Identification of patient-related, healthcare-related and knowledge-related factors associated with inadequate blood pressure control in outpatients: a cross-sectional study in Serbia

Olga Horvat, Tinde Haltgato, Anastazija Stojić-Milosavljević, Milica Paut Kusturica, Zorana Kovačević, Dragica Bukumiric, Ana Tomas

ABSTRACT

Objective To determine rate of blood pressure (BP) control and to analyse patient-related, medication-related and healthcare system-related factors associated with poor BP control in outpatients with hypertension (HT).

Design Cross-sectional study.

Setting Two study sites with different levels of healthcare (primary healthcare (PHC) and secondary level of healthcare (SHC)) in Vojvodina, Northern Serbia.

Participants A total of 581 patients (response rate 96.8%) visiting their primary care physician between July 2019 and June 2020 filled out a pretested semistructured questionnaire and had a BP reading during their regular appointments.

Primary and secondary outcome measures Data on demographics, medication, BP control (target systolic BP≤140 mm Hg and/or diastolic BP≤90 mm Hg) and knowledge on HT was collected. Based on the median of knowledge score, patients were classified as having poor, average and adequate knowledge.

Results Majority of the respondents (74.9%) had poorly controlled BP and had HT longer than 10 years. Larger number of patients at PHC site was managed with monotherapy while at the SHC majority received three or more antihypertensive drugs. Respondents from SHC showed a significantly lower knowledge score (9, 2–15) compared with the respondents from PHC (11, 4–15, p=0.001). The share of respondents with adequate knowledge on HT was significantly higher in the group with good BP control (26% and 9.2%, respectively). In a multivariate regression analysis, factors associated with poor BP control were knowledge (B=-1.091; p<0.001), number of drugs (B=0.0536; p<0.001) and complications (B=0.0898; p=0.004).

Conclusions Poor BP control is common in outpatients in Serbia, irrespective of the availability of different levels of healthcare. Patients with poor knowledge on HT, with complications of HT and those with multiple antihypertensive drugs, were at particular risk of poor BP control. Our study could serve as a basis for targeted interventions to improve HT management.

INTRODUCTION

Hypertension (HT), one of the most prevalent asymptomatic chronic diseases affecting approximately 1.39 billion people worldwide, is the major risk factor for cardiovascular diseases (CVDs).1

Similar to trends in high-income countries of the world, CVDs mortality rates are finally declining in Serbia. Although the mortality rates for ischaemic heart diseases and for cerebrovascular diseases decrease (by 19.8% and 34.9%, respectively) between 2010 and 2019 in Serbia, death rates from hypertensive diseases increase by 132.0%.2

Serbia belongs to the group of countries with a very high prevalence of HT in Europe: in 2006, 2013 and 2019, the prevalence of HT was 46.5%, 47.5% and 46.2% among the population aged 20 and over, respectively.3
This indicates that the prevalence of HT in the adult population remained the same. Furthermore, the prevalence of undiagnosed and poorly controlled HT is also high, only 20.9% of treated patients have well-controlled blood pressure (BP).13 14

The factors associated with uncontrolled BP reported in the literature are described as patient related, medication related and healthcare system related.6–9 The patient oriented factors include sociodemographic and clinical characteristics as well as patient’s knowledge about HT. It is frequently reported that patients with HT are least knowledgeable on normal BP values and lifestyle changes during the treatment process.10–12 The medication-related factors include duration and complexity of treatment, type of medications, side effects, etc. Factors associated with the healthcare system include accessibility of healthcare or how the HT services are organised and delivered at the different levels of care (primary, secondary and tertiary care). While HT is managed at all levels of healthcare in Serbia, patients with uncomplicated HT are usually cared for at primary care centres, generally having easier access to providers. Complex cases with other comorbidities or cardiovascular complications treated at secondary (general and specialised hospitals) and tertiary (teaching hospitals) levels generally have easier access to specialists when needed, but may face longer waiting time and shorter contact time. These issues may affect the delivery of HT care and control rates.13 14

Adequate data are not available on BP control and factors that may be associated with uncontrolled BP in Serbia. Therefore, the objective of this study was to determine patients’ BP control status as well as to analyse patient-related, medication-related and healthcare system-related factors associated with uncontrolled BP among hypertensive patients.

METHODS

Data collection

The study was conducted in two study sites with different levels of healthcare in Vojvodina, the Northern part of Serbia. In Backa Topola municipality with 33,321 inhabitants, which has only primary healthcare (PHC) centre (patients with HT are cared by primary care physicians—general practitioners (GPs) and internal medicine specialists—internists, referred to further as PHC) and Sombor municipality with 85,903 inhabitants (according to the 2011 Census), which has both PHC centre where HT patients are cared only by GPs and general hospital equipped with acute coronary units, post coronary units, departments of cardiology and angiogram units where patients with HT are cared by cardiologists (referred to further as secondary healthcare (SHC)). The research was carried out between 1 July 2019 and 30 June 2020.

A total of 581 patients (330 PHC and 251 from SHC) who visited their primary care physician between July 2019 and June 2020 were recruited during their regular appointments.

The sample size for this study was estimated according to the number of patients older than 20 years with diagnosis of HT in cities where the study was conducted. Based on the total number of diagnoses of HT obtained from the Institutes of Public Health of these two municipalities, it was estimated that 3896 patients with HT aged 20 years or older in Sombor and 2462 patients in PHC seek treatment in these municipalities. Using this as the study’s population size, the calculated sample size was 86 for SHC and 134 for PHC (at 95% confidence and 5% margin of error). This was then deliberately exceeded to increase the power of the study and to provide for exclusions, dropouts and the need to perform subgroup analysis. Hence, a total sample size of fewer than 600 patients was targeted.

Respondents were patients at least 20 years old, diagnosed with essential HT (based on an International Statistical Classification of Diseases, 10th Revision code I10: Hypertensio arterialis essentialis (primaria)), at least 1 year before the study onset, treated for HT with at least one antihypertensive drug for at least 6 months.15 The exclusion criteria were: patients aged<20, patients who had secondary HT, pregnant women and those with acute diseases during the survey period. All patients were informed of the purpose and nature of the study and have provided written informed consent to participate.

A trained interviewer used pretested semistructured questionnaire (online supplemental file 1) to collect information. The questionnaire was divided into two sections. The first section consisted of questions referring to the patient-related and medication-related characteristics of respondents. The second section was related to knowledge on HT and consisted of 15 claims that were supposed to be categorised as ‘yes’, ‘no’ or ‘do not know’. The knowledge score was determined by giving one point for each correct answer and the maximum score was 15. The subjects were classified further in the respect to the median knowledge score of the total sample 10 (range, 2–15) into those with poor knowledge (score<8), those with average knowledge (score between 9 and 12) and those with adequate knowledge (score between 13 and 15). The knowledge scale was adapted from one used in a similar study in Cameroon to assess knowledge of HT.16 To enable correct answers, necessary modifications were made to questions and statements. The content, comprehension, readability and design of the questionnaire were pretested on 30 adult subjects. BP was measured two times on the same arm after the participant had been seated at rest for 10 min, and the average of both values was considered the BP of the participant.

Data analysis

Descriptive and comparative statistical data analysis was performed with the IBM SPSS Statistics V.22 software. Out of descriptive statistical methods, measures of central tendency (mean, median), measures of variability (SD) and frequency were used. For testing the hypotheses, χ² test was used to test the difference in frequencies between
groups and Mann-Whitney test for variables with non-parametric distribution. One categorical variable was created—BP control status: good BP control (systolic BP $\leq 140$ mm Hg and/or diastolic BP $\leq 90$ mm Hg) and poor BP control (systolic BP $>140$ mm Hg and/or diastolic BP $>90$ mm Hg). Multivariate logistic regression analysis was conducted to determine whether variable factors significantly predicted poor BP control. Results were expressed as slope coefficients (B) and ORs with 95% CIs. All p values less than 0.05 were considered significant.

**Patient and public involvement**

Patients and the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

**RESULTS**

**Patient-related and medication-related characteristics**

Out of 600 hypertensive patients who were contacted, 581 accepted to fill out the questionnaire (response rate 96.8%). A proportion of 58.3% were women and the mean age was 65.6±9.6 years. In addition, 43.2% of the respondents were from SHC and 56.8% were from PHC. Several characteristics were statistically different between respondents from PHC and SHC municipalities (table 1). The largest share of the respondents from SHC had only primary level of education (61.0%), while majority of the respondents from PHC had completed secondary school (47.6%) (p=0.004). The duration of HT was most frequently above 15 years for the patients from SHC compared with the patients from PHC where it was between 10 and 14 years (p<0.001). Respondents from SHC had more common complications of HT (acute myocardial infarction, stroke, chronic renal insufficiency or hypertensive retinopathy) (p=0.001). Regarding the hypertensive heart disease complications, acute myocardial infarction was the most frequent complication in PHC as well as in SHC (55.3% and 59.3%, respectively), without a statistically significant difference (p=0.243).

There was no significant difference in the frequency of other HT complications between respondents of PHC and SHC (p=0.05). Respondents from PHC were most commonly treated with one antihypertensive, whereas respondents from SHC were most commonly treated with three or more antihypertensive drugs (37.7% and 45.7%, respectively) (p=0.002).

**Knowledge on HT**

Additionally, out of total sample, 29.4% showed a poor knowledge, 57.1% demonstrated an average, while 13.4% had adequate knowledge on HT. The highest percentage of correct answers was recorded for the statement ‘HT can lead to other life-threatening diseases’, while the lowest percentage was noted for the statement ‘Dietary approaches to reducing HT do no good’ (table 2).

Respondents from both study sites (PHC and SHC) most frequently had average knowledge. Out of PHC respondents, 61.8% showed average knowledge compared with 51% of SHC respondents (p=0.001). Respondents from SHC showed a significantly lower knowledge score compared with the respondents from PHC (p=0.001). The median knowledge score of the respondents from SHC was 9 (range 2–15), while the median knowledge score of the respondents from PHC was 11 (range 4–15).

**BP control**

Out of the 581 patients with HT, 74.9% of the respondents had poorly controlled BP and only 25.1% had good controlled BP. There was no statistically significant difference in the control of BP between the respondents from PHC and SHC. Similar percentage of respondents from both study sites (from SHC and from PHC) had poorly controlled BP (24.7% and 25.5%, respectively) (p=0.836).

**Knowledge on HT and BP control status**

In the study sample, the proportion of the respondents with adequate knowledge on HT was significantly higher in the group with good BP control compared with the group with poor BP control (26% and 9.2%, respectively), whereas the proportion of the respondents with poor knowledge on HT was significantly higher in the group with poor BP control compared with the group with good BP control (36.3% and 8.9%, respectively) (p<0.001).

Among respondents from PHC, out of those with poor knowledge almost 90% (89.6%) had uncontrolled BP, compared with 73.5% and 55.1% of the respondents with average and adequate knowledge, respectively (p<0.001). Almost 95% of respondents from SHC with poor knowledge had uncontrolled BP, with average knowledge 68% and with adequate knowledge 44.8% (p<0.001) (figure 1).

**Factors associated with poor BP control**

Eight variables (marital status, education level, employment, duration of HT, using hypolipemic drugs, complications, number of drugs and knowledge of HT) showed a significant association with the respondents’ poor BP control using univariate logistic regression. These eight variables were analysed using a multivariate logistic regression to determine their independent influence on poor BP control (table 3). The model as a whole (with all factors) was statistically significant (p<0.0001). Statistically significant factors associated with poor BP control were knowledge (B=1.091; p<0.0001), number of drugs (B=0.536; p<0.0001) and complications (B=0.898; p=0.0004).

**DISCUSSION**

To the best of our knowledge, this is the first detailed study investigating the factors associated with poorly controlled BP among hypertensive patients in Serbia, as well as one of the few studies conducted in low-income and middle-income countries. Our findings indicate that the rate of well-controlled BP in individuals with HT is low in Serbia.
Table 1  Description of patient and antihypertensive medication characteristics from two study sites with different levels of healthcare

| Factors               | Variables                          | PHC, N (%) | SHC, N (%) | P value | Total, N (%) |
|-----------------------|------------------------------------|------------|------------|---------|--------------|
| **Patient-related factors** |                                    |            |            |         |              |
| Sociodemographic      | Age                                |            |            |         |              |
|                       | 20–45                              | 9 (2.7%)   | 8 (3.2%)   | U=37,174| 17 (2.9%)    |
|                       |                                    |            |            | p=0.015 |              |
|                       | 46–65                              | 158 (47.9%)| 92 (36.7%) |         | 250 (43.0%)  |
|                       |                                    |            |            |         |              |
|                       | ≥66                                | 163 (49.4%)| 151 (60.2%)|         | 314 (54.0%)  |
| Gender                | Male                               | 135 (40.9%)| 107 (42.6%)| χ²=0.174| 242 (41.7%)  |
|                       |                                    |            |            | p=0.677 |              |
|                       | Female                             | 195 (59.1%)| 144 (57.4%)|         | 339 (58.3%)  |
| Marital status        | Married                            | 243 (73.6%)| 177 (70.5%)| χ²=2.814| 420 (72.3%)  |
|                       |                                    |            |            | p=0.245 |              |
|                       | Single                             | 12 (3.6%)  | 5 (2.0%)   |         | 17 (2.9%)    |
|                       | Divorced/widow                     | 75 (22.7%) | 69 (27.5%) |         | 144 (24.8%)  |
| Educational status    | Primary                            | 157 (47.6%)| 153 (61.0%)| U=36,300| 310 (53.4%)  |
|                       |                                    |            |            | p=0.004 |              |
|                       | Secondary                          | 157 (47.6%)| 84 (33.5%) |         | 241 (41.5%)  |
|                       | Tertiary                           | 16 (4.8%)  | 14 (5.6%)  |         | 30 (5.2%)    |
| Occupational status   | Employed                           | 71 (21.5%) | 43 (17.1%) | χ²=5.898| 114 (19.6%)  |
|                       |                                    |            |            | p=0.052 |              |
|                       | Unemployed                         | 52 (15.8%) | 27 (10.8%) |         | 79 (13.6%)   |
|                       | Retired                            | 207 (62.7%)| 181 (72.1%)|         | 388 (66.8%)  |
| Clinical              | Visit to general practitioner in the last year |            |            |         |              |
|                       | Yes                                | 235 (71.2%)| 165 (65.7%)| U=37,467| 400 (68.8%)  |
|                       |                                    |            |            | p=0.038 |              |
|                       | No                                 | 95 (28.8%) | 86 (34.3%) |         | 181 (31.2%)  |
| Diabetes mellitus     | Yes                                | 116 (35.2%)| 76 (30.3%) | χ²=1.530| 192 (33.0%)  |
|                       |                                    |            |            | p=0.216 |              |
|                       | No                                 | 214 (64.8%)| 175 (69.7%)|         | 389 (67.0%)  |
| Hypolipemic drugs     | Yes                                | 87 (26.4%) | 86 (34.3%) | χ²=4.254| 173 (29.8%)  |
|                       |                                    |            |            | p=0.039 |              |
|                       | No                                 | 243 (73.6%)| 165 (65.7%)|         | 408 (70.2%)  |
| Complications         | Yes                                | 38 (11.5%) | 54 (21.5%) | χ²=10.695| 92 (15.8%)   |
|                       |                                    |            |            | p=0.001 |              |
|                       | No                                 | 292 (88.5%)| 197 (78.5%)|         | 489 (84.2%)  |
| Duration of HT        | Less than 5 years                  | 46 (13.9%) | 26 (10.4%) | U=34,173| 72 (12.4%)   |
|                       |                                    |            |            | p<0.001 |              |
|                       | 5–9 years                          | 78 (23.6%) | 44 (17.5%) |         | 122 (21.0%)  |
|                       | 10–14 years                        | 104 (31.5%)| 60 (23.9%) |         | 164 (28.2%)  |
|                       | ≥15 years                          | 102 (30.9%)| 121 (48.2%)|         | 223 (38.4%)  |
| Medication-related factors | Number of drugs                   |            |            |         |              |
|                       | One                                | 92 (37.7%) | 45 (18.9%) | U=35,346| 137 (23.6%)  |
|                       |                                    |            |            | p=0.002 |              |
|                       | Two                                | 114 (31.5%)| 86 (35.4%) |         | 200 (34.4%)  |
|                       | Three and above                    | 124 (30.8%)| 120 (45.7%)|         | 244 (42.0%)  |
|                       | HT treatment                       |            |            |         |              |
|                       | Monotherapy                        | 74 (22.4%) | 39 (15.5%) | χ²=7.373| 113 (19.4%)  |
|                       |                                    |            |            | p=0.025 |              |
|                       | Polytherapy in one tablet (fixed dosed) | 16 (4.8%)  | 6 (2.4%)   |         | 22 (3.8%)    |
|                       | Polytherapy                        | 240 (72.8%)| 206 (82.1%)|         | 446 (76.8%)  |

HT, hypertension; PHC, primary level of healthcare; SHC, secondary level of healthcare.
| Question                                                                 | PHC | SHC | P value | Total |
|------------------------------------------------------------------------|-----|-----|---------|-------|
| 120/80 mm Hg value of BP is normal                                      | 294 | 211 | 0.075   | 505   |
| When BP is higher than 140/90 mm Hg is called HT                       | 260 | 219 | 0.008   | 479   |
| A patient always has symptoms such as headache, dizziness and fatigue each time his/her BP is high | 283 | 225 | 0.162   | 508   |
| Both men and women have equal chances of developing HT                 | 231 | 94  | <0.001  | 325   |
| HT is a curable condition                                              | 256 | 143 | <0.001  | 399   |
| The older the person is, the greater their chances of having HT         | 143 | 136 | 0.010   | 279   |
| Smoking increases the chances of developing HT                         | 242 | 177 | 0.453   | 419   |
| Eating fatty foods increases the chances of developing HT              | 286 | 198 | 0.013   | 484   |
| Being overweight increases the chances of developing HT                | 292 | 185 | <0.001  | 477   |
| Regular physical activity reduces a person’s chances of developing HT  | 265 | 158 | <0.001  | 423   |
| Eating more salt has no effect on BP                                   | 112 | 132 | <0.001  | 244   |
| Dietary approaches to reduce HT do no good                              | 88  | 34  | <0.001  | 122   |
| Red meat is good for control of HT                                     | 161 | 99  | 0.025   | 260   |
| Medication alone can control HT                                        | 159 | 85  | 0.001   | 244   |
| HT can lead to other life-threatening diseases                          | 316 | 241 | 0.877   | 557   |

BP, blood pressure; HT, hypertension; PHC, primary level of healthcare; SHC, secondary level of healthcare.
(25.1%), which is in accordance with previous studies conducted in Serbia. This rate was the same or lower in comparison with the results from other European countries such as Romania 25%, Greece 32.8%, Belgium 45%, France 49.1%, whereas in the USA, more than 50% of patients with HT reached the target values of BP, that is, below 140/90 mm Hg (52.5%). Moreover, the latest study on worldwide trends in HT control showed that the control rates in 2019 were highest in South Korea, Canada and Iceland (>50%), followed by the USA, Costa Rica, Germany, Portugal and Taiwan. On the other hand, rates were below 10% in Nepal, Indonesia, sub-Saharan Africa and Oceania as well as in some countries in North Africa, Central and South Asia and Eastern Europe (Moldova). Furthermore, in the present study, the level of healthcare did not influence BP control. Namely, we found no differences between the study sites (PHC and SHC) in adequacy of BP control. Although systems that emphasise regular, ongoing primary care and have BP management guidelines in place should, in theory, have more success at controlling HT, the literature is unclear as to which systems of care provide superior care for patients with HT. Other studies also found no evidence that system of care or physician specialty achieved consistently better outcomes than others for patients with HT. Moreover, the high percentage of patients with poorly controlled BP in Serbia is alarming and requires attention. Especially considering that according to the latest 2021 report from the European Society of Cardiology (ESC), Serbia ranks seventh in terms of HT prevalence and ninth in terms of prevalence of stroke among 57 ESC member countries.

Although it is likely that similar processes exist in other parts of Serbia and the results of this study could be used as a basis for a larger survey which could attempt to confirm them in a broader setting. In addition, our respondents were in majority above the age of 66 and mostly retired, but Serbia has one of the largest elderly population segments in the world, with 17.2% of its citizens estimated to be 65 years and older.

In the present study, all patients had been diagnosed with HT at least 1 year before, and more than half of them (57.1%) showed only an average knowledge and 29.4%
of them showed a poor knowledge on the definition, lifestyle, treatment and complications of HT. Similarly, according to the research performed by various authors, knowledge on HT among patients is very poor.

In our study, knowledge was the poorest with regard to knowledge on diet and treatment and the best with regard to complications. In several other studies, the lowest knowledge levels were also found in the ‘diet’ domain, as in the present study. In contrast, other authors reported the highest knowledge levels in the ‘lifestyle’ domain.

The current study has revealed that respondents from SHC showed a significantly lower knowledge score compared with the respondents from PHC (p=0.001). One explanation for this may be in differences regarding sociodemographic variables between the two study sites: respondents from SHC most commonly had only primary education and 60% of SHC respondents were over 66 years. Similarly, the study from the USA revealed that medical knowledge level increased proportionally with increment in degree of education and decrement in age, whereas the results from Turkey confirmed only the effect of education on knowledge about HT but not the effect of age. This conflicting result can be due to the different effects of educational status on the medical knowledge of the countries with different level of industrialisation. Another explanation may be in variation in care. Many previous studies demonstrated that physicians with higher qualifications and longer duration of practice performed better in the case of HT treatment in comparison with doctors with lower qualifications. However, the evidence regarding advantages of specialist management in regard to patient outcomes is scarce. The significantly better knowledge score among PHC respondents who were cared by GPs and internists regarding the lifestyle domain was recorded for all statements with the exception of those related to sodium intake and smoking. Interestingly, SHC respondents were more knowledgeable about the benefit of lowering salt intake (p<0.001). Although less than 2300 mg/day sodium intake is generally recommended, Serbians consume a mean of 3900 mg/day. Moreover, in 2019, every 11th inhabitant of Serbia was adding salt to food before trying it (9.5%) and this habit did not change significantly from the 2013 and 2006 surveys. It may be difficult for GPs and internists to provide patient education at the same level as cardiologists, as demonstrated by the significant and large difference found in the well-known lifestyle modification factor, decreasing salt intake (p<0.01).

On the other hand, smoking cessation is recognised by all physicians at both study sites (PHC and SHC) as an important area of education. Although the smoking prevalence rate is declining over time in Serbia, it is still high. As WHO reported, the smoking rate in the Serbian adult population stood at 33% in 2019. There were only two other European countries with smoking rates exceeding the 30% threshold: Bulgaria (32%) and Croatia (31%). According to our own analysis as well as the opinions given by healthcare experts, smoking cessation is more widely promoted and acknowledged that changes to other lifestyle habits in Serbia, and BP control by patients may improve if the reduction in salt intake is recognised as being as important as smoking cessation.

One of the explanations could also be the increase in the percentage of the population who have their GPs during the last 20 years in Serbia. According to the results of the Serbian National Health Survey, a significant increase in the percentage of the adult population who had their GPs was recorded during the last 20 years. In 2019, 91.1% of the population over the age of 19 stated that they had their GP, whereas the respective percentage in 2013, 2006 and 2000 were: 91.7%, 50.6% and 43.3%, respectively. This increase is consistent with the strategy of the European Forum for Primary Care, according to which a strong PHC system is better prepared to provide comprehensive healthcare and effectively coordinate the follow-up of chronic conditions. The reported number of GPs is relatively high—71 per 100 000 population—when compared with neighbouring countries and with other countries in the region (51 in Croatia, 52 in Slovenia, 43 in Montenegro and 43 in Greece). The average number of adults (aged 19 years and older) listed per GP is 1430, which is reasonable for providing comprehensive GP services. In case of prevention and control of HT, PHC facilities including GPs can deliver a defined package of services consisting of information, education and communication related to a healthy lifestyle and proper nutrition. In addition, the study analysing the demographic inequalities in the utilisation of health service in Serbia showed that higher levels of PHC utilisation among the elderly and women, which is consistent with the demographic profile of the respondents in our study. Finally, the differences in patient’s knowledge score on HT between two study sites in Serbia may be due to the easier access to the PHC centres (PHC respondents), whereas access to cardiologists requires longer waiting times and shorter contact time (SHC respondents). Furthermore, diseases of the cardiovascular system are the most commonly registered diseases in PHC (18% of all registered cases in Serbia). Fewer than 20% of all consultations with specialists are first consultations; the remainder are follow-up visits after diagnostic tests. This creates some accessibility problems and an increasing number of cases are being reported of patients with non-communicable diseases having to wait more than 1 month for a consultation. Frequent and prolonged feedback at follow-up consultations is a key intervention tool used to alter patient behaviour.

Although some studies have been done on awareness in hypertensive patients in Serbia, however, these have mainly focused on risk factor identification for HT and not primarily on control of HT. Therefore, some of the most interesting conclusions are delivered from the logistic regression analysis conducted to determine patient-related, medication-related and healthcare system-related factors associated with uncontrolled BP.
The multivariate analysis demonstrated that knowledge on HT, complications of HT and the number of antihypertensive drugs were significant in controlling BP.

Knowledge has been a significant factor for poorly controlled BP, as with each higher degree of knowledge on HT respondents’ chance of poor control of BP decreased by 66%. A number of studies have shown that adequate patient’s knowledge on HT (including patient’s knowledge of their target BP) influences BP control. However, this correlation between patients’ knowledge about HT and control of their BP is not a consistent finding, with a study in Turkey and South Africa showing no significant relationship between patients’ HT knowledge score and actually having a controlled BP.

Additionally, we also found that patients treated with multiple antihypertensive drugs had greater chances of inadequate BP control. This is in accordance with many previous studies that demonstrated that patients on complex and multiple medications had poorer BP control more often compared with patients on one medication. This result could be explained by the fact that patients whose BP is more difficult to control are likely to be treated with multiple drugs. Among patients treated with multiple antihypertensive drugs, treatment with a pill containing low doses of two or more antihypertensive drugs were shown to lead to an increased proportion of patients achieving their target BP goal versus usual care. Use of such medication as initial therapy or to replace monotherapy may be an effective way to improve BP control and physicians should discuss with patients the potential complications of the disease, seek out the presence of such symptoms and when they occur, modify therapy. Therefore, fixed-dose combination therapy has the potential to address this barrier to improve BP control. Moreover, the 2018 guidelines of the European Society of Hypertension and the ESC shifted the preferred treatment strategy from a step-based approach towards a single pill combination-based strategy in case of uncontrolled BP. Also, above-mentioned lifestyle changes have a pivotal role in reducing the number of medications among hypertensive patients, as well as the dosages of antihypertensive drugs.

The multivariate analysis also demonstrated that respondents with complications of HT had 1.7 times the likelihood of poorly controlled BP compared with those without complications. Despite the fact that 95.9% of respondents in our study sample claimed that HT can lead to other life-threatening diseases, 64.9% of the respondents with complications of HT had poorly controlled BP. Thus, there is a difference between knowledge and practice, which means that although knowing what can be done, they do not act according to such knowledge. The impact of complications on HT control has not been examined extensively in large studies. Few studies demonstrated no significant association between BP control and history of cardiovascular/cerebrovascular disease. In contrast, in the study of Knight et al., a history of myocardial infarction or angina or congestive heart failure in patients with HT was associated with better BP control.

Limitations
Several limitations of the study deserve mention. First, our respondents were in majority above the age of 66 years and mostly retired, but Serbia has one of the largest elderly population segments in the world, with 17.2% of its citizens estimated to be 65 years or older. Second, because self-administered questionnaires are used instead of face-to-face interviews that are considered the gold standard method for survey administration, there is a possibility that participants may have over-reported or under-reported socially desirable behaviours. Thirdly, because BP control was assessed on only one point office reading, it could be subjected to many variables. People with HT often experience a spike in BP when the reading is taken in a physician’s office, leaving doctors with inaccurate information to determine the course of treatment and the status of BP control. To account for this ‘white coat effect’, researchers found significantly greater accuracy when several BP readings were combined from measurements taken at home or in the doctor’s office.

CONCLUSION
This study provides a framework for identifying hypertensive patients who are at high risk of poor control. Therefore, special attention should be given to patients with complications and those with multiple antihypertensive drugs treatment. Furthermore, patients with poor knowledge on HT should be informed more about their disease, especially on lifestyle modification, to enable them to participate more in their own management. Many of the factors identified may be amenable to improvement. These data provide further evidence that poor BP control is common in a variety of healthcare settings and that patients at particular risk of poor control can be identified. Targeted interventions to improve management in such patients could make a substantial difference in stemming the epidemic of poorly controlled HT in Serbia.

Author affiliations
1Department of Pharmacology and Toxicology, Faculty of Medicine Novi Sad, University of Novi Sad, Novi Sad, Serbia
2Health Center “Dr Janoš Hadži” Bačka Topola, Novi Sad, Serbia
3Institute of Cardiovascular Diseases of Vojvodina, Sremska Kamenica, Serbia, University of Novi Sad, Faculty of Medicine, Novi Sad, Serbia
4Department of Veterinary Medicine, Faculty of Agriculture, University of Novi Sad, Novi Sad, Serbia

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contributed to the writing and critical revision of the paper. OH is the guarantor. All authors have read and approved the final manuscript.

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Patient consent for publication Consent obtained directly from patient(s)

Ethics approval This study involves human participants. The survey protocol was approved by the ethics committee of the Faculty of Medicine in Novi Sad (approval number 01-39/2/1), the ethics committee of the Primary Health Care Centers of both municipalities (approval numbers 01-1493 and 2252019-1). Participants gave informed consent to participate in the study before taking part.

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ORCID iD Milica Paut Kusturica http://orcid.org/0000-0003-0972-5115

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