# Blood pressure control and cardiovascular risk profile in hypertensive patients from central and eastern European countries: results of the BP-CARE study 

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| Aims | Limited information is available on office and ambulatory blood pressure (BP) control as well as on cardiovascular (CV) risk profile in treated hypertensive patients living in central and eastern European countries. |
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| Methods and results | In 2008, a survey on 7860 treated hypertensive patients followed by non-specialist or specialist physicians was carried out in nine central and eastern European countries (Albania, Belarus, Bosnia, Czech Republic, Latvia, Romania, Serbia, Slovakia, and Ukraine). Cardiovascular risk assessment was based on personal history, clinic BP values, as well as target organ damage evaluation. Patients had a mean ( $\pm$ SD) age of $60.1 \pm 11$ years, and the majority of them ( $83.5 \%$ ) were followed by specialists. Average clinic BP was $149.3 \pm 17 / 88.8 \pm 11 \mathrm{mmHg}$. About $70 \%$ of patients displayed a very high-risk profile. Electrocardiogram was performed in $99 \%$ of patients, echocardiography in $65 \%$, carotid ultrasound in $24 \%$, fundoscopy in $68 \%$, and search for microalbuminuria in $10 \%$. Ambulatory BP monitoring was performed in about one-fifth of the recruited patients. Despite the widespread use of combination treatment ( $87 \%$ of the patients), office BP control ( $<140 / 90 \mathrm{mmHg}$ ) was achieved in $27.1 \%$ only, the corresponding control rate for ambulatory BP $(<130 / 80 \mathrm{mmHg})$ being $35.7 \%$. Blood pressure control was (i) variable among different countries, (ii) worse for systolic than for diastolic BP, (iii) slightly better in patients followed by specialists than by non-specialists, (iv) unrelated to patients' age, and (v) more unsatisfactory in high-risk hypertensives and in patients with coronary heart disease, stroke, or renal failure. |
| Conclusion | These data provide evidence that in central and eastern European countries office and ambulatory BP control are unsatisfactory, particularly in patients at very high CV risk, and not differ from that seen in Western Europe. They also show that assessment of subclinical organ damage is quite common, except for microalbuminuria, and that combination drug treatment is frequently used. |

Keywords Blood pressure - Cardiovascular risk • Risk factors - Hypertension

[^0]A number of studies have shown that hypertension clusters with other cardiovascular (CV) risk factors, such as overweight or obesity, hypercholesterolaemia, glucose intolerance, or diabetes mellitus. ${ }^{1-8}$ This clustering carries two major adverse consequences. First, it aggravates the overall risk profile of the patient, because the association of risk factors has a more than additive effect on the overall CV risk. ${ }^{9,10}$ Second, it makes the therapeutic intervention aimed at reducing high blood pressure (BP) more difficult, because BP control by treatment is less successful in patients in whom hypertension coexists with obesity, dyslipidaemia, or diabetes. ${ }^{11,12}$

In Europe, information on the association between hypertension and other CV risk factors as well as on BP control by antihypertensive treatment has been mainly obtained in western European countries, ${ }^{13-18}$ whereas data from central and eastern European countries have remained scanty. ${ }^{7,19-23}$ With this background in mind, we designed the Blood Pressure control rate and CArdiovascular Risk profilE (BP-CARE) study. Its aim was to collect information on the rate of office and ambulatory BP control in a large number of treated hypertensive patients under specialist or general practitioner care living in several central and eastern European countries, using the same methodology to allow for comparisons among countries. It was also aimed at assessing the risk factors associated with hypertension to quantify total CV risk and to examine its relationship with a higher or lower rate of BP control. Blood pressure control was assessed also by ambulatory BP monitoring because ambulatory BP has been shown to be more closely related to prognosis than office $B P .^{24}$

## Methods

## Study population

The BP-CARE study was an open cross-sectional survey of patients with a previous diagnosis of essential hypertension and under antihypertensive drug treatment, who were routinely visited by either a specialist or a non-specialist physician in nine central and eastern European countries (Albania, Belarus, Bosnia, Czech Republic, Latvia, Romania, Serbia, Slovakia, and Ukraine). To obtain a sample size of approximately 8000 patients, $\sim 800$ physicians were involved in the study, with the task of recruiting a minimum of 10 consecutive male or female patients with an age range between 30 and 75 years. Recruitment had to be performed between 1 February and 30 April 2008. No exclusion criteria were applied, except for the need of patients' written consent to collect data, under an obligation to keep them confidentially, as required by European law.

## Measurements

In each patient, data collection consisted of (i) demography, i.e. age and gender, (ii) height, weight, body mass index (body weight in kilograms divided by height in square metres, $\mathrm{kg} / \mathrm{m}^{2}$ ), and waist circumference, (iii) family and personal clinical history, (iv) life habits and presence of CV risk factors, (v) duration of hypertension and current antihypertensive drug treatment, (vi) performance, within 12 months from the clinical visit, of standard laboratory tests (fasting blood glucose, total and HDL cholesterol, triglycerides, serum creatinine, haematocrit, alanine and aspartate aminotransferase and serum potassium), and urine analysis as well as examinations aimed at defining the presence of subclinical organ damage, such as
an electrocardiogram (EKG), an echocardiogram, fundoscopy, carotid ultrasound, search for microalbuminuria, and (vii) BP and heart rate values. Office BP was measured by a sphygmomanometer three times within a 15 min time interval with the patient in the sitting position. The first and fifth Korotkoff sounds were used to identify systolic and diastolic BP values, respectively. Heart rate was also measured three times using palpation of the radial artery (30 s). Blood pressure and heart rate data were averaged but the first and third measurement were also considered separately. In about onefifth of the patients, 24 h ambulatory BP monitoring was performed within 1 month from patients'recruitment into the study by validated devices. Data were analysed by standardized methodology and recordings accepted only if at least $70 \%$ of the automatic readings (one every 20 min ) were available validated devices. ${ }^{12}$

Risk factors were defined as visceral obesity [waist circumference $>102 \mathrm{~cm}$ (males) and $>88 \mathrm{~cm}$ (females)], cigarette smoking, total serum cholesterol $>200 \mathrm{mg} / \mathrm{dL}$, diabetes mellitus (diagnosed either by blood glucose $\geq 126 \mathrm{mg} / \mathrm{dL}$ on two different occasions or by the use of antidiabetic drugs), age $>55$ (males) and $>65$ (females) years, history of CV disease (stroke or transient cerebral ischaemic attacks, myocardial infarction, percutaneous coronary angioplasty, or myocardial revascularization), renal failure, or evidence of subclinical organ damage. The diagnosis of the metabolic syndrome was made by using the National Cholesterol Education Program, Adult Treatment Panel III classification criteria. ${ }^{25}$ Subclinical organ damage was identified by the presence of electrocardiographic or echocardiographic signs of left ventricular hypertrophy, retinopathy of Grades 3 or 4 , ultrasound carotid artery plaques, an estimated glomerular filtration rate (Modifications of Diet in Renal Disease formula) $<60 \mathrm{~mL} / \mathrm{min} / 1.73 \mathrm{~m}^{2,26}$ or the presence of microalbuminuria.

## Data analysis

The main study aim was to assess the rate of BP control according to the European Society of Hypertension/European Society of Cardiology (ESH/ESC) guidelines, ${ }^{12}$ i.e. to determine how many patients had office BP values (i) $<140 \mathrm{mmHg}$ systolic and 90 mmHg diastolic, in the presence of a low-to-moderate CV risk profile, and (ii) $\leq 130 \mathrm{mmHg}$ systolic and 80 mmHg diastolic in the presence of a high or very high CV risk profile. The study was also aimed at assessing the rate of ambulatory BP control according to the above-mentioned guidelines, i.e. to determine how many patients had $24 \mathrm{~h} B P$ values $\leq 130 \mathrm{mmHg}$ systolic and $80 \mathrm{mmHg} .{ }^{12}$ Cardiovascular risk profile was quantified as indicated by the ESH/ESC guidelines, i.e. by taking into account demography, clinical risk factors, and subclinical organ damage. ${ }^{12}$ Secondary objectives were to determine the rate of BP control according to (i) the individual country, (ii) non-specialist or specialist care, (iii) patient's gender and age, and (iv) the level of total CV risk. Additional objectives were to see how often the physicians involved in the survey made use of examinations regarded by ESH/ESC guidelines as routine or desirable to adequately characterize CV risk and BP status, and thus to more properly decide about treatment. Data are expressed as means $\pm$ standard deviations (SD) or as per cent values. Because of the descriptive nature of the results, no statistical test was applied to the data collected, except for Pearson $\chi^{2}$ statistics, which was employed to assess the statistical significance of the differences in the rate of ambulatory vs. clinic BP control (systolic and diastolic) in the 1537 patients who displayed both evaluations. All analyses were performed with SAS software version 9.1 (SAS Institute Inc., Cary, NC, USA).

## Results

## Patients' characteristics

Eight hundred and eleven physicians took part in the study, enrolling a total of 7923 treated hypertensive patients. Of these, the information required by the study protocol was not available in 63 patients, making data analysis possible in 7860 patients, i.e. $99.2 \%$ of the sample group enrolled. As shown in Table 1, the nine central and eastern European countries involved in the study showed recruitment rates different from each other, with the highest in Belarus ( $40.6 \%$ ) and the lowest in Ukraine (1.3\%). The physicians participating in the study were much more frequently specialist than non-specialist although with noticeable differences among countries. There were also large differences among countries in gender representation, age, body weight, blood glucose, and lipid profile although, on average, (i) males and females were similarly represented, (ii) age was about 60 years, (iii) lipid profile was suboptimal, and (iv) blood glucose was within the impaired fasting glucose range.

## Blood pressure data

As shown in Figure 1, average office BP values in the group as a whole were close to 150 mmHg systolic and only slightly less than 90 mmHg diastolic, again with noticeable differences among countries. On average, only about one-fifth of the overall number of patients enrolled showed office BP values $<140 /$ 90 mmHg , with the highest control rate shown in patients recruited in the Czech Republic (51\%) and the lowest one in Ukraine (16.5\%), followed by Latvia (18.9\%; Figure 2). In the patients in whom ambulatory BP was assessed, office BP control was less frequent than the ambulatory BP one, which, however, was seen in about one-third of the recruited patients (Figure 3). As illustrated in Table 2, left column, the average data showed no substantial difference in the rate of office BP control between male and female patients, younger and older than 60 years, and individuals on combination treatment (the majority, i.e. $\sim 87 \%$ ) as compared with those on monotherapy. There was a higher rate of office BP control (i) when calculations were based on the third as compared with the first BP value, (ii) in patients followed by specialists as compared with those followed by non-specialists, (iii) in the hypertensive stage belonging to Stages 1 and 2 as compared with Stage 3, and (iv) for diastolic as compared with systolic values (Figure 3). Ambulatory BP control showed a similar trend (Table 2, right column and Figure 3).

## Cardiovascular risk factors and total cardiovascular risk profile

Figure 4 shows the prevalence of other risk factors and subclinical organ damage in the treated hypertensive individuals of the study. Data are shown as average values. Smoking prevalence was relatively low (although with wide differences among countries), whereas there was on average a high proportion of patients with hypercholesterolaemia, overweight, obesity, diabetes mellitus, and metabolic syndrome. There was also an overall high rate of history of CV disease and subclinical organ damage, for which reason the majority of the population
Table I Demographic, anthropometric, haemodynamic, and metabolic data in the patients' population as a whole and subdivided according to the different countries

| Variable | Bosnia | Albania | Belarus | Slovakia | Czech Republic | Serbia | Ukraine | Latvia | Romania | Total sample |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| N | 802 | 459 | 3192 | 1349 | 536 | 501 | 99 | 433 | 489 | 7860 |
| Age (years) | $60.8 \pm 10$ | $58.8 \pm 10$ | $56.5 \pm 12$ | $61.7 \pm 12$ | $61.7 \pm 11$ | $59.9 \pm 11$ | $56.9 \pm 11$ | $62.5 \pm 12$ | $61.7 \pm 10$ | $60.1 \pm 11$ |
| M/F (\%) | 46.6/53.4 | 48.6/51.4 | 50.9/49.1 | 49.4/50.6 | 60.7/39.3 | 48.4/51.6 | 57.0/43.0 | 39.8/60.2 | 40.5/59.5 | 49.1/50.9 |
| Spec/NS (\%) | 99.0/1.0 | 100.0/0.0 | 42.0/58.0 | 78.9/21.1 | 83.3/16.7 | 99.8/0.2 | 70.0/30.0 | 78.0/22.0 | 100.0/0.0 | 83.5/16 |
| HR (b.p.m.) | $78.0 \pm 11$ | $74.6 \pm 10$ | $74.8 \pm 9$ | $71.2 \pm 9$ | $70.3 \pm 10$ | $76.2 \pm 12$ | $78.1 \pm 12$ | $73.3 \pm 15$ | $75.7 \pm 11$ | $74.7 \pm 11$ |
| BMI ( $\mathrm{kg} / \mathrm{m}^{2}$ ) | $30.3 \pm 7$ | $29.0 \pm 5$ | $29.7 \pm 6$ | $29.4 \pm 7$ | $30.1 \pm 7$ | $28.2 \pm 4$ | $31.4 \pm 5$ | $31.3 \pm 8$ | $30.1 \pm 9$ | $29.9 \pm 7$ |
| WC (cm) | $99.5 \pm 14$ | $102.2 \pm 12$ | $94.9 \pm 13$ | $96.0 \pm 13$ | $99.3 \pm 15$ | $95.3 \pm 14$ | $101.9 \pm 12$ | $98.2 \pm 15$ | $96.4 \pm 13$ | $98.2 \pm 14$ |
| Fasting blood glucose (mg/dL) | $110.0 \pm 31$ | $117.0 \pm 35$ | $96.6 \pm 26$ | $106.0 \pm 31$ | $111.7 \pm 35$ | $110.6 \pm 34$ | $100.7 \pm 28$ | $110.4 \pm 29$ | $111.8 \pm 35$ | $108.4 \pm 32$ |
| Tot chol (mg/dL) | $230.2 \pm 53$ | $207.6 \pm 50$ | $214.3 \pm 45$ | $204.0 \pm 37$ | $192.1 \pm 40$ | $236.5 \pm 54$ | $229.8 \pm 41$ | $221.4 \pm 57$ | $213.17 \pm 49$ | $216.6 \pm 47$ |
| HDL chol (mg/dL) | $54.4 \pm 34$ | $40.7 \pm 12$ | $52.4 \pm 29$ | $52.0 \pm 17$ | $50.3 \pm 15$ | $49.3 \pm 20$ | $51.8 \pm 20$ | $51.9 \pm 19$ | $48.0 \pm 13$ | $55.7 \pm 21$ |
| Triglyc (mg/dL) | $189.7 \pm 98$ | $194.8 \pm 99$ | $166.4 \pm 95$ | $165.9 \pm 89$ | $159.2 \pm 81$ | $187.6 \pm 81$ | $210.4 \pm 101$ | $173.9 \pm 80$ | $154.0 \pm 71$ | $178.0 \pm 88$ |

Data are shown as mean $\pm$ SD.
M/F, male/female; Spec, specialist; NS, non-specialists; HR, heart rate; BMI, body mass index; WC, waist circumference; Tot chol, total cholesterol; HDL chol, HDL cholesterol; triglyc, triglycerides.


Figure I Mean values ( $\pm$ standard deviation) of systolic $(S)$ and diastolic (D) blood pressure (BP) in the groups of patients enrolled in the different central and eastern European countries participating at the BP-CARE survey. Data are also shown as average values for the whole population.


Figure 2 Percentage of patients displaying office blood pressure values (<controlled blood pressure and $\geq$ uncontrolled blood pressure) $140 / 90 \mathrm{mmHg}$ in the different central and eastern European countries participating in the BP-CARE survey. Data are also shown as average values for the whole population.
recruited was at high or very high risk. As shown in Table 2, prevalence of office and ambulatory BP control was lower in the high vs. the lower risk population and in the high risk category in patients with a history of coronary heart disease, history of stroke, renal damage, or diabetes (office BP control $15.6,9.8,12.0$, and $12.2 \%$, respectively).

## Frequency of target organ damage assessment

As already mentioned in the Methods section, the present study was also aimed at determining how often examinations recommended by European guidelines are performed in central and


Figure 3 Percentage of patients displaying office blood pressure values $<$ and $\geq 140 / 90 \mathrm{mmHg}$ and ambulatory blood pressure values $<$ and $\geq 130 / 80 \mathrm{mmHg}$. Data are shown as average values of the 1537 patients with available office and ambulatory blood pressure data. Asterisks $(* * P<0.01)$ refer to the statistical significance of the percentage of office vs. ambulatory blood pressure control. SBP, systolic blood pressure; DBP, diastolic blood pressure.

Table 2 Behaviour of blood pressure control according to different characteristics of the study population, sequence of blood pressure measurements, use of monotherapy or combination treatment, and severity of the hypertensive state and patient's risk profile.

| Population/BP measurement/type of antihypertensive drug treatment/severity of hypertension | Office BP control ( $n=1537$ ) (\%) | 24 h BP control ( $n=1537$ ) (\%) |
| :---: | :---: | :---: |
| $<60$ years | 28.0 | 34.4 |
| $>60$ years | 26.2 | 36.1 |
| Male | 31.5 | 37.7 |
| Female | 26.6 | 32.2 |
| General practitioner | 19.2 | 25.2 |
| Specialist | 28.1 | 36.5 |
| First BP measurement | 21.5 | n.a. |
| Third BP measurement | 30.2 | n.a. |
| Monotherapy | 31.8 | 36.4 |
| Combination therapy | 28.2 | 35.8 |
| Hypertension |  |  |
| Stage 1 | 33.4 | 40.2 |
| Stage 2 | 26.1 | 36.2 |
| Stage 3 | 20.7 | 26.4 |
| Low/medium risk | 31.2 | 38.7 |
| High risk | 24.5 | 32.4 |

[^1]eastern European countries. In virtually all the patients enrolled in the study (98.8\%), an EKG evaluation was performed. Echocardiography and funduscopy were performed quite frequently, i.e. in about two-thirds of the population sample (64.5 and $67.8 \%$, respectively). Carotid ultrasonography was performed much less frequently (24.1\%) and search for microalbuminuria was even more rare (10.0\%).

## Discussion

The present study provides information on the rate of BP control in a large number of treated hypertensive patients from several central and eastern European countries. The main results can be summarized as follows. First, the rate of office BP control was low as it amounted to only about one-fourth of the treated hypertensive patients surveyed. Second, control of systolic BP was about half that of diastolic BP. Third, office BP control was similarly low in both genders and it was unrelated to patients' age. Fourth, the rate of office BP control was slightly greater in patients followed by specialists than in those followed by non-specialists and different from country to country. It can be thus concluded that, similar to what has been reported for western European countries, ${ }^{13-18}$ BP control of hypertensive patients remains a major unsolved problem also in Central and, particularly, in Eastern Europe. This has major implications for public health, because poor BP control has been shown to be associated with a marked increase in the risk of CV fatal and non-fatal events. ${ }^{27-30}$ This is particularly the case of uncontrolled systolic BP, because systolic BP carries a prognostic importance greater than diastolic BP , particularly in old age, when hypertension is very common. ${ }^{31-33}$


Figure 4 Percentage of patients with concomitant risk factors and subclinical organ damage in the BP-CARE survey. HDL, high-density cholesterol; creat clear, creatinine clearance.

Our data on BP control in central and eastern European countries have several other elements of interest. One, the per cent of patients found to be controlled is not significantly different to that found in western European countries (such as Belgium, France, Germany, Hungary, Italy, Norway, the Netherlands, Spain, and Sweden), i.e. around $25 \%$ of the hypertensive population surveyed. ${ }^{13-18,34,35}$ This was also the case for the figures of ambulatory BP control, which in the present study were similar to those seen in the Pressioni Arteriose Monitorate e Loro Associazioni study. ${ }^{36}$ However, while in western European countries, this figure was usually derived from studies involving both untreated and treated patients, in the present study only treated hypertensive patients were recruited. Assuming that treatment was given to $70 \%$ of all hypertensives, this lowers the proportion of BP control to $17 \%$ of the overall hypertensive population, a figure that is less than that seen in most studies conducted in western European countries. Thus, as far as BP control is concerned, the situation in Central and Eastern Europe may be worse. This may originate from a less well-organized healthcare system. It may additionally depend on the lower availability in these countries of modern drugs that allow BP to be better controlled with a reduced number of side effects. Two, despite the lower BP control rate, the use of combination drug treatment was quite common, the overall $80 \%$ figure comparing favourably with figures available for Western Europe $(\sim 30-35 \%) .{ }^{12}$ We can speculate this to be due to the fact that the patients recruited in the present central and eastern European study had frequently a high or very high CV risk profile, a condition in which effective BP reductions are more difficult to be obtained, making combination drug treatment more frequently necessary. Three, the fact that BP control was overall similarly unsatisfactory in patients followed by specialists
or non-specialists should not necessarily be interpreted as to mean that specialists do not provide more expert treatment. It is possible that by and large specialists took care of patients showing a higher degree of subclinical organ damage and CV risk, which made BP control more difficult. Finally, confirming data obtained in Western Europe, ${ }^{13-18}$ the more aggressive office $B P$ targets recommended by guidelines in hypertensive individuals at high or very high risk ${ }^{12}$ were very rarely achieved in central and eastern European countries, indicating that guidelines recommendations remain largely without implementation throughout Europe. The consequences are difficult to be established, however, because the degree of the additional benefit provided by aggressive BP reductions when the CV risk is high or very high has recently been challenged, ${ }^{37}$ and the matter requires further evidence.

Our study also provides information on three other issues. The first issue refers to the fact that our study provides data on ambulatory BP control by treatment in the context of the routine clinical setting of eastern European countries that were not available before. The data show that ambulatory BP is controlled in a minority of patients and that thus the inability of treatment to effectively reduce an elevated $B P$ is a real phenomenon rather than artifactually originating from a 'white-coat' effect, i.e. a temporary BP increase during the physician's visit. ${ }^{38}$ It should be emphasized, however, that similarly to what has been reported in studies performed in Western Europe, ${ }^{39-43}$ the percentage of patients showing ambulatory BP control was greater than that showing office BP control. This may be accounted for by the large prevalence ( $\sim 40 \%$ ) of patients with a 'white-coat' hypertension, that is the condition in which ambulatory BP is normal even before treatment. ${ }^{12}$ Two, our results are in line with the evidence
obtained repeatedly in studies performed elsewhere that hypertension is associated with a high prevalence of metabolic risk factors as well as of frank obesity. ${ }^{1-8}$ This was accompanied by a frequent history of CV disease and subclinical organ damage, which made total CV risk high or very high in the majority of the patients surveyed. Although in line with the high prevalence of CV disease in Central and Eastern Europe, this finding may be in part accounted for by the prevalence in the survey of patients followed by specialists as compared with general practitioners (only $\sim 15 \%$ ). In other words, the CV risk profile of the patients enrolled in the present study may be not representative of the general hypertensive population living in central and eastern European countries. The third issue concerns the frequency at which central and eastern European physicians make use of examinations recommend by the European guidelines as necessary (routine) or desirable to clinically characterize the hypertensive status and favour appropriate treatment choices. Three remarks are worth making. One, an EKG was made available in a much higher proportion of patients (virtually all) than in similar studies in Western Europe. ${ }^{12}$ Two, in line with similar studies elsewhere, examination such as carotid ultrasound remains relatively rare. Three, despite the ESH/ESC guidelines recommendations to search for microalbuminuria routinely (given its predictive value, simplicity, and low cost), ${ }^{12}$ this examination has by no means become routine in clinical practice also in Central and Eastern Europe.

Our study has a number of limitations. As mentioned above, our data may not represent the BP control rate, CV risk profile, and diagnostic trends of the general hypertensive population of the participating countries because our study was not a populationbased study and a low percentage of general practitioners was involved. Furthermore, the information collected on subclinical organ damage is only of qualitative nature not allowing to precisely quantify the severity of organ damage present in the study population. Three, the study design did not allow a deeper insight into the reasons for the differences in BP control seen in different countries except for the fact that this was not due to differences among countries in the proportion of specialists and nonspecialists involved or in the prevalence of high or very high-risk conditions.

## Supplementary material

Supplementary material is available at European Heart Journal online.

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[^1]:    n.a., not applicable.

