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Original article

Relationship between perceived stress and levels of blood pressure: single center study

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Summary

Introduction. High blood pressure (HBP) is a significant cardiovascular risk factor, with hypertension recognized as a leading cause of global mortality. This study aims to investigate the correlation between perceived stress and blood pressure levels among patients diagnosed with hypertension.

Methods. A cross-sectional study was conducted involving 80 hypertensive patients at the Institute for Cardiovascular Diseases "Dedinje". Comprehensive clinical examinations, including 24-hour ambulatory blood pressure monitoring (ABPM) and Perceived Stress Scale (PSS) assessments were performed.

Results. The results revealed a significant positive correlation between PSS scores and blood pressure levels ($r = 0.65$, $p < 0.001$), indicating that higher perceived stress is associated with elevated blood pressure. Furthermore, no statistically significant difference was found between stress levels and sex or smoking status.

Conclusion. These findings underscore the importance of stress management interventions in hypertension treatment, suggesting that addressing perceived stress could enhance therapeutic outcomes for patients.

Keywords: high blood pressure, perceived stress, ambulatory blood pressure monitoring, cardiovascular health

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Introduction

High blood pressure (HBP) is an important cardiovascular risk factor, with hypertension experts still debating threshold at which the specific BP should be deemed abnormal. Currently, it is widely accepted, based on extensive epidemiological and intervention studies, that blood pressure levels of ≥140/90mmHg are indicative of hypertension [1]. Ambulatory blood pressure monitoring (ABPM) is recognized as the gold standard for diagnosing hypertension [2]. According to the European Society of Hypertension practice guidelines, hypertension is diagnosed when a 24-hour ABP exceeds 130/80 mmHg, awake ABP surpasses 135/85 mmHg, and/or sleep ABP exceeds 120/70 mmHg. For ABPM to be considered valid, it must include at least 70% valid measurements or encompass 20 valid daytime readings alongside seven valid nighttime readings [3].

Arterial hypertension is responsible for approximately 10 million deaths worldwide annually, and is widely considered to be a leading factor contributing to the overall global disease burden of disease [4]. In the modern era, psychological stress has garnered increasing recognition as a significant risk factor for the onset and exacerbation of various diseases, including hypertension. Lifestyle modifications are universally recommended for individuals with elevated blood pressure levels [5]. Among the recommended non-pharmacological interventions, stress reduction is considered to be one of the most important factors in the management of hypertension [6].

Chronic medical conditions are often associated with the relatively high prevalence of anxiety, mood disorders, and other mental illnesses, highlighting the overall impact of psychological stress on cardiovascular diseases. The perceived level of stress reflects an individual's response to stressors, encompassing various life aspects such as work, family dynamics, financial concerns, interpersonal relationships, and daily responsibilities. Researches indicate that both stress and lifestyle choices are significant risk factors for the development and exacerbation of hypertension. The "fight or flight" response is an automatic physiological reaction to an event that is perceived as stressful or frightening and it makes heart rate and blood pressure levels increase. Indirectly, stress can influence blood pressure through unhealthy behaviors, including poor diet, physical inactivity, and substance abuse.

The World Health Organization (WHO) defines an individual's quality of life as the perception of their position within society, considering the cultural and value systems they live in, and how this relates to their goals [7]. This broad perspective highlights how quality of life intricately influences physical and mental health, personal beliefs, and social interactions. Therefore, understanding the intricate relationship between perceived stress and blood pressure levels is pivotal for the development of more effective preventive and interventional strategies [7, 8].

The primary aim of this study is to investigate the correlation between perceived stress and blood pressure levels.

Methods

Our cross-sectional study enrolled 80 consecutive patients diagnosed with hypertension who sought care at Institute for Cardiovascular Diseases "Dedinje", Center for Hypertension, from October 1st 2023 to February 1st 2024. Demographic data including sex, age, and smoking status were recorded for all patient who also subsequently underwent a comprehensive clinical examination featuring 24-hour ambulatory blood pressure monitoring, recognized as the premier clinical tool for blood pressure measurement. Additionally, all patients were given a Perceived Stress Scale (PSS) questionnaire* to complete during their appointment. The study was performed

in accordance to the ethical principles outlined in the Declaration of Helsinki.

The PSS is a widely utilized questionnaire designed to evaluate an individual's perception of stress in recent times. The inception of the PSS in 1983 marked its significance in understanding the impact of various situations on emotions and stress perception. This questionnaire inquires about the patients' feelings and thoughts over the preceding month and their frequency. PSS scores ranging from 0 to 13 denote a low stress level; scores from 14 to 26 suggest a moderate stress level, while scores from 27 to 40 indicate a high exposure to stress (Questionnaire*).

Statistical Analysis

Results are presented as count (%), mean ± standard deviation depending on data type. Data Analysis included student's t-test and one-way ANOVA to analyze differences in means between groups, Pearson's chi-squared test was used to analyze the differences of distribution of discrete variables, and Spearman's rank correlation coefficient for correlations between continuous variables. All p-values less than 0.05 were considered significant. All data were analyzed using SPSS 29.0.

***Questionnaire**

Perceived stress scale (PSS)

For each question choose from the following alternatives:

0 - never, 1 - almost never, 2 - sometimes, 3 - fairly often, 4 - very often

_____ 1. In the last month, how often have you been upset because of something that happened unexpectedly?
_____ 2. In the last month, how often have you felt that you were unable to control the important things in your life?
_____ 3. In the last month, how often have you felt nervous and stressed?
_____ 4. In the last month, how often have you felt confident about your ability to handle your personal problems?
_____ 5. In the last month, how often have you felt that things were going your way?
_____ 6. In the last month, how often have you found that you could not cope with all the things that you had to do?
_____ 7. In the last month, how often have you been able to control irritations in your life
_____ 8. In the last month, how often have you felt that you were on top of things?
_____ 9. In the last month, how often have you been angered because of things that happened that were outside of your control?
_____ 10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

*For answers under serial number 4, 5, 7 and 8 score values 0=4; 1=3; 2=2; 3=1; 4=0. The PSS score is based on the individual's self-assessment.

Results

Our study included, 45 females and 35 males with an average age of 59.2±7.5 and 56.4±6.4, respectively. Within the male cohort there were 19 smokers and 16 non-smokers, while in the female cohort there were 23 smokers and 22 non smokers (Table 1).

Table 1. General demographic characteristics of study cohort

Age	57.6±12.2
Smoking (yes)	41 (51.2%)
PSS Score	23.8±7.5
Systolic BP (mmHg)	125.9±12.9
Diastolic BP (mmHg)	75.9±14.1

All values presented as n (%) or mean ± SD depending on variable.

The average PSS score in our study cohort was 23.78, which was indicative of moderate stress levels. Further analysis, revealed no statistically significant correlation between PSS scores and age (p=0.7), suggesting that stress perception was not age-dependent in this study population. Notably, we observed a significant positive correlation between PSS scores and blood pressure levels ($r = 0.65$, $p < 0.001$), indicating that higher stress perceptions were associated with elevated blood pressure. Additionally, when stratifying the cohort by stress levels as indicated by their PSS score, we observed the statistically significant difference in systolic blood pressure between the groups ($p<0.001$). Conversely, there was no the statistically significant difference observed between sex and stress levels (p=0.22). Similarly, analysis showed that there was also no the statistically significant difference in PSS scores between smokers and non-smokers (p=0.15), suggesting that smoking status alone did not influence perceived stress.

Discussion

In today's dynamic world, stress has become an ubiquitous component of daily life, elevating the significance of its impact on blood pressure [9]. While stress is not a direct cause of hypertension, it can influence its onset and further progression. Hypertension, in 95% of cases, is classified as "essential," where the exact cause is unknown, highlighting the importance of identifying contributing factors. Stress may exacerbate hypertension through repeated elevations in blood pressure and by stimulating the nervous system to produce vasoconstrictors, which in turn raise blood pressure. Moreover, when one risk factor is coupled with other stress-producing factors, the effect on blood pressure is multiplied [10, 11, 12]. Previous studies have shown that stress is not only associated with hypertension, but also with a broader spectrum of cardiovascular diseases [13, 14].

The pathophysiological mechanisms of stress involve a complex interplay between the brain, autonomic nervous system, and endocrine system, leading to metabolic, inflammatory, and hemostatic abnormalities. The brain plays a pivotal role in mediating stress responses, interpreting external stimuli, and determining what constitutes a stressor [15]. Current evidence suggests that sensitivity and response to stress are modulated by a variety of genetic and epigenetic factors. However, it still remains unclear whether perceived stress is associated with hypertension.

Interestingly, in our study we observed a marginally lower stress level in smokers compared to non-smokers. While this difference was not statistically significant, it is suggestive of a potential trend worthy of further investigation.

In our study of 80 patients we found a positive correlation between PSS scores and blood pressure indicating that higher perceived stress levels were associated with an increased blood pressure levels in patients with hypertension. Similarly, Palagini et al also found a positive

correlation between hypertension and PSS scores [16]. Contrary to our findings, studies by Li et al and Hassoun et al showed that there was inverse relationship between perceived stress and blood pressure [17, 18]. Moreover, in a large cohort study conducted by Wiernik et al, it was concluded that perceived stress was associated with higher BP, but only when occupational status was excluded [19]. Furthermore, a study by Schneider et al suggested that non-pharmacologic reduction of stress could be associated with long-term decreases in mortality in older populations having high blood pressure [20].

Interestingly, our study observed a marginally lower stress level in smokers compared to non-smokers, though this difference was not statistically significant, suggesting a potential trend worthy of further investigation.

Conclusion

Our findings highlight a significant link between perceived stress and hypertension, indicating that heightened stress levels may contribute to increased blood pressure. This further supports the advantages for incorporating stress management interventions into both the prevention and treatment of hypertension. The integration of psychotherapeutic approaches could potentially enhance the efficacy of conventional medical therapies in hypertensive patients. By targeting stress as a modifiable risk factor, healthcare practitioners have the opportunity to improve cardiovascular health outcomes in individuals with hypertension.

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Ethical approval. The Ethics Committee of the Institute for Cardiovascular Diseases "Dedinje"approved the study and informed consent was obtained from all individual respondents. The research was conducted according to the Declaration of Helsinki.

Conflicts of interest. The authors declare no conflict of interest.

References:

1. Gupta R. Hypertension in India--definition, prevalence and evaluation. J Indian Med Assoc 1999;97(3):74–80.
2. Krakoff LR. Cost-effectiveness of ambulatory blood pressure: a reanalysis. Hypertension 2006;47(1):29–34.
3. Yusuf S, Hawken S, Ôunpuu S, Dans T, Avezum A, Lanas F, et al. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. Lancet 2004;364(9438):937–52.
4. Hengel FE, Sommer C, Wenzel U. Arterial hypertension. Dtsch Med Wochenschr 2022;147(7):414–28.
5. Elliott WJ. Systemic hypertension. Curr Probl Cardiol 2007;32(4):201–59.
6. Mahmood S, Shah KU, Khan TM, Nawaz S, Rashid H, Baqar SW, et al. Non-pharmacological management of hypertension: in the light of current research. Ir J Med Sci 2019;188(2):437–52.
7. Achangwa C, Lee TJ, Park J, Lee MS. Quality of life and associated factors of international students in South Korea: A cross-sectional study using the WHOQOL-BREF instrument. Healthcare Basel 2022;10(7):1262.
8. Cantín M. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. Reviewing the latest version. Int J Med Surg Sci 2014;1(4):339–46.

9. de la Sierra A. Ambulatory blood pressure monitoring is a useful tool for all patients. Hipertens Riesgo Vasc 2017;34(1):45–9.

10. Harris KM, Gaffey AE, Schwartz JE, Krantz DS, Burg MM. The Perceived Stress Scale as a measure of stress: decomposing score variance in longitudinal behavioral medicine studies. Ann Behav Med 2023;57(10):846–54.

11. Naik GS, Gaur GS, Pal GK. Effect of modified slow breathing exercise on perceived stress and basal cardiovascular parameters. Int J Yoga 2018;11(1):53–8.

12. Kulkarni S, O'Farrell I, Erasi M, Kochar MS. Stress and hypertension. WMJ 1998;97(11):34–8.

13. Valenzuela PL, Carrera-Bastos P, Gálvez BG, Ruiz-Hurtado G, Ordovas JM, Ruilope LM, et al. Lifestyle interventions for the prevention and treatment of hypertension. Nat Rev Cardiol 2021;18(4):251–75.

14. Gao Y, Rong H, Zhang Y, Yuan M, Xu Y, Ma J. Perceived stress in Chinese patients with coronary heart disease: a cross-sectional study. BMJ Open 2022;12(3):e051419.

15. McEwen BS, Gianaros PJ. Central role of the brain in stress and adaptation: links to socioeconomic status, health, and disease. Ann N Y Acad Sci 2010;1186:190–222.

16. Palagini L, Bruno RM, Cheng P, Mauri M, Taddei S, Ghiadoni L, et al. Relationship between insomnia symptoms, perceived stress and coping strategies in subjects with arterial hypertension: psychological factors may play a modulating role. Sleep Med 2016;19:108–15.

17. Hassoun L, Herrmann-Lingen C, Hapke U, Neuhauser H, Scheidt-Nave C, Meyer T. Association between chronic stress and blood pressure: findings from the German Health Interview and Examination Survey for Adults 2008–2011. Psychosom Med 2015;77(5):575–82.

18. Li D, Rong C, Kang Q. Association between perceived stress and hypertension in Chinese adults: a population-based survey. J Hum Hypertens 2023;37(4):321–6.

19. Wiernik E, Pannier B, Czernichow S, Nabi H, Hanon O, Simon T, et al. Occupational status moderates the association between current perceived stress and high blood pressure: evidence from the IPC cohort study. Hypertension 2013;61(3):571–7.

20. Schneider RH, Alexander CN, Staggers F, Rainforth M, Salerno JW, Hartz A, et al. Long-term effects of stress reduction on mortality in persons≥ 55 years of age with systemic hypertension. Am J Cardiol 2005;95(9):1060–4.

Odnos između uočenog stresa i nivoa krvnog pritiska: studija centra

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Uvod. Visok krvni pritisak (VKP) je značajan kardiovaskularni faktor rizika, pri čemu se hipertenzija prepoznaje kao vodeći uzrok globalnog mortaliteta. Cilj ove studije je istražiti povezanost između percipiranog stresa i nivoa krvnog pritiska kod pacijenata kojima je dijagnostikovana hipertenzija.

Metode. Sprovedena je studija preseka koja je obuhvatila 80 hipertenzivnih pacijenata u Institutu za kardiovaskularne bolesti „Dedinje." Izvršeni su sveobuhvatni klinički pregledi, uključujući 24-časovno ambulantno praćenje krvnog pritiska (ABPM) i procenu "Perceived Stress Scale" (PSS).

Rezultati. Rezultati su pokazali značajnu pozitivnu korelaciju između PSS skora i nivoa krvnog pritiska ($r = 0,65$, $p < 0,001$), što ukazuje da je veći percipirani stres povezan sa povišenim krvnim pritiskom. Takođe, nije pronađena statistički značajna razlika između nivoa stresa i pola ili statusa pušenja.

Zaključak. Ovi nalazi naglašavaju važnost intervencija za upravljanje stresom u lečenju hipertenzije, sugerišući da bi adresiranje percipiranog stresa moglo poboljšati terapijske rezultate kod pacijenata.

Ključne reči: visok krvni pritisak, percipirani stres, ambulantno praćenje krvnog pritiska, kardiovaskularno zdravlje