBP levels as compared to each of the other groups ($p < 0.001$ for each comparison). As far as the comparison between treated and untreated hypertensives is concerned, non-significant differences in BP levels between the two groups were evident, with the exception of DBP which was found to be significantly higher in untreated female as comparison to treated female employees (Table 3). The absence of significant differences in BP levels between treated and untreated hypertensives is in agreement with the very low level of hypertension control achieved in the study population.

DISCUSSION

This study aimed to investigate the prevalence, awareness, treatment and control of hypertension in a sample of the active Greek population, consisting of young and middle-aged employees in factories and commercial companies in the wide area of Naoussa, in Northern Greece. The main finding of this study was that hypertension represents a high-prevalent cardiovascular risk factor in the working population of Greece, as hypertension was detected in 34.9% of men and 22.4% of women participants. Most importantly, these elevated rates of hypertension prevalence were accompanied by very low rates of awareness and treatment of hypertension, resulting in disappointing levels of hypertension control (only 4.2% for

men and 16.2% for women). Further, prevalence of hypertension was higher among older compared to younger employees and among obese and overweight compared to lean employees, while education level was not associated with the hypertension status in this analysis.

The first epidemiological study which aimed to investigate the burden of hypertension in Greece was conducted in the population of 694 adult permanent inhabitants of the village Didima¹⁶. The estimated prevalence of hypertension in this study was 30.2% for men and 27.1% for women¹⁶. In a second study which included 2282 randomly selected adults from the Province of Attica (including the major metropolis of Athens), hypertension was detected in 38.2% of men and 23.9% of women participants¹¹. Similar rates of hypertension prevalence (32.1% for men and 28.7% for women) were also found in a sample of 1986 factory workers participating in the Naoussa study¹³. In contrast, a subsequent report from the Greek compartment of the European Prospective Investigation into Cancer and Nutrition (EPIC) study, the only national survey in the field comprising data from 26913 adults, raised the rate of hypertension prevalence in the Greek population to 40.2% for men and 38.9% for women¹². These results, however, contradicted the findings of previous studies and came in for important criticism, as EPIC study was originally designed to investigate a rather distinct research question²⁰; thus, despite the large sample size and the coverage of all different geographical regions of the country, EPIC suffered from important methodological limitations, mainly in BP determination (i.e., evaluation of study participants only in one occasion, only 2 BP measurements), that may have substantially affected the reported results of this study on the epidemiological characteristics of hypertension in Greece¹². The recently published Hypertension Study in General Practice in Hellas (HYPERTENSHELL), which was carried out in 98 Health Care Units throughout Greece and enrolled

11950 individuals reported a rate of hypertension prevalence of 33.6% in men and 28.4% in women²¹. In the present study, which perhaps followed the most careful approach of the issue of accurate BP determination (evaluating all study participants in 2 occasions and obtaining repeated BP measurements in each visit), the estimated rate of hypertension prevalence was 34.9% for men and 22.4% for women, confirming the findings of ATTICA¹¹ and HYPERTENSHELL²¹ studies.

In addition to the above, more than 70% of hypertensive participants in the present study were unaware of their condition and more than 80% were not receiving any antihypertensive medication. The reported levels of awareness and treatment of hypertension in previous epidemiological studies in Greece were ranging from 40% to 60%^{11,16,21}, with the exception of the Naoussa study, in which the estimates of awareness and treatment of hypertension were found to be much closer to the findings of the present study (awareness rate, 18.6% and treatment rate, 11.8%)¹³. Epidemiological studies have shown that the levels of awareness and treatment of hypertension exhibit an increasing trend in parallel to ageing²². Taking into account that the vast majority of the employees participating in the present study were <50 years old, one possible explanation for the lower than previously reported levels of awareness and treatment of hypertension could be the lower average age of the population studied. Further, it has been reported that younger subjects with a free medical history avoid obtaining BP measurements on a regular basis, whereas most of them cannot become familiar with the idea of suffering from a dangerous disease or ignore the deleterious effects that accompany uncontrolled hypertension.

With regards to hypertension control, the present study showed that only 4.2% of hypertensive men and 16.2% of hypertensive women were achieving adequate control of their BP levels. These disappointing rates of hypertension control are compatible with the results of earlier international epidemiological surveys conducted in other European countries in the late 1990s, in which the levels of hypertension control were also well below 10%⁹. However, previous studies that investigated the epidemiology of hypertension in Greece gave variable estimates of the level of hypertension control achieved in the general population. In particular, the first estimate of the level of hypertension control in Greece was 27% in Didima study¹⁶. The subsequent

ATTICA (11) and EPIC¹² studies reported lower rates of hypertension control in the Greek population (about 15%), whereas in Naoussa study the reported rate of hypertension control was even lower (only 2.2%)¹³. In contrast, HYPERTENSHELL study raised the rate of hypertension control in Greece to about 33%²¹; unfortunately, this rate is not directly comparable with the results of the present and the other Greek studies in the field, as in HYPERTENSHELL study the rate of hypertension control was calculated only among hypertensive patients currently receiving antihypertensive treatment and thus, the percentage of hypertensive subjects (both treated and untreated) achieving adequate control of hypertension remained unknown²¹.

One of the most important methodological issues in the design of all epidemiological studies aiming to investigate the prevalence of hypertension in the general population, including this one, is the bias introduced in determination of BP levels, due to the “white-coat” phenomenon^{23,24}. In this regard, we attempted to minimize this source of bias in the present survey evaluating all study participants in two separate visits with 1-week interval between them, obtaining repeated BP measurements in each occasion and including only the average of BP measurements taken in the second visit in our analysis. Another possible limitation is that BP measurements in the present study were taken in spaces of the offices of factories and commercial companies instead of the home or clinic setting, as happened in other epidemiological studies with a similar concept in Greece^{11,12,16,21}. Although BP measurements were performed according to current international guidelines^{17,18}, it could be argued that the “job” environment represents a more stressing setting and thus, it may have influenced the accuracy of BP determination in our study²⁵. However, since there are no studies so far directly comparing BP readings obtained by a physician at home or clinic setting and in job, the extent to which the “job” environment has led to an overestimation of the prevalence of hypertension in the present survey remains largely unknown.

In conclusion, this study suggests that hypertension represents a high-prevalent risk factor for cardiovascular disease in a sample of the working population of Greece. The very low rates of awareness, treatment and control of hypertension shown in the present study highlight the important role of primary health care and industrial medicine in

developing more effective strategies targeting on prevention and treatment of hypertension in this specific population in future.

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Σκοπός. Οι μελέτες που αφορούν την επιδημιολογία της υπέρτασης στην Ελλάδα έδωσαν ποικίλες εκτιμήσεις του επιπολασμού, της επίγνωσης, της θεραπείας και του ελέγχου της στο γενικό πληθυσμό. Σκοπός αυτής της μελέτης είναι να συνεισφέρει επιδημιολογικά δεδομένα σχετικά με τη νόσο, εξετάζοντας ένα δείγμα εργαζομένων στη βιομηχανία και το εμπόριο στην ευρύτερη περιοχή της Νάουσας. **Μέθοδοι.** Ένα σύνολο 503 εργαζομένων (338 άνδρες και 165 γυναίκες), 18-65 ετών, συμμετείχαν σε αυτή την επιδημιολογική μελέτη εγκάρσιας τομής. Κάθε εργαζόμενος εξετάστηκε δύο φορές και σε κάθε εξέταση μετρήθηκε τρεις φορές η αρτηριακή του πίεση (ΑΠ). Στην ανάλυση χρησιμοποιήθηκαν μόνο οι μέσες τιμές της δεύτερης επίσκεψης, σύμφωνα με το όριο 140/90 mmHg για τη διάγνωση της υπέρτασης. **Αποτελέσματα.** Ο επιπολασμός της ΑΥ ήταν 34,9% για τους άνδρες και 22,4% για τις γυναίκες ($p < 0,01$). Τα επίπεδα επίγνωσης, θεραπείας και ελέγχου της υπέρτασης

ήταν 23,7%, 14,4% και 4,4% για τους άντρες και 32,4%, 24,3% και 16,2% για τις γυναίκες αντίστοιχα. Ο έλεγχος της υπέρτασης διέφερε σημαντικά μεταξύ αντρών και γυναικών. Μεταξύ αυτών που λάμβαναν θεραπεία, ο έλεγχος ήταν 29,4% για τους άντρες και 66,7% για τις γυναίκες ($p = 0,103$). **Συμπεράσματα.** Η μελέτη δείχνει ότι η υπέρταση είναι ένας πολύ συχνός παράγοντας καρδιαγγειακού κινδύνου σε νέους και μέσης ηλικίας εργαζόμενους. Τα απογοητευτικά επίπεδα επίγνωσης, θεραπείας και ελέγχου της υπέρτασης αναδεικνύουν το σημαντικό ρόλο της πρωτοβάθμιας φροντίδας υγείας και της ιατρικής της εργασίας στην ανάπτυξη πιο αποτελεσματικών στρατηγικών για την πρόληψη και θεραπεία της σε αυτό τον πληθυσμό στο μέλλον.

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