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Hypertension in working age population: influence of gender and education

Introduction Hypertension is the most common cardiovascular disease (CVD) and a major cause of premature death. Studies of age/gender-related and social aspects of the disease and assessment of the efficacy of antihypertensive treatment are essential elements of epidemiological monitoring of hypertension. These studies are necessary to support a reasonable approach to planning further therapeutic and preventive interventions.

Objective Assess the prevalence of hypertension in the working-age population and to examine the relationship between hypertension patterns and level of education of respondents taking into account age, gender, and the main aspects of lifestyle.

Materials and Methods The study included industrial workers who underwent a routine medical examination in September – November 2015. A total of 2432 subjects (59% males and 41% of females) were surveyed. The study design was cross-sectional and analytical. Anonymous surveys using the WHO STEPS questionnaire, anthropometric measurements, and BP measurements were analyzed. Questions about hypertension included awareness of the presence of the disease and the administration of antihypertensive drugs. Hypertension was diagnosed if systolic blood pressure (SBP) ≥140 mmHg and/or diastolic blood pressure (DBP) ≥90 mmHg, or if antihypertensive drugs had been prescribed. The efficacy of treatment was assessed by the percentage of patients who reached the target BP values (<140/90 mmHg), including those treated with antihypertensive drugs. Control of hypertension was judged by the percentage of patients with the target BP values among all respondents with hypertension.

Results Hypertension was diagnosed in 40% of the study subjects. The disease was more prevalent in males (odds ratio (OR)=1.21), in overweight, and obese patients (OR=2.5) and was less prevalent in subjects with higher education (OR=0.6). No significant association of lifestyle, i.e., smoking, alcohol abuse, eating fruits and vegetables, physical activity with the prevalence of hypertension was revealed. 76% of respondents with hypertension knew about their disease. Of those who did not take antihypertensive drugs, this value was 51%. Awareness was higher in patients with severe hypertension (OR=2.5), in overweight and obese patients (OR=1.96), and among respondents with higher education (OR=1.55). Awareness was significantly lower in males (OR=0.44). 50% of respondents with hypertension and 52% of responders with severe hypertension took antihypertensive drugs. Among those taking drugs, the number of males was 50% of the number of females (OR=0.49). Regardless their lifestyle, target BP values were detected in 39% of patients taking antihypertensive drugs. Target values were detected less frequently in males (OR=0.63) and in overweight patients (OR=0.48), and significantly more frequently in patients with higher education (OR=2.28).

Conclusion The prevalence of hypertension in working patients was 40%. Males were more likely to suffer hypertension and to be less aware of their disease. The target blood pressure values were less frequently observed in males during the treatment. On the other hand, patients with higher education had a lower prevalence of hypertension, were significantly more aware of the disease, and the efficacy of treatment than those with secondary or primary school education. Overall, the study confirmed that a sample of industrial workers could be a reliable source for monitoring hypertension. Significant gender differences and an independent protective effect of the level of education were identified in the epidemiology of hypertension. These should be taken into account in future studies.

Keywords Hypertension; working age; gender differences; level of education; target blood pressure; efficacy of treatment

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Introduction

Hypertension is the most common chronic disease. High blood pressure (BP) is considered to be a major preventable cause of premature death and disability worldwide [1, 2]. The increasing incidence of hypertension is a major cause of the global epidemic of cardiovascular diseases and chronic kidney disease. It entails a serious burden on the healthcare system and increases financial costs to society [3]. In recent decades, the prevalence of hypertension has increased in low- and middle-income countries and has not changed or has decreased in developed countries [4]. The key factor for the prevention of hypertension-related complications is to achieve a target BP with adequate treatment [5, 6]. Clinical studies have shown that antihypertensive treatment reduced the risk of CHD, stroke, heart failure, and all-cause mortality in patients with hypertension [6]. In recent decades, antihypertensive treatment has played an essential role in reducing cardiovascular mortality in the United States and other developed countries [7]. The International Society of Hypertension identified improving hypertension control as a priority in the management of non-communicable diseases [8].

The World Health Organization (WHO) reported that, in 2014, hypertension was diagnosed in every third resident of the Russian Federation over 18 years old [9]. In 1993–2013, a negligible but statistically significant increase in the incidence of hypertension was observed in the Russian Federation due to more hypertensive male patients [10]. A large-scale epidemiological study (ESSE-RF) was carried out in 9 regions of the Russian Federation in 2012–2013 to assess the prevalence of risk factors for non-communicable diseases and hypertension. The study sample (15,300 subjects) was drawn from the population attached to public healthcare facilities [11]. The ESSE-RF study revealed significant regional variability in the prevalence of risk factors for non-communicable diseases and the epidemiology of hypertension, with the Sverdlovsk Region not included in the studied territories. These features and constraints of the national epidemiological data mostly defined the objectives of this study.

It should be noted that, in the recent decade, considerable efforts to improve hypertension control were made at the federal and regional levels. These included high-quality international and national clinical guidelines available for healthcare professionals, a full range of modern antihypertensive drugs presented in the Russian Pharmacopoeia, and development of affordable prevention and population screening programs.

Thus, it is essential, from a scientific and practical perspective, to assess the efficacy of the measures taken, such as, achieving the target BP and to explore factors associated with control of hypertension. In addition, planning of future preventive and therapeutic measures requires identification of the most vulnerable population groups with a high prevalence and poor control of hypertension, while taking into account age, gender, and social characteristics. The ESSE-RF study and a number of other studies showed lower treatment adherence in males, especially of younger age. These studies also found that the degree of hypertension control depends on the level of education, which may be a marker of a particular lifestyle [10–12].

In general, the original Russian data on the association of education level and of other social and demographic factors with hypertension control are quite limited. Moreover, in the context of reducing premature cardiovascular mortality, it is particularly important to analyze hypertension patterns in the working population who are likely not to seek medical attention and are poorly aware of their high BP. The study of hypertension in the population attached to the public healthcare facilities can result in erroneous findings due to higher morbidity of respondents and lower coverage of the working population. A sample of the organized working-age population, i.e., employees of industrial enterprises, was used in this study to prevent these constraints.

Objective

Assess the prevalence of hypertension and the degree of BP control in working-age people, taking into account gender, age, and level of education.

Materials and Methods

The study was organized by the Sverdlovsk Regional Center for Medical Prevention and conducted at the Yekaterinburg Medical Research Center for Prevention and Health Protection of Industrial Workers of Rospotrebnadzor, at the Health Center of JSC Uralelectromed in Verkhnyaya Pyshma, and at the Scientific and Production Corporation Uralvagonzavod in Nizhny Tagil.

Respondents were employees of industrial enterprises of Ekaterinburg and Sverdlovsk region 18 years and older, who underwent a routine medical examination in September – November, 2015.

A total of 2,432 subjects (59.4% males and 40.6% females) were surveyed. Their median age was 45 years (18–78 years).

Gender/age structure of the sample differed from the Russian working-age population [13] with a prevalence of males and a significantly larger number of 45–49 year old subjects, 24.2% in the sample vs 8.4% in the Russian Federation (Fig. 1). 70% of the subjects had secondary and/or vocational education, 26% had higher and/or

undergraduate education, and 4% had not finished secondary school.

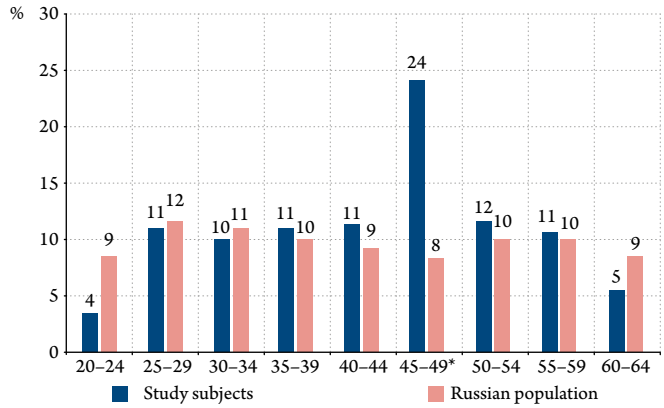
The sample size was determined using OpenEpi 3.03 [14]. Recommendations of the working group of the global survey of the prevalence of tobacco smoking as a risk factor of chronic non-communicable diseases were used as methodical guidelines [15].

Calculations took into account the likely prevalence of the main outcomes studied, according to the current WHO data at the time of the study: 39.5% smoking, 33.3% hypertension, 62.0% overweight and obesity [9]. Bias was limited to 3%. Given the clustered nature of the sampling, a design effect equal to two was used, i.e., the estimated number of participants was doubled in order to compensate for the possible impact of a grouping effect on the prevalence and patterns of the studied outcomes. As a result, the largest sample value was selected with a 95% confidence interval (CI) of 2,047 subjects. Given possible loss of data, the final sample size was increased by 20%, up to 2,456 subjects. The study design was cross-sectional. Methods were anonymous questionnaire, tonometry, and measurements of weight, height, and waist circumference.

The WHO STEPS instrument was used to develop the questionnaire [16]. The typical STEPS was adapted and reduced without loss or misrepresentation of the structure and content. The questionnaire included 15 questions about gender, age, education, smoking, consumption of alcohol, consumption of vegetables and fruits, duration of daily walking, awareness of the presence of hypertension, and information on prescription of antihypertensive drugs. The questionnaire was also developed to collect objective data on BP, height, weight, and waist circumference. The question about smoking distinguished between subjects who smoked every day (at least a cigarette almost every day for a month or more) and those who smoked less frequently. Consumption of more than 10 and 5 units of alcohol per week was considered hazardous for males and females, respectively [17, 18].

Key recommendations for a balanced diet include regular consumption of vegetables and fruits, specifically at least 500 g/day (≥5 servings), excluding potatoes [17], or at least 200 g/day (2–3 servings) [19]. In this study, a daily intake of fewer than five servings of vegetables and/or fruits was considered insufficient. BP was measured twice on either arm with an interval of not less than 3 min. The mean value of the two measurements was recorded. Hypertension was diagnosed if SBP ≥140 mmHg and/or DBP ≥90 mmHg, or if antihypertensive drugs were taken. The efficacy of treatment was assessed by the percentage of respondents who had reached the target BP values (<140/90 mmHg) among all patients treated with antihypertensive drugs. The hypertension control

Figure 1. The age structure of the study respondents compared with the working-age population of the Russian Federation



** – the difference is significant, p<0.0001.*

was judged by the percentage of patients with target BP values among all respondents with hypertension. Based measurements of height and weight, BMI was calculated using the formula: BMI (kg/m^2). = body weight/height^2. BMI was interpreted according to WHO guidelines [20]. Criteria used were overweight, BMI ≥25 kg/m^2; preobesity, BMI 25–29.9 kg/m^2; obesity, BMI ≥30 kg/m^2.

Statistical data were processed with Gretl-2015d. Quantitative variables are presented as means and standard deviations or, in the case of an abnormal distribution, as medians and semi-interquartile ranges. Interactions between hypertension patterns and other factors (gender and age, smoking, alcohol abuse, obesity, education) were analyzed with multivariate regression modeling using either linear or logistic regression. The degree of association was expressed in terms of the corrected coefficients or odds ratio (OR) with 95% CI. The influence of the studied factors was considered significant if $p<0.05$.

Results and Discussion

Blood pressure values

The median SBP was 124 mmHg, and the median DBP was 80 mmHg. The mean BP values were higher in males than in females. As compared with the nationwide data, the mean BP values were lower, particularly in males (Table 1).

Median BP values in respondents with higher education were significantly lower than in subjects with primary or secondary education, 120/72 mmHg vs 125/77 mmHg. Multivariate analysis confirmed an independent association between BP and the respondents' gender and education with independent effects of age, weight, and alcohol consumption. SBP, adjusted for use of antihypertensive drugs, was consistently higher in older age groups, in males (by 8 mmHg), in overweight patients, and with alcohol abuse (by 3 mmHg). Patients with higher education had corrected SBP lower by 3.3 mmHg (Table 2). Eating

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vegetables and fruits, level of physical activity, and smoking status did not independently affect BP.

Correlation of education with BP was identified in a series of studies [21–23]. A relatively low level of education is generally considered a social marker associated with unhealthy diets, smoking, alcohol abuse, high level of occupational stress, and low income. In this study, the level of education had an effect on SBP regardless of the respondents' lifestyle. This suggests an independent, protective effect of higher education and its correlation with economic and occupational factors.

Prevalence of hypertension

Hypertension was diagnosed in 40% of the respondents (41% males and 39% females), including grade 1 hypertension, 69%; grade 2 hypertension, 22%; grade 3 hypertension, 9%. These findings, both total and in males, were slightly lower than for the nationwide data (Table 1). There was a steady increase in the incidence of hypertension with age, from 7% in patients under 25 years to 75% in patients 65 years and older.

Multivariate analysis confirmed independent associations of weight, age and male gender with the diagnosis of hypertension (Table 3). Inadequate intake of fruits and vegetables was associated with the diagnosis of hypertension as well, but this association was not statistically significant. No convincing association was identified between the presence of hypertension and risk factors such as alcohol abuse, smoking, and low physical activity.

This could be explained by a truly weak effect of the listed factors in the study sample or the result of less accurate or biased self-assessment by the surveyed respondents. On the other hand, chances that subjects with higher education would have hypertension were 40% lower, regardless of lifestyle, gender, weight, and age (Table 3).

Awareness of the presence of hypertension

Among all patients with hypertension, 76% were aware that they had high BP (85% of females and 70% of males). In other words, 24% of respondents with hypertension first learned of their high BP during the study. The aware patients had all been informed about their high BP by a healthcare professional or were patients treated with antihypertensive drugs. These findings were slightly higher than the results of the ESSE-RF study (Table 1).

Among patients with hypertension who did not take antihypertensive drugs, only 51% had been aware of high BP (49% males and 55% females), i.e., half of them first learned of their diagnosis during the study. As compared with data from 8 years ago, the awareness of hypertension in the Sverdlovsk Region increased by 1.5–2 times. In 2007, 50% of respondents were aware of their hypertension; 34% were males, and 62% were females [24].

Table 1. Hypertension patterns in the working population vs the general Russian population

Parameter		SR*	RF**
Median SBP, mmHg	Total	124	130.7
	Male	126	135.0
	Female	120	127.5
Median DBP, mmHg	Total	80	81.6
	Male	81	84.1
	Female	80	80.0
Prevalence of hypertension, %	Total	39.8	44.0
	Male	40.6	48.2
	Female	38.7	40.8
Awareness of hypertension,%	Total	75.7	73.1
	Male	70.0	67.6
	Female	84.6	78.9
Awareness of hypertension among patients who did not receive antihypertensive drugs, %	Total	51.2	–
	Male	49.4	–
	Female	55.7	–
Treatment with antihypertensive drugs among all patients with hypertension, %	Total	50.3	50.5
	Male	40.7	39.5
	Female	65.2	60.9
Treatment with antihypertensive drugs among all patients aware of their high BP, %	Total	65.9	–
	Male	57.8	–
	Female	76.5	–
Efficacy of treatment with antihypertensive drugs, %	Total	39.1	49.2
	Male	33.3	41.4
	Female	44.7	53.5
Control of hypertension, %	Female	19.4	22.7
	Male	13.4	14.4
	Female	28.8	30.9

* - SR, Sverdlovsk region, data of this study;
** - ESSE-RF data (mean values).
SBP, systolic blood pressure; DBP, diastolic blood pressure.

On the other hand, among those who knew about their diagnosis of hypertension and did not take antihypertensive drugs, 44% had normal BP at the time of the survey. These respondents might have been incorrectly diagnosed with hypertension, or a healthcare professional had registered a situational increase in BP. Based on these data, respondents' awareness of the presence of hypertension cannot be considered a reliable epidemiological criterion for the disease control.

Multivariate analysis revealed an independent association of weight, age, high BP, male gender, and level of education with awareness of hypertension (Table 4). Awareness among older, overweight, and obese respondents was higher than in subjects with BP ≥160/100 mmHg (grade 2 and 3 hypertension). Male patients were significantly less aware of their high BP

than females (OR=0.44), and higher education was independently associated with greater awareness (OR = 1.55) (Table 4).

Thus, the most significant factor influencing the awareness of hypertension, besides the age of the respondents, was a substantial, and probably symptomatic, increase in BP, which forced the respondents to more actively seek medical attention. The association of overweight and obesity with a greater awareness of hypertension can be explained by the higher morbidity of such patients and also by their seeking medical aid more frequently. Greater awareness among patients with higher education could be a result of more access to medical care, a more proactive approach to health maintenance, and the intrinsic effect of education. However, this study did not focus on confirming these suggestions.

Table 2. Factors independently associated with SBP

Factor	mmHg*	95% CI	p
Administration of antihypertensive drugs	12.2	10.1-14.2	<0.001
Male	8.1	6.8-9.4	<0.001
Alcohol abuse	2.8	0.56-5.1	0.014
BMI (per each additional kg/m^2)	0.6	0.43-0.75	<0.001
Age (per each additional year)	0.4	0.27-0.39	<0.001
Higher education	-3.3	-4.6 – -2.1	<0.001

* – adjusted rates, multiple linear regression adjusted for heteroscedasticity. BP, blood pressure; CI, confidence interval; BMI, body mass index.

Table 3. Factors independently associated with hypertension

Factor	OR*	95% CI	p
Overweight and obesity	2.5	2.04-3.06	<0.001
Diet poor in fruits and vegetables	1.28	0.97-1.68	0.08
Male	1.21	1.0-1.46	0.049
Age (per each additional year)	1.07	1.06-1.08	<0.001
Higher education	0.6	0.49-0.76	<0.001

*– adjusted odds ratio, multiple linear regression. OR, odds ratio; CI, confidence interval.

Table 4. Factors independently associated with the awareness of hypertension

Factor	OR*	95% CI	p
Severe hypertension (BP ≥160/100 mmHg)	2.5	1.65-3.78	<0.001
Overweight and obesity	1.96	1.39-2.78	<0.001
Higher education	1.55	1.01-2.40	0.048
Age (per each additional year)	1.03	1.01-1.05	<0.001
Male	0.44	0.31-0.63	<0.001

* – adjusted odds ratio, multiple linear regression. BP, blood pressure; OR, odds ratio; CI, confidence interval.

Administration of antihypertensive drugs

50% of respondents with hypertension took antihypertensive drugs. There were more females than males (65% vs 41%), which was comparable with the findings of the ESSE-RF study (Table 1). Compared to the 2007 data, administration of antihypertensive drugs increased by almost 10% in the Sverdlovsk region [24]. A regular increase in the incidence of hypertension with age was also revealed, from 26% in patients under 35 years to 76% in patients above 64 years old. Among respondents aware of hypertension, 66% took antihypertensive drugs (78% females and 58% males), while only 52% of respondents with severe hypertension (grade 2 and 3) took antihypertensive drugs (61% females and 47% males).

Multivariate analysis confirmed a significant gender-related difference in adherence to drug treatment of hypertension. Female patients previously diagnosed with hypertension took antihypertensive drugs twice as frequently as male patients (OR = 0.49), regardless of age and presence of severe hypertension (Table 5). No convincing association of lifestyle and level of education with administration of antihypertensive drugs was identified.

Efficacy of treatment with antihypertensive drugs

39% of patients with hypertension achieved the target BP, <140/90 mmHg. The efficacy of treatment was higher in females than in males (45% vs 33%). These findings were approximately 10% lower than the nationwide data [11] (Table 1). In the past 8 years, the efficacy of hypertension treatment increased more than 5 times in the Sverdlovsk Region (from 8% to 40%) [24], which reflects the general trend in the Russian Federation [10], although it remains insufficient. In developed countries, the number of patients with controlled hypertension has reached 60–70% [25, 26]. For example, the NHANES study (2009-2012) found that the target BP values were achieved in 68.9% of US patients receiving antihypertensive drugs [12]. In Canada, the efficacy of hypertension treatment was 66% in 2009 [27] and is projected to increase to 78% in 2020 [28].

Patients with higher education more frequently had target BP values, 56% vs 34% (p<0.05) of those with

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primary or secondary education. This pattern remained after adjusting for the respondents' lifestyle, gender, and weight. The adjusted odds to achieve the target BP values in more-educated patients were 2.3 times higher, regardless of other factors.

Male gender and overweight were independently associated with low efficacy of antihypertensive treatment (Table 6). No convincing association of smoking, alcohol consumption, physical activity, and diet with efficacy of antihypertensive treatment was identified.

The independent effect of education on the efficacy of antihypertensive treatment generally agrees with the findings of Russian and international studies. For example, one of the factors associated with inadequate efficacy hypertension treatment in Russia in 1993–2013 was a low level of education [10]. The protective effect of higher education is often attributed to the association with a higher living standard, which in turn contributes to a healthy lifestyle and maintaining a normal BP [23]. According to the US National Center for Health Statistics, the level of hypertension control in people with high socioeconomic status, i.e., income more than 400% of the minimum subsistence level, is significantly higher than in those with income below subsistence line (43.2% vs 30.2%) [28]. In addition to correlation with the level of living standards, education can have its own protective effect due to the

Table 5. Factors independently associated with the administration of antihypertensive drugs in patients with previously diagnosed hypertension

Factor	OR*	95% CI	p
Age (per each additional year)	1.05	1.03-1.07	<0.001
Severe hypertension (BP ≥160/100 mmHg)	0.45	0.31-0.63	<0.001
Male	0.49	0.35-0.69	<0.001

* – adjusted odds ratio, multiple linear regression.
BP, blood pressure; OR, odds ratio;
CI, confidence interval.

Table 6. Factors associated with the target BP in patients treated with antihypertensive drugs

Factor	OR*	95% CI	p
Higher education	2.28	1.43-3.63	<0.001
Male	0.63	0.43-0.92	0.017
Overweight and obesity	0.48	0.29-0.79	0.004

* – adjusted odds ratio, multiple linear regression.
BP, blood pressure; OR, odds ratio;
CI, confidence interval.

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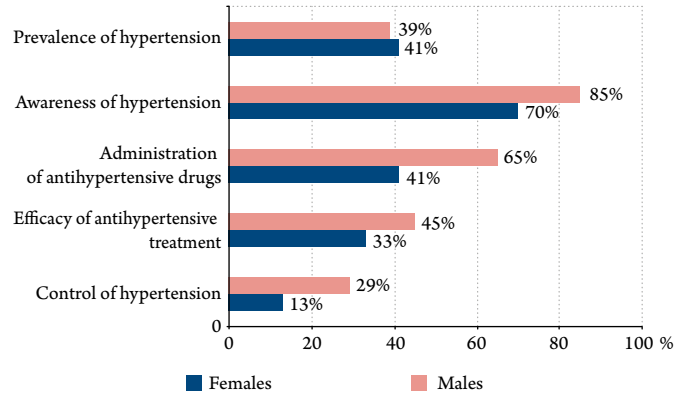
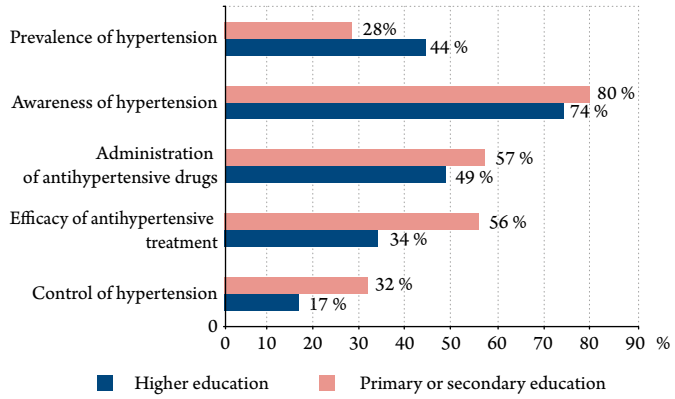
Figure 2. Gender-dependent epidemiology of hypertension



The differences are significant except for the prevalence of hypertension, p<0.05.

Figure 3. Education-dependent epidemiology of hypertension



All differences are significant, p<0.05.

development of healthy behavior and a more conscious attitude to treatment.

The influence of other factors also agrees with the disease presentation and does not contradict the world literature. Worse control of hypertension in overweight patients was to be expected. Shalnova et al. also noted the role of obesity as a factor reducing the efficacy of antihypertensive treatment [10]. Low efficacy of antihypertensive drugs in males must be studied separately, since it is gender-related specifics of behavior and effects of professional factors that affect efficacy rather than genetic peculiarities.

Control of hypertension

Hypertension, whether treated or not with antihypertensive drugs, was controlled (BP <140/90 mmHg) in 19% of all patients. Specifically, hypertension was more often controlled in females than in males (29% vs. 13%). This is comparable with the nationwide findings of ESSE-RF study (Table 1). Thus, the overwhelming majority (80%) of patients with hypertension had not achieved target BP values. The world literature generally shows a similar situation. A systematic review of the population-based studies of hypertension epidemiology carried out in 90 countries in 2005–2014 showed that hypertension was controlled in only 13.8% of cases. In high-income countries, the control rate of hypertension was significantly higher than in the low- and middle-income countries (28.4% vs 7.7%) [3, 25, 26].

In this study, suboptimal population-based control of hypertension was primarily due to low awareness of high BP. 24% of respondents were first diagnosed with hypertension during the study. Only 49% of respondents who did not take antihypertensive drugs were aware of their high BP), suggesting lack of preventive screening tonometry in asymptomatic patients. Control of the disease was also reduced due to low adherence to antihypertensive drug therapy. Only 52% of patients with severe hypertension took antihypertensive drugs. Reduced control of hypertension was also due to low efficacy of drug therapy, since only 39% of patients treated with antihypertensive drugs had target BP.

Conclusion

Arterial hypertension was diagnosed in 40% of working subjects. The prevalence of hypertension was higher in older, overweight, and obese patients, in males, and in patients with primary or secondary education.

76% of patients with hypertension were aware of their disease, and 50% were treated with antihypertensive drugs. Only 19% of all patients with hypertension had target BP <140/90 mmHg, whereas 39% of patients treated with antihypertensive drugs achieved target BP. As compared with female patients, fewer males were aware of their hypertension. Fewer males took antihypertensive drugs, and their target BP was more rarely achieved with drug treatment (Figure 2). Patients with higher education had lower SBP, lower prevalence of hypertension, better awareness of the disease, and better efficacy of antihypertensive treatment, regardless of their lifestyle (Figure 3).

The identified epidemiological patterns of hypertension are generally comparable with Russian and international findings, which suggests that a routine professional examination of the working population is a reliable tool for surveying and monitoring hypertension. At the present time, a cardiovascular prognosis can be substantially improved, which is an additional argument for the thorough study of hypertension in this population group. This study identified patients who are in particular need of early diagnosis and more effective control of hypertension. These patients are male workers with primary or secondary education.

The study revealed several positive changes from the epidemiological data of 8 years ago, such as higher awareness

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of the presence of hypertension and more patients treated with antihypertensive drugs achieving target BP. This generally agrees with Russian and international trends in surveying and monitoring of the disease. On the other hand, 44% of respondents, who had been informed by healthcare professionals about high BP, had normal BP without taking antihypertensive drugs, suggesting overdiagnosis of the disease. However, the prevalence of hypertension remains high in the Russian Federation, and the total number of patients who achieve target BP is low, about 20%.

Overall, results of this study may be useful for researching the comparative epidemiology of hypertension in a gender-related and social context and for planning preventive and treatment programs aimed at improving control of the disease in both the general and working populations. Given the identified, strong independent effect of educational level on the epidemiology of hypertension, we can recommend this parameter for surveying and monitoring the disease along with conventional risk factors. The mechanism by which education prevents and improves the course of hypertension needs to be studied further. In particular, whether a higher level of education is an independent protective factor, or whether it acts as a marker associated with higher income and/or a relatively low level of professional stress should be determined.

Limitations of the study

This study was carried out on a sample of the working population of an industrial region, i.e., all respondents were actively employed by large enterprises and organizations. In terms of social characteristics, this sample differs from the general working-age population. Relatively many respondents were 45–49 years old, so the study results should be extrapolated carefully to the general population. The cross-sectional design of the study does not allow us to clearly establish a causal link between a higher level of education and superior epidemiology of hypertension, although the identified association can guide further observational and experimental studies.

No conflict of interest is reported.

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