Determinants of Elevated Blood Pressure Among Young Adults in Indonesia

Vita Widyasari[1(✉)] and Okti Ratna Mafruhah[2,3]

[1] Cluster of Public Health Science, Faculty of Medicine, Universitas Islam Indonesia, Yogyakarta, Indonesia
`vita.widyasari@uii.ac.id`
[2] Department of Pharmacy, Universitas Islam Indonesia, Yogyakarta, Indonesia
[3] School of Pharmacy and Graduate Institute, China Medical University, Taichung, Taiwan

Abstract. Based on the results of the RISKESDAS 2018, the prevalence of hypertension in people aged > 18 years has increased from 25.8% (2013) to 34.1% (2018). Several factors, especially modifiable factors, need to be further identified to prevent an increase in blood pressure in young adults. The objective of this study was to identify related factors of elevated blood pressure (BP) among young adults in Indonesia. This is a cross-sectional study using the national population survey, Indonesia Family Live Survey (IFLS) 2014–15 wave 5. Only those who were 26 to 35 years old were included in the analyses. Elevated BP was defined as mean systole $\geq$ 120mmHg and diastole $\geq$ 80mmHg based on three times measurements. Odds Ratio (OR) with the Confidence Interval of 95% (95% CI) was calculated to determine factors associated with elevated BP in young adults. Among 7,250 young adult participants, 3,732 (51,5%) participants had elevated BP. Men were 2.64 times more likely to have elevated BP than women (95% CI 2.39–2.92). Education background $\leq$ 12 years (OR = 1.35, 95% CI 1.20–1.52), abnormal BMI (OR = 1.46, 95% CI 1.32–1.60), smoking habit (OR = 2.09, 95% CI 1.88–2.31), strenuous physical activity (OR = 1.41, 95% CI 1.26–1.58) and soda consumption (OR = 1.20, 95% CI 1.06–1.35) were also identified as predictors of elevated BP. In conclusion, elevated BP in young adults was associated with gender, education, BMI, smoking habit, strenuous physical activity, and soda consumption.

Keywords: Elevated Blood Pressure · Young Adult · Risk Factor

1 Introduction

Hypertension is a chronic disease characterized by elevated blood pressure (BP) to be 140/90 mmHg or higher [1]. Currently, hypertension remains the leading risk factor for mortality and disability worldwide accounting for a total of 10.4 million deaths per year and 218 million DALYs, respectively [2]. Although hypertension is a preventable and modifiable disease with a healthy lifestyle and good medication adherence, its prevalence is steadily high and consistently increased particularly in Low- and Middle- Income Countries (LMICs) in the last decade [3]. In 2010, around 30% of adults (or 1.39 billion) in the world were estimated to have hypertension. The majority of them (1.04 billion)

came from LMICs, and one of fourth were young adults age 20–40 years [3]. Those numbers may be greater since the hypertension definition has been changed by American Heart Association (AHA) in 2017 [4].

Having hypertension before age 40 years is harmful to health. A study among young adults reports the incidence rates of cardiovascular disease of people who have elevated BP, stage 1, and stage 2 hypertension increase 2.7, 3, and even 8 times per 1000 person-years, respectively. Although having elevated BP at a younger age is an absolutely risky condition, however, the young adults group may have a lower perceived risk. For example, in the United States, younger adults with ages between 18 and 39 years are reported have lack awareness of high BP. They are less likely to have hypertension monitoring, and intend to have late diagnosis of hypertension [5]. In LMICs, only one-third of young adults are considering hypertension prevention, and less than 10% have control their BP [6]. Although those are big potential problems for the future health system, lack of data about hypertension determinants leads the slow prevention and treatment for young adults [7].

Similarly, with other LMICs, Indonesia with high population of adults also faces same problems with hypertension prevalence and recognizing of its determinants. According to the Indonesia national survey (RISKESDAS) 2018 results, the prevalence of hypertension in people over the age of 18 has increased from 25.8% in 2013 to 34.1% in 2018 [8]. Only a few of study with big sample size has been done to identify elevated BP determinants in Indonesia. The previous studies have been identified several determinants of hypertension among adults more than age 40 years [9] based on national survey data and adolescents [10] from twelve high schools in a province. However, only a regional study has been conducted among young adults in 2017, and none of the current study has updated the findings on nationwide scale. As hypertension determinants among age groups may have differences [11], it is very important to identify the determinants among young adults in Indonesia who have elevated BP based on a national survey. Those will give a significant contribution to future prevention efforts, especially on modifiable factors, among healthcare providers, policy makers, and the general population. This study aimed to identify related factors of elevated BP among young adults in Indonesia.

2   Method

2.1   Source of Data

This was a cross-sectional study using secondary data. The data was analyzed from Indonesia Family Life Survey (IFLS), a longitudinal demographic and health survey. The first wave survey began in 1993, the data collected from two focuses, household, and community, at 13 out of 27 Indonesian provinces [12] (now, Indonesia is divided into 34 provinces). The location of survey was divide in three regions, Sumatra land (South Sumatra, West Sumatra, Lampung, East Sumatra), Java land (DKI Jakarta, West Java, Central Java, East Java) and other land (Bali, Nusa Tenggara Barat, Sulawesi Selatan, Kalimantan Selatan). The sample covered 83% of the population in Indonesia. The sample of this study was collected from IFLS wave 5 that was conducted from

September 2014 – July 2015 [13]. The complete version of the IFLS research design can be found at http://www.rand.org/labor/FLS/IFLS.html.

2.2 Research Variables

1) **Sociodemographic**. Sociodemographic factors included age, gender, educational background, marital status, and living area. A young adult was defined as someone between the ages of 26 and 35 [14]. Gender was divided into two categories: male and female. The educational background was divided into two categories: less than equal with 12 years and more than 12 years. Marital status was divided into four categories: unmarried, married, widow (divorce by law), and widow (the spouse passed away). The living area was then divided into two categories: urban and rural.

2) **Physical examination**. BP and Body Mass Index (BMI) was examined. The trained interviewers took three consecutive systolic and diastolic BP measures at home in a seated position using an Omron meter, HEM-7203. The majority of the time, a regular-sized cuff was utilized, but large cuffs were accessible when required. The initial BP measurement was examined at the beginning of the research interview, followed by two further examinations throughout the session. The current study is limited to people who had the BP measurement. The mean BP was derived arithmetically for the three readings of each systolic and diastolic BP. Based on JNC 7, elevated BP was defined as mean systole $\geq$ 120mmHg and diastole $\geq$ 80mmHg [15]. BMI was calculated by dividing weight in kilograms by height in meters square. Normal BMI was defined as having a BMI between 18.5 and 25. BMI less than or greater than these thresholds were considered abnormal.

3) **Lifestyle and eating behavior** Smoking, strenuous activity, instant noodle consumption, soda consumption, and fried food consumption were included in the lifestyle and eating behavior category. Smoking was classified as either yes or no. The strenuous activity was calculated as yes if the respondent engages in strenuous activities such as cycling while carrying heavy objects, hoeing, digging, and so on for at least 10 min on seven consecutive days. Consumption of instant noodles, soda, and fried foods was counted as yes if it occurred within the last 7 days.

2.3 Statistical Analysis

Basic characteristics of participants were presented with numbers with percentages and mean with standard deviation. The odds ratio (OR) with 95% confidence interval (95% CI) and p-value was used to calculate the association of the risk factors with elevated BP. All analyses were performed using SPSS for the Windows version.

2.4 Ethical Clearance

The authors used secondary data from the IFLS 5 to conduct the research. A reviewer committee from Institutional Review Boards (IRB) at RAND Corp. in the United States and Universitas Gadjah Mada (UGM) in Indonesia reviewed and approved the IFLS 5 questionnaires and its procedures. In the initial interviews, all participants gave their

written informed consent. Participants' personal information was kept anonymous and confidential. The dataset can be downloaded for free after registering on RAND Labor and Population's website at http://www.rand.org/labor/FLS/IFLS/download.html.

3 Result and Discussion

A total of 7,250 people between the ages of 26 and 35 were enrolled in the study. Females, with an education of less than or equal to 12 years, married, and residing in urban areas dominated the sociodemographic profile. Elevated BP was reported in 51.50 percent of respondents, while abnormal BMI was found in 43.48 percent. Smokers as well as those who engaged in strenuous physical exercise each contributed 30.46 percent and 20.41 percent of the total. More than half of those polled consumed instant noodles and fried foods but did not consume soda in the previous seven days (see Table 1).

Table 1. Basic Characteristics Of Participants

Variable	Frequency (%)
Sociodemographic	
Gender	
Male	2,747 (37.89)
Female	4,503 (62.11)
Age (mean, SD)	30.44 (2.79)
Education background	
≤ 12 years	5,910 (81.52)
> 12 years	1,340 (18.48)
Marital status	
Unmarried	764 (10.54)
Married	6,266 (86.43)
Widow (divorced by law)	189 (2.61)
Widow (the spouse passes away)	31 (0.43)
Living area	
Urban	4,313 (59.49)
Rural	2,937 (40.51)
Physical examination	
Blood pressure	
Elevated BP	3,731 (51.50)
Normal BP	3,519 (48.50)
BMI	

(*continued*)

Table 1. (*continued*)

Variable	Frequency (%)
Abnormal	3,152 (43.48)
Normal	4,098 (56.52)
Lifestyle and eating behavior	
Smoking	
Yes	2,208 (30.46)
No	5,042 (69.54)
Strenuous physical activity	
Yes	1,480 (20.41)
No	5,770 (79.59)
Instant noodle consumption	
Yes	5,262 (72.58)
No	1,988 (27.42)
Soda consumption	
Yes	1,387 (19.13)
No	5,863 (80.87)
Fried food consumption	
Yes	4,789 (66.06)
No	2,461 (33.94)

Table 2. Factors Associated With Elevated Blood Pressure

Variable	Elevated BP Frequency	Normal BP Frequency	OR	95% CI	p-value
Sociodemographic					
Gender					
Male	1,817	930	2.643	2.394–2.917	< 0.001
Female	1,914	2,589			
Education					
≤ 12 years	3,123	2,787	1.349	1.198–1.520	< 0.001
> 12 years	608	732			
Marital status					
Unmarried	491	273	1		

Table 2. (*continued*)

Variable	Elevated BP Frequency	Normal BP Frequency	OR	95% CI	p-value
Married	3,137	3,129	1.794	1.535–2.097	< 0.000
Widow (divorced by law)	87	102	2.109	1.528–2.910	< 0.000
Widow (the spouse passes away)	16	15	1.686	0.821–3.463	0.155
Living area					
Urban	2,179	2,134	0.911	0.830–1.001	0.052
Rural	1,552	1,385			
Physical examination					
BMI					
Abnormal	1,789	1,363	1.457	1.327–1.600	< 0.000
Normal	1,942	2,156			
Lifestyle and eating behavior					
Smoking					
Yes	1,413	795	2.089	1.884–2.315	< 0.000
No	2,318	2,724			
Strenuous physical activity					
Yes	862	618	1.410	1.257–1.583	< 0.000
No	2,869	2,901			
Instant noodle consumption					
Yes	2,716	2,546	1.023	0.922–1.134	0.671
No	1,015	973			
Soda consumption					
Yes	764	623	1.197	1.064–1.346	0.003
No	2,967	2,896			
Fried food consumption					
Yes	2,445	2344	0.953	0.865–1.050	0.333
No	1,286	1175			

Table 2 presents the data of the factor associated with elevated BP. The odds ratio and 95% confidence intervals are shown. Male had 2.64 times the chance of having elevated BP than females (95% CI 2.39–2.92). When compared to non-smokers, smoking contributed more than twice as much to having elevated BP (OR = 2.09, 95% CI 1.88–2.31). Strenuous physical activity (OR = 1.41, 95% CI 1.26–1.58) and drinking soda (OR = 1.20, 95% CI 1.06–1.35) were also found to be predictors of elevated BP. Married and widowed respondents had a significant association with elevated BP when compared

to unmarried respondents. Living area, consumption of instant noodles and fried foods did not show a significant association.

4   Discussion

The term "elevated BP" was used because the physical examination only performed in a single visit, even though it has been done three times in a row. To confirm the diagnosis of hypertension, 2–3 office visits at 1–4-week intervals (depending on the BP level) are usually required. If the BP is 180/110 mm Hg and there is evidence of cardiovascular disease, the diagnosis may be made in a single visit [16].

According to the findings, a variety of preventable and irreversible factors can influence the elevated BP of young adult respondents in Indonesia. Physical performance, as well as lifestyle and eating habits, are all factors that can be managed in the future to lower the risk of hypertension and other cardiovascular diseases.

Our study shows that men have more elevated BP. These results are also in line with many other studies [17-19]. Women are more aware of hypertension than males, and men have a higher prevalence of hypertension until beyond menopause [20-22]. The role of the kidneys, the renin–angiotensin system, relaxin, and developmental programming are all being investigated in new investigations into the mechanisms that cause sex/gender disparities in hypertension [20]. Elevated BP was also linked to a lack of knowledge. A similar study conducted in Korea came to the same conclusion. When it compares to individuals with higher level of education, those with less than 12 years of school had a 1.13 to 3.85 higher risk of hypertension [19].

In our study, soda consumption was linked to higher BP in young individuals. Consumption of sugar-sweetened beverages (SSB) was substantially related with an elevated risk of hypertension in patients with a BMI of more than 25 kg/m2, according to a study by Kwak et al. [23]. Whereas the mechanisms by which a higher SSB intake increases the risk of high BP are unknown. There are various possibilities for the link between SSB intake and incident high BP. Excess sugar consumption, particularly fructose, can cause acute and long-term increases in blood uric acid levels [24]. This rise in blood uric acid activates the renin-angiotensin system, resulting in a decrease in nitric oxide production [25, 26]. Nitric oxide is a vasodilator, and a decrease in its production can result in high blood pressure [27]. The strength of this research is this study uses a nationally representative sample from Indonesia. Furthermore, because RAND used standard and valid tools for data collection, the probability of measurement error in our study is lower than in other single cross-sectional studies. However, there are some potential limitations to this study. Due to a lack of data in the survey, we were unable to assess the relationships between hypertension and several important determinants, such as salt and sugar intake. Furthermore, all of the other data analyzed in this study was based on self-reporting, potentially over- or under-reported.

5   Conclusion

In this study, it was discovered that more than a half of the young adult participants had elevated BP. Various modifiable and non-modifiable factors were linked to this

condition. Male gender and a low educational background were factors that cannot be changed. Making BMI normal, staying away from smokes, decreasing excess exercise, and reducing soda consumption were all aspects that can be optimized in the endeavor to prevent high BP.

References

1. J. M. Flack and B. Adekola, "Blood pressure and the new ACC/AHA hypertension guidelines," Trends Cardiovasc. Med., vol. 30, no. 3, pp. 160–164, 2020.
2. D. S. Jeffrey, A. Ashkan, G. Emmanuela, S. L. Stephen, A. Degu, and H. A. Kalkidan, "Global, regional, and national comparative risk assessment of 84 behavioral, environmental and occupational, and metabolic risks or clusters of risks for 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017," Lancet, vol. 392, no. 10159, pp. 1923–1994, 2018.
3. K. T. Mills et al., "Global disparities of hypertension prevalence and control: a systematic analysis of population-based studies from 90 countries," Circulation, vol. 134, no. 6, pp. 441–450, 2016.
4. A. J. Martínez-Rueda, A. Olivas-Martínez, O. Vega-Vega, J. I. Fonseca-Correa, and R. Correa-Rotter, "New 2017 American College of Cardiology/American Heart Association High Blood Pressure Guideline: Healthcare Impact in Mexico and Other Developing Countries," Hypertension, vol. 73, no. 1, pp. 142–147, 2019.
5. H. C. Gooding, S. McGinty, T. K. Richmond, M. W. Gillman, and A. E. Field, "Hypertension awareness and control among young adults in the national longitudinal study of adolescent health," J. Gen. Intern. Med., vol. 29, no. 8, pp. 1098–1104, 2014.
6. L. Gray, I.-M. Lee, H. D. Sesso, and G. D. Batty, "Blood pressure in early adulthood, hypertension in middle age, and future cardiovascular disease mortality: HAHS (Harvard Alumni Health Study)," J. Am. Coll. Cardiol., vol. 58, no. 23, pp. 2396–2403, 2011.
7. W. K. Bosu, "Determinants of mean blood pressure and hypertension among workers in west africa," Int. J. Hypertens., vol. 2016, 2016.
8. Kementerian Kesehatan RI and Badan Penelitian dan Pengembangan Kesehatan Kementrian Kesehatan RI, "Laporan nasional RISKESDAS 2018," 2019.
9. M. A. Hussain, A. Al Mamun, C. Reid, and R. R. Huxley, "Prevalence, awareness, treatment and control of hypertension in Indonesian adults aged≥ 40 years: findings from the Indonesia Family Life Survey (IFLS)," PLoS One, vol. 11, no. 8, p. e0160922, 2016.
10. A. Kurnianto, D. Kurniadi Sunjaya, F. Ruluwedrata Rinawan, and D. Hilmanto, "Prevalence of Hypertension and Its Associated Factors among Indonesian Adolescents," Int. J. Hypertens., vol. 2020, 2020.
11. B. M. Egan, J. Li, I. F. Shatat, J. M. Fuller, and A. Sinopoli, "Closing the gap in hypertension control between younger and older adults: National Health and Nutrition Examination Survey (NHANES) 1988 to 2010," Circulation, vol. 129, no. 20, pp. 2052–2061, 2014.
12. J. Strauss, F. Witoelar, B. Sikoki, and A. M. Wattie, "The Fourth Wave of the Indonesia Family Life Survey (IFLS4): Overview and Field Report," RAND, no. WR-675/1-NIA/NICHD, 2009.

13. J. Strauss, F. Witoelar, and B. Sikoki, "The Fifth Wave of the Indonesia Family Life Survey (IFLS5): Overview and Field Report," RAND, no. WR-1143/1-NIA/NICHD, 2016.
14. Depkes RI, Klasifikasi Umur Menurut Kategori. Jakarta: Dirjen Yankes, 2009.
15. A. V. Chobanian et al., "Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure," Hypertension, vol. 42, no. 6, pp. 1206–1252, 2003.
16. T. Unger et al., "2020 International Society of Hypertension global hypertension practice guidelines," Hypertension, vol. 75, no. 6, pp. 1334–1357, 2020.
17. B. Everett and A. Zajacova, "Gender differences in hypertension and hypertension awareness among young adults," Biodemography Soc. Biol., vol. 61, no. 1, pp. 1–17, 2015.
18. M. Hasan et al., "Prevalence and determinants of hypertension among adult population in Nepal: Data from Nepal Demographic and Health Survey 2016," PLoS One, vol. 13, no. 5, p. e0198028, 2018.
19. H. M. Choi, H. C. Kim, and D. R. Kang, "Sex differences in hypertension prevalence and control: analysis of the 2010-2014 Korea National Health and Nutrition Examination Survey," PLoS One, vol. 12, no. 5, p. e0178334, 2017.
20. J. F. Reckelhoff, "Gender differences in hypertension," Curr. Opin. Nephrol. Hypertens., vol. 27, no. 3, pp. 176–181, 2018.
21. J.-J. Song, Z. Ma, J. Wang, L.-X. Chen, and J.-C. Zhong, "Gender differences in hypertension," J. Cardiovasc. Transl. Res., vol. 13, no. 1, pp. 47–54, 2020.
22. P. Di Giosia, P. Giorgini, C. A. Stamerra, M. Petrarca, C. Ferri, and A. Sahebkar, "Gender differences in epidemiology, pathophysiology, and treatment of hypertension," Curr. Atheroscler. Rep., vol. 20, no. 3, pp. 1–7, 2018.
23. J. H. Kwak, G. Jo, H.-K. Chung, and M.-J. Shin, "Association between sugar-sweetened beverage consumption and incident hypertension in Korean adults: a prospective study," Eur. J. Nutr., vol. 58, no. 3, pp. 1009–1017, 2019.
24. H. K. Choi, W. Willett, and G. Curhan, "Fructose-rich beverages and risk of gout in women," Jama, vol. 304, no. 20, pp. 2270–2278, 2010.
25. D. I. Feig, D.-H. Kang, and R. J. Johnson, "Uric acid and cardiovascular risk," N. Engl. J. Med., vol. 359, no. 17, pp. 1811–1821, 2008.
26. D. I. Feig et al., "Serum uric acid: a risk factor and a target for treatment?," J. Am. Soc. Nephrol., vol. 17, no. 4 suppl 2, pp. S69–S73, 2006.
27. S. E. Perez-Pozo, J. Schold, T. Nakagawa, L. G. Sánchez-Lozada, R. J. Johnson, and J. L. Lillo, "Excessive fructose intake induces the features of metabolic syndrome in healthy adult men: role of uric acid in the hypertensive response," Int. J. Obes., vol. 34, no. 3, pp. 454–461, 2010