Evaluation of arterial hypertension control in family practice in Slovenia

Ovrednotenje nadzora arterijske hipertenzije v ambulantah družinske medicine v Sloveniji

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Izvleček

Izhodišča: V študiji, ki je vključevala okrog 20.000 slovenskih bolnikov z arterijsko hipertenzijo (AH), smo ugotavljali nadzor krvnega tlaka v odvisnosti od spola in starosti, nadzor AH v obdobju 2002–2008 in ocenili možni vpliv izbranih kazalnikov kakovosti na nadzor krvnega tlaka.

Metode: Študija je potekala v okviru projekta »Kakovost v zdravstvu Slovenije« z dovoljenjem Komisije Republike Slovenije za medicinsko etiko. Rezultate smo statistično analizirali in jih ovrednotili.

Rezultati: Nadzor AH v obdobju 2002–2008 je bil sorazmerno dober (55,8 %, 95 % CI: 55.1–56.5) in se je v tem obdobju značilno povečal. Rezultat, da gre za boljši nadzor v letu 2006 v primerjavi z 2002, je na podlagi našega statističnega modela predvsem posledica nižjega krvnega tlaka pred začetkom zdravljenja. Nenadzorovana AH je bila predvsem posledica nezadostno nadzorovanega sistoličnega krvnega tlaka. Nadzor AH je bil boljši pri bolj pogosti kontroli krvnega tlaka v intervalih, manjših od šestih mesecev.

Zaključki: Glede na rezultate naše študije je nadzor AH v ambulantah družinske medicine v Sloveniji sorazmerno dober v primerjavi z drugimi evropskimi državami, vendar moramo pri tem upoštevati, da podatki veljajo samo za bolnike, ki so obiskali svojega zdravnika - specialista družinske medicine.

Abstract

Objective: We performed a study on almost 20,000 Slovene patients with arterial hypertension (AH) to evaluate age- and gender-dependent blood pressure control, differences in the rate of AH control in the period 2002–2008, and to validate a potential impact of selected quality indicators on blood pressure control.

Methods: The study was conducted as a part of the "Quality of Healthcare in Slovenia" project, in agreement with the National Medical Ethics Committee of the Republic of Slovenia. Appropriate statistical analyses were performed and the results evaluated.

Results: Arterial hypertension control was relatively high (55.8 %, 95 % CI: 55.1–56.5) in the period 2002–2008 and improved significantly during that period. Based on our statistical model, the improved AH control in year 2006 compared to 2002 is particularly due to lower initial blood pressure values before treatment. Uncontrolled AH was largely attributed to uncontrolled systolic blood pressure. We found positive association between AH control and the frequency of blood pressure control in less than six-month time intervals.

Conclusions: According to our results, AH control in family practice in Slovenia is relatively high compared to other European countries, but the results refer only to patients visiting their family medicine physicians.

Introduction

Arterial hypertension (AH; defined as systolic blood pressure ≥ 140 mmHg and/ or diastolic blood pressure ≥ 90 mmHg) is the most important modifiable risk factor for cardiovascular diseases and mortality in developed countries.[1] In Slovenia, mortality due to consequences of arterial hypertension (AH) is estimated between 2400–4500

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deaths per year.[2] There are several different estimates of AH prevalence in Slovenia. According to the data from the Slovene National Registry of Persons at High Risk for Cardiovascular Diseases (ROKVB), which includes more than 293,850 preventive visits, 35 % of Slovene citizens (men above 35 and women above 40 years of age) are diagnosed with AH.[3] According to the data from the CINDI (WHO Countrywide Integrated Noncommunicable Disease Intervention) program, AH prevalence in Slovene adult population aged 25 to 64 years is estimated to be even higher, about 39.5 % in years 2002/2003.[4] Considering recent epidemiological study in 3067 Slovene individuals from the general population older than 20 years, the prevalence of AH above 50 % is estimated to be among the highest of European developed countries.[5] According to a cross-sectional study, based on an anonymous questionnaire survey among 410 randomly chosen Slovene inhabitants, 30.2 % declared they had high blood pressure.[6]

Various national health programs were designed and implemented to combat cardiovascular diseases in Slovenia. One of the most extensive is the CINDI program, implemented in early nineties.[7] The guidelines for the management of AH in Slovenia were updated and the number of prescriptions of antihypertensives per 1000 inhabitants increased by 57 % during the period of 2002–2008, which is comparable or even higher compared to other developed European countries.[8] However, the blood pressure control in Slovenia was still suboptimal according to previous studies. In the latest study performed in 2006, the target blood pressure (under 140/90 mmHg) was reached in 40.1 % of 980 AH patients attending their family medicine physicians.[9] Since approximately half of the individuals with AH from the general Slovene population visit their physicians, the number of adequately controlled hypertensive patients is probably even lower; it is also lower compared to other developed countries.[9-11]

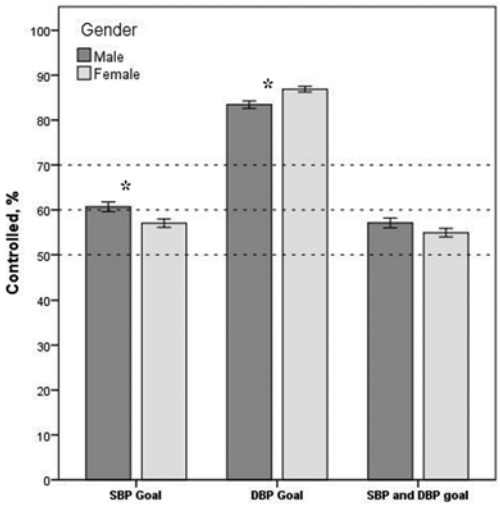
Results from studies on changes in the rates of awareness, prevalence, treatment and control of AH in the USA and Canada over the past two decades were published recently.[10,11] In both countries, the rate of AH control among hypertensives has improved markedly during this time and was 64.6 % in 2009 in Canada and 50.1 % in 2007–2008 in the USA, which is higher compared to the majority of European countries.[12,13] Since AH prevalence is high and AH control often suboptimal, AH still remains a Slovene, European and also world-wide current health issue, accompanied by great costs.

In the light of the above snapshot, the main aims of the present study on Slovene hypertensive population of almost 20,000 patients, treated in the period 2002–2008, were: (i) to evaluate age- and gender-dependent differential systolic blood pressure (SBP) and diastolic blood pressure (DBP) control, (ii) to evaluate differences in rate of AH control in the period 2002–2008, and (iii) to validate the potential impact of selected quality indicators on blood pressure control.

Patients and Methods

The study was cross-sectional and was conducted as part of the "Quality of Healthcare in Slovenia" project, in agreement with the National Medical Ethics Committee of the Republic of Slovenia. The majority of data were gathered during the five-year period between 2002 and 2006 by 360 family medicine physicians from all regions of Slovenia. We certify that all applicable institutional and governmental regulations concerning the ethical use of human volunteers were followed during this research.

Collaborating family medicine physicians were supposed to collect data from 50 to 100 consecutive patients diagnosed with AH. Data on the following six quality indicators for AH control were collected: (i) data on brachial arterial pressure (SBP, DBP), obtained at one visit before a patient had started to receive antihypertensive treatment (AHT; marked as "before AHT"), (ii) the average of the last three recorded measurements of SBP and DBP, when the majority of patients were treated with AHT (marked as "during AHT"), (iii) data on patient's inclusion in the register of hypertensive patients, (iv) data on three measurements of blood



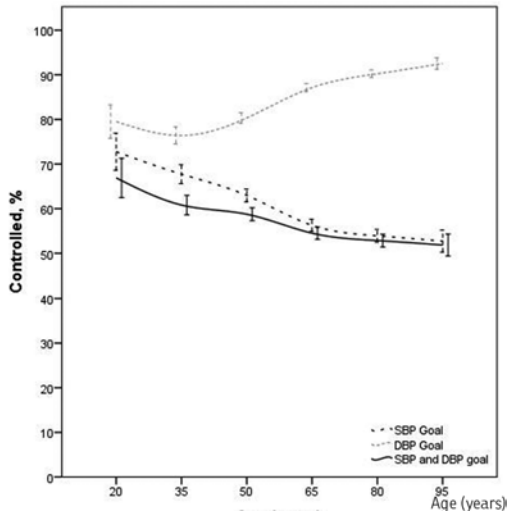


Figure 1: Rate of systolic blood pressure goal, diastolic blood pressure goal, or both, the systolic and diastolic goal, by gender (*left*) and age (*right*) in Slovene hypertensive patients during antihypertensive treatment
Controlled, %: Percentage of hypertensive patients with blood pressure < 140/90 mmHg during antihypertensive treatment
*Abbreviations: DBP-diastolic blood pressure, SBP-systolic blood pressure, *-statistically significant difference between men and women (Fisher's exact test)*

pressure recorded at three different visits before AHT, (v) data on patient's blood pressure control in time intervals shorter than six months, and (vi) data on patient's referral to the specialist for AH. The last four collected data are yes/no variables. All the data were taken from patients' medical records. Data on patients' age and gender and physicians' gender were also collected.

Results are expressed as mean values and proportion with standard deviations or 95 % confidence intervals (Cls). Independent samples t-test for continuous and Chi-square or Fisher's exact test for categorical data were used. For line smoothing, polynomial approximation was used.

Patients under the age of 18 and patients with missing values for any of the selected types of data were excluded from the study. Physicians (27 out of 360 or 7.5 %) who treated less than 30 patients were also excluded from the analyses, therefore 429 patients were excluded. The final analysed sample included 18,260 Slovene patients diagnosed with AH. Multiple linear regression was used to examine relations of initial blood pressure, period of data collection (2006 vs. 2002), patient age and gender on blood pressure outcome. Multiple logistic regression analysis was used to identify the independent associates of blood pressure control; blood pressure control (< 140/90 mmHg) was a dependent variable, while four previously mentioned quality indicators (iii-vi), physician's success rate, patient's age and gender and physician's gender were used as independent variables. Physician's success rate was defined as a percentage of adequately treated patients (target blood pressure value < 140/90 mmHg) by each individual physician where the observed patient was omitted from the calculation.

Statistical analyses were performed using the Statistical Package for Social Sciences for Windows ver. 18 (SPSS Inc., Chicago, IL). Due to the large sample size, $p < 0.001$ was considered statistically significant.

Results

Patients' characteristics

18,260 AH patients treated in the period 2002–2008 were included in our study. The study sample characteristics are summarized below and presented according to gender in Table 1. Among 18,260 patients included in the analysis, there were 7,726 (42.3 %) men and 10,534 (57.7 %) women. The mean age of our patients was (63.6 ± 12.1) years and 49.4 % of them were older than 65 years, 44.6 % were 45–64 and only 6.0 % were 18–44 years of age. Women were significantly older than men (women: 65.5 years ± 11.8 years; men: 60.9 years ± 11.9 years). Mean SBP and DBP before AHT in the whole study sample were (172.8 ± 18.1) mmHg and (101.6 ± 10.4) mmHg, respectively. During AHT, both mean SBP and DBP were significantly lower than before AHT; (142.0 ± 14.2) mmHg and (84.6 ± 8.3) mmHg for SBP and DBP, respectively.

Differential systolic blood pressure and diastolic blood pressure control

Among 18,260 hypertensive patients 1.7 % (95 % CI: 1.5–1.9) of patients had isolated diastolic hypertension before AHT, 19.7 % (95 % CI: 19.1–20.3) isolated systolic hypertension (ISH) and 78.6 % (95 % CI: 78.0–79.2) AH, respectively. During AHT there were 58.5 % (95 % CI: 57.8–59.2) patients controlled to the systolic goal, 85.4 % (95 % CI: 84.9–85.9) to the diastolic goal, and 55.8 % (95 % CI: 55.1–56.5) to both, the systolic as well as diastolic goal. Among patients aged < 65 years, 58.9 % (95 % CI: 57.9–59.9) of patients had controlled blood pressure. Arterial hypertension control was significantly less successful (52.7 %, 95 % CI: 51.7–53.7) in patients aged ≥ 65 years. Figure 1 demonstrates rates of DBP, SBP and the overall blood pressure control according to age and gender. Women had significantly lower rate of SBP control (60.7 %, 95 % CI: 59.8–61.6 and 57.0 %, 95 % CI: 55.9–58.1, respectively) but significantly higher rate of DBP control than men (86.9 %, 95 % CI: 86.3–87.5 and 83.4 %, 95 % CI: 82.6–84.2, respectively); the rate of both, SBP and DBP control, did not reach statistical difference between men and men. Older patients had lower rates of SBP control and overall control but higher rates of DBP control.

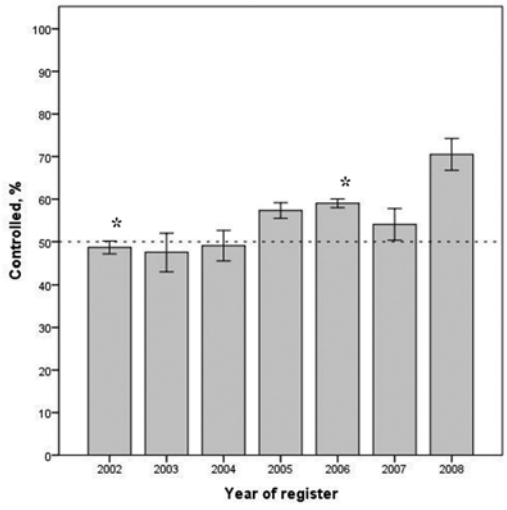
Arterial hypertension control in the period 2002–2008

Table 2 presents blood pressure values before and during AHT in the period 2002–2008. Comparing 2002 and 2006, when the majority of data were collected, mean SBP and mean DBP, both before and during AHT, were significantly lower in 2006 in men and women separately as well as when considering all patients as a whole. Mean differences

Table 1: Blood pressure and arterial hypertension grading before and during antihypertensive treatment according to patients' gender

Blood pressure	Mean value ± standard deviation (95 % CI) (mmHg) before AHT			Mean value ± standard deviation (95 % CI) (mmHg) during AHT		
	men n = 7726	women n = 10534	p	men n = 7726	women n = 10534	p
SBP *	171.1 ± 18.0 (170.7–171.5)	174.1 ± 18.1 (173.8–174.5)	<0.001	141.3 ± 14.0 (141.0–141.6)	142.5 ± 14.4 (142.2–142.8)	<0.001
DBP *	102.3 ± 10.5 (102.1–102.6)	101.1 ± 10.2 (100.9–101.3)	<0.001	85.2 ± 8.4 (85.0.7–85.4)	84.2 ± 8.1 (84.1–84.4)	<0.001
Arterial hypertension grade	Number (%) of patients before AHT			Number (%) of patients during AHT		
grade 1 hypertension	215 (2.8 %)	226 (2.2 %)		538 (7.0 %)	572 (5.4 %)	
grade 2 hypertension *	2749 (35.6 %)	3374 (32.0 %)	<0.001	591 (7.7 %)	632 (6.0 %)	<0.001
grade 3 hypertension	3424 (44.3 %)	4679 (44.4 %)		150 (1.9 %)	177 (1.7 %)	
normal blood pressure	0	0		4411 (57.1 %)	5785 (54.9 %)	
isolated systolic hypertension*	1338 (17.3 %)	2255 (21.4 %)		2036 (26.4 %)	3368 (32.0 %)	

Abbreviations: AHT-antihypertensive treatment, DBP-diastolic blood pressure, SBP-systolic blood pressure
normal blood pressure (SBP < 140 mmHg and DBP < 90 mmHg)
grade 1 hypertension (SBP ≥ 140–159 mmHg and/or DBP ≥ 90–94 mmHg)
grade 2 hypertension (SBP ≥ 160–179 mmHg and/or DBP ≥ 100–109 mmHg)
grade 3 hypertension (SBP ≥ 180 mmHg and/or DBP ≥ 110 mmHg)
isolated systolic hypertension (SBP ≥ 140 and DBP < 90 mmHg)
**statistically significant difference between men and women, both, before and during AHT (independent samples t-test for continuous and Chi-square test for categorical data)*



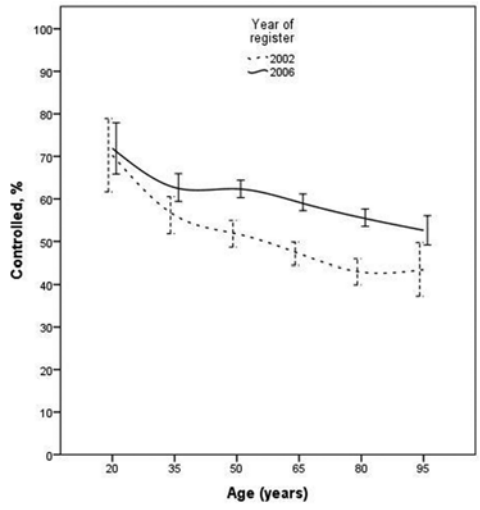


Figure 2: Arterial hypertension control during antihypertensive treatment in years 2002–2008 *(left).* Comparison of arterial hypertension control during antihypertensive treatment for years 2002 and 2006 according to patients' age *(right). Controlled, %: Percentage of patients with blood pressure < 140/90 mmHg during antihypertensive treatment*
**statistically significant difference in percentage of patients with controlled blood pressure between years 2002 and 2006 (Fisher's exact test)*

between blood pressure values during and before AHT were greater in 2006 compared to 2002, but were not significantly different. Follow-up linear regression suggests that SBP and DBP in 2006 resulted in improved outcome primarily due to lower initial SBP and DBP values, collected before AHT (Table 3). Arterial hypertension control improved significantly during 2002–2008 as presented in Figure 2, and was 48.7 % (95 % Cl: 47.2–50.2) and 59.0 % (95 % Cl: 58.0–60.0) in years 2002 and 2006, respectively.

Multivariate model of arterial hypertension control

Multivariate analysis (Table 4) showed that higher physician's success rate (OR = 55.80, 95 % CI: 46.83–66.49, p < 0.001) and more frequent blood pressure control in less than six-month time intervals (OR = 1.24, 95 % CI: 1.15–1.34, p < 0.001) were positively associated with controlled AH. Patient's age 39 years or less was used as a reference for controlled AH where older age groups resulted in negative association for controlled AH, age group 80 years or more had the lowest odds (OR 0.56, 95 % CI: 0.44–0.71, p < 0.001).

Discussion

The main purpose of our study was to evaluate the quality of blood pressure control in 18,260 patients diagnosed with AH in Slovene family practice. In Slovenia, mortality rate due to cardiovascular disease in 2008 was higher (234.9 per 100.000 inhabitants) than in Europe (227.2 per 100.000 inhabitants), and as such, the evaluation of AH control is of great importance.[14] In our study the target blood pressure value < 140/90 mmHg was achieved in 55.8 % of all treated hypertensive patients, which is relatively high compared to other developed countries.[13,15] We also studied differences in AH control rates in the period 2002–2008 and the possible impact of selected quality indicators on blood pressure control. Arterial hypertension control improved significantly in 2006 compared to 2002 (the majority of data were obtained during 2002 and 2006); improved outcome is based on our statistical model primarily due to lower initial SBP and DBP values before AHT (Table 3). That may emphasize the meaning of preventive efforts for better AH control. The SBP goal was achieved less frequently than the DBP goal, and the difference increased with patient's age. According to our multivariate regression model, higher physician's success rate, more frequent control of blood pressure in time intervals shorter than six months and lower patient's age were independently associated with better blood pressure control.

Arterial hypertension control and differential systolic blood pressure and diastolic blood pressure control

The relatively high number of patients with controlled blood pressure in our study (55.8 %) is higher compared to 40.1 % con-

trolled in a study from 2006, which included 980 Slovene hypertensive patients attending their family medicine physicians.[9] In both, the present and the previous study, the percentage of controlled patients was higher than in earlier national studies using similar methodology.[16-18] In a study on Slovene hypertensive patients conducted within family medicine physicians in 1999, only 9.1 % of patients had controlled AH according to the criteria 130/85 mmHg for patients younger than 65 years and 140/90 mmHg for patients age 65 and older.[16] In our opinion, the reasons for better AH control in our study might be well implemented guidelines, appropriate treatment (often using combinational therapy, which is reflected in rising consumption of antihypertensives), many international and national programs, performed to combat cardiovascular diseases, greater awareness of patients and implementation of quality control in the Slovene healthcare system. The results of our study are comparable with the results from a recent French study in which 58 % controlled patients in daily practice of family medicine physicians were observed.[19] Epidemiological studies indicate that adequate control in the overall population vary greatly among different countries (from 8.3 % to 42 %), but has increased during recent decades, especially in the USA and Canada.[10,11] According to the systematic worldwide analysis, the latter countries were within ten countries with the lowest SBP values in 2008 in adults age ≥ 25 years.[12]

The key question is whether our results actually reflect the real situation in Slovene population or are they overestimated. By far the largest number of patients and collaborating family medicine physicians were included in our study compared to other similar Slovene studies. Due to the lack of data we were unable to consider patients' co-morbidities, such as chronic kidney disease, diabetes, stable angina, acute coronary syndrome, or left ventricular dysfunction, in which the target blood pressure levels of 130/80 mmHg or even lower are recommended. Also, the possibility of sampling errors

Table 2: Blood pressure values and differences before and during antihypertensive treatment in the period 2002–2008

Year	Number of patients	Age (mean ± SD) (95 % CI) (years)	SBP (mean ± SD) (95 % CI) (mmHg) before AHT	DBP (mean ± SD) (95 % CI) (mmHg) before AHT	SBP (mean ± SD) (95 % CI) (mmHg) during AHT	DBP (mean ± SD) (95 % CI) (mmHg) during AHT	Difference in SBP (before – during AHT) (mean ± SD) (95 % CI) (mmHg)	Difference in DBP (before – during AHT) (mean ± SD) (95 % CI) (mmHg)
2002*	**4195**	**63.1 ± 11.7 (62.8–63.5)**	**175.0 ± 19.3 (174.4–175.6)**	**103.0 ± 10.4 (102.7–103.3)**	**144.1 ± 14.6 (143.7–144.6)**	**86.3 ± 8.1 (86.1–86.5)**	**30.9 ± 20.5 (30.3–31.5)**	**16.7 ± 11.4 (16.4–17.0)**
2003	486	61.2 ± 11.5 (60.1–62.2)	170.2 ± 17.7 (168.7–171.8)	102.5 ± 9.7 (101.6–103.3)	144.5 ± 14.3 (143.2–145.8)	86.3 ± 8.5 (85.5–87.0)	25.7 ± 19.6 (24.0–27.5)	16.2 ± 11.7 (15.2–17.3)
2004	752	64.6 ± 12.7 (63.7–65.5)	174.4 ± 17.6 (173.1–175.6)	102.7 ± 10.2 (101.9–103.4)	144.6 ± 16.2 (143.5–145.8)	85.4 ± 9.6 (84.7–86.0)	29.8 ± 21.2 (28.2–31.3)	17.3 ± 12.4 (16.4–18.2)
2005	2795	64.2 ± 12.0 (63.7–64.6)	172.6 ± 17.7 (172.0–173.3)	101.6 ± 10.3 (101.2–102.0)	141.3 ± 13.9 (140.8–141.4)	83.6 ± 8.0 (83.3–83.9)	31.3 ± 19.6 (30.6–32.0)	18.0 ± 11.3 (17.6–18.4)
2006*	**8769**	**64.4 ± 12.1 (64.2–64.7)**	**172.2 ± 17.8 (171.9–172.6)**	**101.0 ± 10.4 (100.8–101.2)**	**141.1 ± 13.9 (140.8–141.4)**	**84.1 ± 8.0 (84.0–84.3)**	**31.1 ± 19.3 (30.7–31.5)**	**16.9 ± 11.4 (16.6–17.1)**
2007	690	65.1 ± 12.5 (64.2–66.0)	170.2 ± 15.9 (169.0–171.4)	99.9 ± 9.8 (99.2–100.6)	141.8 ± 13.4 (140.8–142.8)	84.7 ± 8.8 (84.0–85.3)	28.4 ± 18.0 (27.1–29.8)	15.2 ± 11.6 (14.3–16.1)
2008	573	65.6 ± 12.3 (64.6–66.6)	170.6 ± 16.9 (169.2–172.0)	100.3 ± 9.9 (99.5–101.1)	138.3 ± 13.3 (137.2–139.4)	82.6 ± 8.5 (81.9–83.3)	32.2 ± 19.4 (30.6–33.8)	17.7 ± 12.1 (16.7–18.7)

Abbreviations: AHT-antihypertensive treatment, DBP-diastolic blood pressure, SBP-systolic blood pressure, SD-standard deviation
/bold**- statistically significant difference in mean age and mean blood pressure values between years 2002 and 2006 (independent samples t-test)*
Mean differences in SBP or DBP between, during and before AHT were not significantly different between years 2002 and 2006 (independent samples t-test).

(possibility of inclusion of patients with better blood pressure control and rounding values up or down) cannot be excluded since the primary goal of data gathering was evaluating physicians' work as part of the "Quality of Healthcare in Slovenia" project. Accordingly, in our analyses blood pressure levels were kept as recommended by guidelines. Moreover, we were not able to obtain data on blood pressure measurement protocol or criteria used for AH diagnosis. The data were simply taken from patients' medical records and as such reflect the actual conditions. Also, a possibility of errors in data transfer to our database as well as deficient recording into the patients' medical records could not be excluded. Our results apply only to patients who visit their family medicine physicians. In view of the fact that only a half of the patients diagnosed with AH visit their physicians, the blood pressure control in the overall population of Slovene AH patients might actually be lower. In European developed countries blood pressure control is usually varying between 20 to 40 % in treated hypertensive patients.[13,20] Other studies have shown that the required blood pressure values were achieved in 8.3–63.0 % of treated hypertensive patients and were not frequently above 50 %.[21,22] In a study of 455 hypertensive patients treated in daily practice of Latvian family physicians, 46.2 % attained their target blood pressure (< 140/90 mmHg or < 135/85–125/75 mmHg dependent on their cardiovascular risk). Among 5413 Danish hypertensive patients treated in general practice only 29.1 % achieved optimal BP control. Recent data from BP-CARE study, conducted in »less« developed Central and East European Countries with 7860 treated hypertensive patients selected from clinical visits to family medicine physicians or specialists showed that blood pressure control was achieved in only 27.1 % of treated hypertensive persons. [23] In comparison with the above-mentioned studies, the AH control in our patients was much higher and the question of overestimated results remains.

Furthermore, our study provided some other interesting observations. Mean SBP was higher and mean DBP was lower in women than men, and hence women had significantly higher mean PP than men. However, the differences are probably not of clinical relevance. This is contradictory to the results from a longitudinal study of twelve-year blood pressure dynamics in a representative general population of a total of 4409 adults (age ≥ 25 years) in Slovenia, which showed lower mean SBP and DBP in women compared to men.[4] In that respect, it should be considered that women in our study were significantly older than men and that the studied population is significantly older than the general Slovene population. On the other hand, higher prevalence of ISH in women was confirmed in many other studies and also in our previous work.[24-27] Prospective studies strongly suggest that SBP is a better predictor of cardiovascular disease risk than AH, especially in older adults (age > 55).[12] Patients included in our study were controlled in 58.5 % to SBP goal, in 85.4 % to DBP goal and in 55.8 % to both, the SBP and DBP goals. Thus, lower SBP control was overwhelmingly responsible for the rates of overall control to the goals, which is in accordance with the results on the 1959 hypertensive subjects from the Framingham Heart Study.[28] This is not surprising since education efforts have traditionally placed more emphasis on DBP, and several surveys have shown that clinicians tend to accept higher SBP than recommended in the guidelines before prescribing or changing antihypertensive therapy.[29] In accordance with the Framingham Heart Study, women in our study also had significantly higher control to DBP goal, but lower control to SBP goal and to both goals, the SBP and DBP, compared to men.[28] Similarly, with higher patients' age, the SBP and the overall control rates were lower, but DBP control rate was higher. Due to a relatively small number (585, 3.2 %) of patients in age groups < 40 and > 90 years, the results in blood pressure goals in these groups should be considered with caution.

In accordance with other studies, we found a higher SBP but lower DBP with increasing age, and consequently, a higher prevalence of ISH in older patients.[27,29] Interestingly, the prevalence of ISH increased significantly during AHT in both men and

women. With regard to high PP values and high ISH prevalence in treated Slovene patients diagnosed with AH, the quality of ISH control may not be optimal and should be improved. However, our results are in accordance with the results from other studies in which a large proportion of uncontrolled ISH among treated antihypertensive patients was confirmed.[30]

Trends in AH control rate in the period 2002–2008

The percentage of controlled hypertensive patients was the highest in years 2008, 2005 and 2006, but the number of included patients was by far the highest in 2006, 2002 and 2005. The improvement in AH control during 2002–2008 might be considered consistent with the data that showed marked increase (more than a half) in the use of antihypertensives in years 2002–2008.[7] The increase in the number of prescriptions for antihypertensives per 1000 inhabitants between the two following years was the highest in 2002–2003 and 2003–2004.[8] However, the wider antihypertensive use could not be considered directly associated with the improvements in AH control, owing to concerns about screening, physicians' and patients' compliance, possible changes in dietary and lifestyle habits.

The most important observation within the CINDI program in the previous decade was the prominent decrease in mean value of SBP in the period 1996/97–2002/03.[4] At the same time, the increase of DBP between 1990/91 and 1996/97, and its decrease between 1996/97 and 2002/03 were registered. The changes in AH prevalence were characterized by its prominent increase between 1990/91 and 1996/97, while during the period 1996/97–2002/03, a minor decrease was registered.[4] Considering this, significant improvement in AH control in the period 2002–2008 (from 48.7 % in 2002 to 59.0 % in 2006 and 70.5 % in 2008) could be pointed out since Slovenia also implemented the CINDI program to combat cardiovascular diseases in early nineties. Additionally, numerous other organizations and activities, such as The National Institute of Public Health of the Republic of Slovenia (educational programs for nurses, Salt and hypertension), Slovenian Hypertension Society (educational programs for nurses, guidelines implementation), Pharmaceutical care programs in hypertension management in community pharmacies, and also students' and public organizations represent a very important base of health promotion and cardiovascular disease prevention activities, inducing the majority of activities towards reducing the AH prevalence in Slovene population.[31]

Multivariate model of arterial hypertension control

Implementation of quality control and improvement in the Slovene healthcare system are essential for its existence and development. Activities for gradual introduction of systematic monitoring, assessment and improvement of the quality of healthcare in Slovenia started more than a decade ago.[32] One of the key prerequisites for the selection of valid, practicable, efficient and reliable quality indicators is the establishment of a

Table 3: Systolic and diastolic blood pressure outcome during antihypertensive treatment

	SBP during AHT			DBP during AHT		
Patient	Beta	t	p	Beta	t	p
Initial blood pressure value; before AHT	0.27	31.28	<0.001	0.23	26.90	<0.001
Age (years)	0.08	9.54	<0.001	-0.19	-21.96	<0.001
Female gender	0.01	1.72	0.085	-0.01	-1.39	0.164
Year of register in 2006	-0.09	-10.16	<0.001	-0.09	-11.29	<0.001
	Model: F = 351.051, df = 4, p < 0.001; R2 = 0.098			Model: F = 418.436, df = 4, p < 0.001; R2 = 0.114		

continuous and methodologically appropriate system for development and implementation of evidence-based clinical practice guidelines. The National guidelines for AH management in Slovenia are adequately updated and in concordance with the European guidelines on AH management.[33] Because of that and the high AH prevalence in Slovenia, AH was chosen as an appropriate field to measure quality in primary care. In our analysis, the impact of selected quality indicators on blood pressure control was validated. The success rate of AH control for a particular physician was defined as a percentage of patients with controlled blood pressure (SBP < 140 mmHg and DBP < 90 mmHg). We found a significant positive association of better AH control with higher physician success rate and with more frequent control of blood pressure in regular six-month time intervals. Also, we were able to confirm the expected negative association between AH control and patients' age. Additionally, regular control of blood pressure seems to be a very important factor affecting blood pressure control, also reflecting patients' compliance and devotion to treatment. Other quality indicators and patients' gender showed no significant association with AH control rate. However, blood pressure control is complex and could be influenced by physicians (physician's attitude to blood pressure reading, additional education, age, gender…), by patients (age, gender, body-mass index, co-morbidities, educational level, socio-economic status,

Table 4: The multivariate model of arterial hypertension control in Slovene hypertensive patients

Factor	Controlled AH		χ^2	OR (95 % CI)	p-value
	yes (%) n = 10,196	no (%) n = 8064			
Physician's gender-female	68.1	65.6	1.15	1.03 (0.97–1.11)	0.285
Patient's gender-female	56.7	58.9	3.49	0.94 (0.88–1.01)	0.062
Inclusion in practice register of hypertensive patients*	54.3	52.8	0.13	1.00 (0.94–1.07)	0.716
Three measurements of blood pressure at three different visits before AHT*	67.4	61.2	1.87	1.05 (0.97–1.13)	0.171
Blood pressure control in less than six month time intervals*	73.4	63.6	35.99	1.24 (1.15–1.34)	< 0.001
Referral to the specialist*	39.8	43.8	4.17	0.93 (0.88–1.00)	0.059
Patient's age (years)					
39 or less	2.9	1.8		1.00 (reference)	
40–49	11.4	9.3	3.31	0.80 (0.64–1.02)	0.069
50–59	25.7	22.8	9.19	0.71 (0.57–0.89)	0.002
60–69	27.6	29.2	18.18	0.62 (0.50–0.77)	<0.001
70–79	24.4	27.5	24.28	0.57 (0.46–0.71)	<0.001
80 or more	8.0	9.4	22.34	0.56 (0.44–0.71)	<0.001
	Mean ± SD	Mean ± SD			
Physician's success rate (%)	63.0 ± 17.9	46.8 ± 18.7	2022.25	55.80 (46.83–66.49)	<0.001

Model: $\chi^2 = 2701.602$; df = 12; p < 0.001; Nagelkerke $R^2 = 0.184$
*Abbreviations: AH-arterial hypertension, AHT-antihypertensive treatment, CI-confidence interval, OR-odds ratio, SD-standard deviation, *-yes/no variables*

sodium intake, lifestyle characteristics …) and by various other factors (accessibility and organisation of healthcare, preventive programs ...).[31] Selected indicators within the "Quality of Healthcare in Slovenia" project focused only on the quality of clinical performance, but not for example also on two other very important aspects: continuity of care and interpersonal effectiveness (patient-physician interaction), which were analyzed in another study.[32]

Our intention was to build a regression model that would to some extent explain the importance of the general physician's support in patients' controlled AH. We were limited in the definition of physicians' success rate which was calculated as percentage of controlled AH patients (from 0 to 100 %). Physicians' success rate was included in a logistic regression model as continuous covariate, which is less common than categorical classification; nevertheless, such strategy was applied in the literature before.[36,37] The regression model was adjusted by age and gender; however, owing to the lack of data, other important demographic covariates, comorbidities, etc. could not be included. Our results indicate that, regardless of age and gender, patients' selection of a particular physician may be favourable. However, both the sensitivity and specificity of the model were relatively low (below 70 %,), and together with the explained variance of 18.4 % suggest that the results should be considered with caution.

Conclusions

Among 18,260 Slovene hypertensive patients visiting family medicine physicians, AH control was relatively high (55.8 %) and improved significantly in the period 2002–2008. Uncontrolled AH was largely attributed to uncontrolled SBP. The prevalence of ISH was even higher during AHT than before AHT and was significantly higher in women than in men of similar age. We found positive associations between AH control and the following indicators: physician's success rate, more frequent control of blood pressure in less than six-month time intervals and also with younger patient's age. Despite the observed marked improvements in AH control in Slovenia, we should not ignore the fact that our results refer only to patients visiting their family medicine physicians. Since cardiovascular diseases remain among the most common causes of premature deaths in Slovenia, continued efforts to optimize management of AH are necessary, including vigilance and reinforcement after improvements.

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