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The interrelation of hypertension, dyslipidaemia, and their combination with sociodemographic and behavioural factors

Yu. I. Grinshtein, V. V. Shabalin, R. R. Ruf

Prof. V. F. Voino-Yasenetsky Krasnoyarsk State Medical University, Krasnoyarsk 660022, Russian Federation

The aim of the research. The aim of this research was to analyse the associations between the risk factors of dyslipidaemia and the combination of dyslipidaemia and hypertension.

Material and Methods. In a randomised sample of 1,603 urban and rural Krasnoyarsk Krai inhabitants aged 25-64 years, we determined the prevalence of hypertension, dyslipidaemia, a combination of hypertension and dyslipidaemia, and the risk factors of dyslipidaemia. With backward-stepwise logistic regression, we analysed the associations between the risk factors of dyslipidaemia and a combination of hypertension and dyslipidaemia.

Results. The male gender (odds ratio 1.49), older age (odds ratio 1.08), and obesity (odds ratios 2.57 for an increased body mass index and 2.28 for an increased waist circumference) had significant associations with a combination of hypertension and dyslipidaemia. Additionally, low physical activity had a negative association (odds ratio 0.24) with combination of hypertension and hypertriglyceridemia.

Conclusion. The male gender, older age, and obesity, known as risk factors of dyslipidaemia, also contribute to an elevated risk of a combination of dyslipidaemia and hypertension. This highlights the importance of implementing preventive and therapeutic strategies for individuals with these risk factors.

Key words: hypertension, dyslipidaemia, lipitension, dyslipidemic hypertension, cardiovascular risk factors, ESSE-RF.

Conflict of interest. The authors declare the absence of obvious and potential conflicts of interest associated with the publication of this article.

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Introduction

The interrelations of hypertension and dyslipidaemia between each other and with the other social, demographic, and behavioural factors have been the subject of research since 1980s [1].

While global mean blood pressure has remained relatively stable or slightly decreased over the past four decades, the prevalence of hypertension (HTN) has increased, particularly in low- and middle- income countries. Established risk factors for HTN include alcohol consumption, lack of physical activity, overweight, and obesity. Other factors, such as smoking, are considered potential risk factors due to weak or moderate associations reported in observational studies [2].

Dyslipidaemia is known for its impact on cardiovascular events and adverse outcomes. The Mendelian randomisation trial conducted by Zanetti et al. in 2020 confirmed the contribution of low-density lipoprotein (LDL), triglycerides (TG), lipoprotein A, and apolipoprotein B to cardiovascular morbidity and mortality. Conversely, high-density lipoprotein (HDL) was found to be a biological marker rather than a risk factor [3]. Established risk factors for dyslipidaemia include behavioural habits (diet, physical activity, smoking, and alcohol consumption) as well as sociodemographic parameters such as residence, economic wellbeing, and educational background [4, 5].

To describe the combination of HTN and dyslipidaemia as a single entity, J. J. Dalal et al. proposed term "lipitension," emphasising the need for active and simultaneous diagnosis and management of these two global cardiovascular risk factors [6].

Classical epidemiological studies such as the Framingham Study [1], have shown that the combination of HTN and dyslipidaemia multiplies cardiovascular risk up to three times. Other studies have highlighted the interrelations of HTN and dyslipidaemia with social, demographic, anthropometric, and behavioural factors such as gender, age, overweight, and physical activity [7, 8].

The Russian ESSE-RF (Epidemiological Survey of cardiovascular diseases in different regions of the Russian Federation) multicentre study reported a 76.1% prevalence of dyslipidaemia among the Russian population [9] and approximately 44 % having HTN [10]. In Krasnoyarsk Krai specifically, HTN was found in 49.4% of individuals, while 40.0% had a combination of HTN and dyslipidaemia. The prevalence of this combination varied by age and gender [11]. Additionally, multivariate regression models revealed the associations between dyslipidaemia and age, gender, alcohol consumption, smoking, and obesity, as well as associations between hypertension and age, obesity, and hyperglycaemia [12]. Therefore, the question remains whether the associations with known risk factors differ for lipitension compared to HTN and dyslipidaemia alone.

Material and Methods

For the ESSE-RF study [13], we recruited 1,603 individuals aged 25-64 years using stratified multistage randomisation from the population of Krasnoyarsk and Beryozovka. The recruitment continued from January to November 2014.

The study was approved by the Independent Ethics Committee. All participants provided informed consent, completed a survey, and underwent anthropometry, office blood pressure measurement, and biochemical blood tests.

The standardised questionnaire consisted of 12 modules based on adapted international methods. It covered sociodemographic status, economic and educational

background, behavioural factors, and the presence of health abnormalities including chronic diseases [13].

The blood samples were obtained from each participant after a median fasting period of 11 hours. Subsequently, the samples underwent centrifugation, refrigeration, and transportation to the federal study centre for analysis. The levels of cholesterol, LDL, HDL, and TG were measured using enzymatic methods with the Abbott Architect c8000 automatic analyser.

We defined hypertension as a blood pressure reading of 140/90 mmHg or higher, or use of antihypertensive medication for at least two weeks before enrolling in the study.

We diagnosed hypercholesterolemia if the measured cholesterol level was higher than 5.0 mmol/l or if the patient reported taking lipid-lowering medication in the questionnaire. For LDL, 3.0 mmol/l and more was an elevated level. When triglyceride level exceeded 1.7 mmol/l, we diagnosed hypertriglyceridemia. A level of HDL less than 1.0 mmol/l in males and 1.2 mmol/l in females we considered as low.

In the statistical calculations using IBM SPSS v 26, we implemented backward-stepwise logistic regression models. The dependent variable was a combination of HTN and dyslipidaemia, and the explanatory variables included sociodemographic and behavioural factors: gender, age, excess fat intake, smoking, alcohol consumption, general (body mass index at 30.0 kg/m^2 and higher) and abdominal (waist circumference greater than 80 cm in females and 94 cm in males) obesity, and physical activity measured by the standardised CINDI questionnaire.

Results and Discussion

The randomised sample included 652 males (39.4%) and 951 females (60.6%) from the Krasnoyarsk Krai population. The detailed distribution of age and gender in the sample is shown in Table 1.

The prevalence of HTN in the sample was at 49.4% (n=792) and 641 (40.0%) individual had HTN combined with at least one lipid profile disorder. A combination of HTN and elevated cholesterol level was found in 507 individuals (31.6%) and 518 (32.3%) individuals had a combination of elevated LDL level and HTN. In 173 (10.8%) subjects we found a combination of low HDL level and HTN. Hypertriglyceridemia combined with HTN was found in 263 (16.5%) persons.

The prevalence of specific lipid profile disorders, alone and in combination with HTN, varied depending on age and gender [15].

The prevalence of behavioural factors included in the regression model is described in Table 2.

Logistic regression analysis revealed significant associations for increased body mass index and abdominal obesity with HTN alone and all combinations of HTN with lipid profile disorders.

Age was associated with a slightly increased risk of HTN and its combinations with dyslipidaemia, except for a decreased HDL level.

Male gender was associated with HTN alone and its combinations with dyslipidaemia.

There was no significant association between physical activity level and lipid profile disorders, except for hypertriglyceridemia combined with HTN and low physical activity.

Excessive alcohol intake, excessive fat intake, and smoking were associated neither with HTN alone, nor with its combination with dyslipidaemia.

The details of significant associations are shown in Table 3.

In the randomised sample of Krasnoyarsk Krai population, there was a significant association between male gender and HTN. The similar odds ratio of male gender we observed for the combination of HTN and hypertriglyceridemia.

Table 1

Gender and age distribution in the randomised sample of Krasnoyarsk Krai population

Age group	Male	Female	Total
25-34	196 (12.2%)	264 (16.6%)	460 (28.8%)
35-44	161 (10.0%)	261 (16.3%)	422 (26.3%)
45-54	124 (7.7%)	196 (12.2%)	320 (19.9%)
55-64	169 (10.5%)	232 (14.5%)	401 (24.5%)

Table 2

The prevalence of behavioural factors included in the regression model

Factor	Prevalence
Excess fat intake	430 (26.8%)
Smoking	409 (25.5%)
Excess alcohol consumption	30 (1.9%)
Obesity	524 (32.7%)
Abdominal obesity	941 (58.7%)
Low physical activity	720 (44.9%)

Table 3

The results of multivariant logistic regression

Variable	HTN	HTN + any DL	HTN + eCHO	HTN + eLDL	HTN + dHDL	HTN + eTG
Male gender	2.30 (1.71-3.08); p <0.001	1.49 (1.12-1.99); p=0.006	NS	NS	NS	2.27 (1.60-3.22); p <0.001
Age	1.08 (1.07-1.10); p <0.001	1.08 (1.07-1.09); p <0.001	1.08 (1.07-1.10); p <0.001	1.07 (1.06-1.09); p <0.001	NS	1.05 (1.04-1.07); p <0.001
Obesity	3.01 (2.13-4.26); p <0.001	2.57 (1.85-3.56); p <0.001	1.78 (1.29-2.46); p <0.001	1.61 (1.17-2.22); p=0.003	2.54 (1.62-4.00); p <0.001	2.35 (1.60-3.44); p <0.001
Abdominal obesity	2.09 (1.50-2.90); p <0.001	2.28 (1.63-3.20); p <0.001	2.03 (1.43-2.88); p <0.001	2.30 (1.62-3.26); p <0.001	2.84 (1.59-5.05); p <0.001	3.43 (2.04-5.77); p <0.001
Low physical activity	NS	NS	NS	NS	NS	0.24 (0.08-0.69); p=0.008

The table demonstrates odd ratios, 95% confidence intervals, and p-value for each explanatory variable. NS – not significant (p >0.05). HTN – Hypertension; DL – Dyslipidemia; eCHO – elevated cholesterol level; eLDL – elevated low-density lipoprotein level; dHDL – decreased high- density lipoprotein level; eTG – elevated triglyceride level. Obesity is the measured body mass index at 30 kg/m^2 or higher; Abdominal obesity is the measured waist circumference greater than 80 cm for women and 94 cm for men; Low physical activity is the low level of physical activity according to CINDI questionnaire.

Our findings align with the study conducted by Chinese authors [4] who observed the association of male gender with a higher risk of dyslipidaemia. The studies from Pakistan [8] and Poland [14] confirmed a higher prevalence of both dyslipidaemia and HTN in males. Conversely, in Nigeria HTN and dyslipidaemia were more prevalent in females [7].

The older age was associated with a slightly increased risk of HTN and all its combinations with dyslipidaemia, except for a combination of lowered HDL level and HTN.

Chinese researchers demonstrated even stronger positive associations between age and dyslipidaemia [4], while the Polish study found no significant associations with age [14]. In Nigeria, significant associations of age with elevated total cholesterol and triglycerides were observed only in individuals younger than 65 years [7].

Our study has demonstrated significant associations of increased body mass index (obesity) and waist circumference (abdominal obesity) with a higher risk of HTN and its combinations with dyslipidaemia. These findings are consistent with the other industrial region of Siberia [15], as well as studies from China [4] and Poland [14]. However, the Nigerian study reported inconsistent findings in this regard [7].

Interestingly, Polish authors reported a significant association between hypertension and elevated triglyceride levels and the time spent in front of a computer (more than two hours daily) [15]. Contrarily, in our study, low physical activity measured with a standardised questionnaire associated negatively with a combination of HTN and hypertriglyceridemia.

Conclusion

The established risk factors for dyslipidaemia have significant associations with both dyslipidaemia alone and its combination with hypertension. This underscores the importance of preventative measures, accurate diagnosis, and effective management of these risk factors.

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Author information

Yuri I. Grinshtein, Dr.Med.Sci., Professor, Prof. V. F. Voino-Yasenetsky Krasnoyarsk State Medical University; Address: 1, Partizan Zheleznyak Str., Krasnoyarsk, Russian Federation 660022; Phone: +7(902)9904664; e-mail: grinstein.yi@mail.ru, http://orcid.org/0000-0001-8847-235X

Vladimir V. Shabalin, Cand. Med. Sci., Associate Professor, Prof. V. F. Voino-Yasenetsky Krasnoyarsk State Medical University; Address: 1, Partizan Zheleznyak Str., Krasnoyarsk, Russian Federation 660022; Phone: +7(913)5679158; e-mail: vlshabalin@yandex.ru, http://orcid.org/0000-0001-8002-2362

Ruslan R. Ruf, Cand.Med.Sci., Prof. V. F. Voino-Yasenetsky Krasnoyarsk State Medical University; Address: 1, Partizan Zheleznyak Str., Krasnoyarsk, Russian Federation 660022; Phone: +7(913)1817866; e-mail: kromsolog@gmail.com, http://orcid.org/0000-0003-1753-6816

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