Undiagnosed Hypertension and Associated Factors among Adults in Kalimantan, Indonesia

Ayunina Rizky Ferdina[1] and Arief Budiman[2]
[1]Research Center for Public Health and Nutrition, National Research and Innovation Agency, Bogor, Indonesia
[2]Department of Health Information Management, Health Polytechnic Kesdam VI, Banjarmasin, Indonesia

Keywords: Undiagnosed Hypertension, Risk Factors, Lifestyle, Sociodemographic, Blood Pressure.

Abstract: Hypertension prevalence in Kalimantan is relatively high compared to in other Indonesian regions but most of the cases were undiagnosed. This study aimed to determine the prevalence of undiagnosed hypertension and analyze the related sociodemographic and lifestyle factors among adults in Kalimantan, Indonesia. An observational, cross-sectional study was performed using data from Riskesdas 2018. Undiagnosed hypertension is operationally defined as having systolic blood pressure $\geq$ 140 mmHg and/or diastolic blood pressure $\geq$ 90 mmHg in the blood pressure measurement conducted in the Riskesdas survey, with no prior diagnosis of hypertension by any health care professional. Odds ratios (OR) computed by logistic regression were estimated to determine the factors associated with undiagnosed hypertension. The undiagnosed hypertension in this population was more prevalent and had significant differences ($p \leq 0.001$) among those who are below 30 years old, living in rural areas, as well as those consuming fruits and/or vegetables $\geq$ 5 portions/day. Certain characteristics revealed in this study as having significant associations with undiagnosed hypertension may be used as guidance in prioritizing hypertension screening in Kalimantan. .

1 INTRODUCTION

Increased blood pressure can trigger various kinds of non-communicable diseases (Kalehoff & Oparil, 2020). It is one of the main causes of premature death in the world. Since a portion of those who exhibit this clinical condition are unaware of it, hypertension is often called the "silent killer" (World Health Organisation (WHO), 2013). A delayed diagnosis of hypertension may cause increased cardiovascular risks (Forouzanfar et al., 2017).

It is already obvious that the trend of hypertension is increasing all over the world, including in Indonesia (Purnamasari, 2018). The prevalence of hypertension is especially high in Kalimantan, which is the Indonesian part of Borneo Island. Almost all of the Kalimantan provinces have hypertension cases above the national level based on the blood pressure measurement data from the latest Indonesian Basic Health Research (Riskesdas, acronym in Indonesian) (Ministry of Health of Indonesia, 2018a, 2018b). However, most of the hypertension cases in this Indonesian part of Borneo Island were not diagnosed by health professionals prior to the survey (Ministry of Health of Indonesia, 2018b).

It shows that Kalimantan faces a challenge to increase awareness of hypertension among its citizens. Without awareness, it is difficult to get individuals to seek treatment and modify their lifestyle to control their blood pressure. A study from another Asian country reported that undiagnosed hypertension poses a serious threat to the development of cardiovascular disease, chronic kidney disease, and all-cause mortality (Choo et al., 2014).

To our knowledge, study on undiagnosed hypertension is still lacking in this biggest island of the country. Therefore, this study examined whether individuals who were unaware of their hypertension condition differed from those who have been diagnosed with the disease. We aimed to assess the prevalence of undiagnosed hypertension among adults in Kalimantan and analyze the associated factors, which would include sociodemographic and lifestyle factors.

Ferdina, A. and Budiman, A.
Undiagnosed Hypertension and Associated Factors among Adults in Kalimantan, Indonesia.
DOI: 10.5220/0011650700003608
In *Proceedings of the 4th International Conference on Social Determinants of Health (ICSDH 2022)*, pages 154-160
ISBN: 978-989-758-621-7; ISSN: 2975-8297

2 METHODS

2.1 Study Design

This is an observational, cross-sectional study using a database of Riskesdas 2018. Riskesdas is a nationwide survey directed by the Ministry of Health of Indonesia and the detailed protocol can be found in its final report (Ministry of Health of Indonesia, 2018b). Riskesdas 2018 samples were selected through a two-stage stratified cluster sample drawn from across the nation.

2.2 Sample

In this study, the population of interest was only those residing in Kalimantan, Indonesia. Besides that, the inclusion criteria include age over 18 years old, located in Kalimantan, not pregnant, and having blood pressure data from the survey. This led to a dataset containing 35,991 adult subjects who were Riskesdas 2018 respondents from Kalimantan whose blood pressure data were collected. We then selected 7,908 hypertensive individuals that were determined referring to their blood pressure data to be analyzed.

2.3 Variables

The dependent variable was the presence of hypertension diagnosis prior to the survey, constructed from the survey data. Undiagnosed hypertension was defined if, at the time of the survey, a subject had a mean SBP value $\geq$ 140 mmHg and/or a mean DBP $\geq$ 90 mmHg blood pressure data compatible with hypertension in the two blood pressure measurements and that hypertension had not been previously diagnosed by any health professional. Otherwise, it was defined as diagnosed hypertension.

The independent variables consist of several sociodemographic and lifestyle characteristics. The sociodemographic characteristics include age group, gender, area of residence, occupation, and educational level. Lifestyle characteristics that are used as the independent variables include behaviors on smoking, alcohol consumption, physical activity, as well as consumption of some food categories. Physical activities are categorized into “active” and “inactive” based on the modified Global Physical Activity Questionnaire which is part of the WHO STEPS instrument (Ministry of Health of Indonesia, 2018b).

Simple questionnaires and food cards were used to ask about the consumption frequency of several food groups, including salty foods, preserved meat, instant foods, and instant seasonings. The frequency of consuming such foods was categorized into “daily” and “not daily”. The frequency of fruit and vegetable consumption was also asked and then categorized into $\geq$5 portions/day and < 5 potions/day. All of those data were collected using a validated questionnaire delivered by trained enumerators (Ministry of Health of Indonesia, 2018b).

2.4 Ethical Consideration

For the primary data collection of Riskesdas 2018, the Ethical Committee of Health Research, NIHRD, Ministry of Health of Indonesia had given their approval with the reference number LB.02.01/2/KE.267/2017. Secondary analysis of the obtained data requires no additional ethical clearance.

2.5 Statistical Analysis

Univariate analyses were performed to characterize the study population. Bivariate analyses were conducted to compare the prevalence of diagnosed and undiagnosed hypertension as well as to obtain crude odds ratio (OR) together with their 95% confidence intervals (CI). Subsequently, with the factors which obtained a value of $p < 0.20$, a multivariate regression model was estimated to obtain adjusted odds ratios (aOR) together with their 95% CI. Significance is determined at $p < 0.05$. A complex sample technique was employed in all analyses, that were performed using the International Business Machines Statistical Package for the Social Sciences (IBM SPSS) version 25.

3 RESULTS

We analyzed almost eight thousand subjects located in Kalimantan who had hypertension during Riskesdas 2018 survey. The distribution of our study subjects disaggregated by their diagnosis status for hypertension and independent variables is described in Table 1.

Table 1: Description of subjects' characteristics and their diagnosis status of hypertension.

Characteristic	N	Hypertension diagnosis status	
		Diagnosed % (95% CI)	Undiagnosed % (95% CI)
Age group (years)			
19-29	399	57.1(49.4-64.5)	42.9(35.5-50.6)
30-39	1018	67.3(63.3-71)	32.7(29-36.7)
40-49	2252	75.7(73.2-78)	24.3(22-26.8)
50-59	2274	80(77.7-82.1)	20(17.9-22.3)
60 or more	1965	80.2(77.8-82.4)	19.8(17.6-22.2)
Gender			
Male	3071	73.4(71.1-75.6)	26.6(24.4-28.9)
Female	4837	77.7(76.1-79.3)	22.3(20.7-23.9)
Area of residence			
Urban	3889	79.4(77.4-81.3)	20.6(18.7-22.6)
Rural	4019	72.8(70.9-74.6)	27.2(25.4-29.1)
Employment status			
Formal employee	1076	75.6(71.9-79)	24.4(21-28.1)
Entrepreneur	1203	76.1(72.7-79.2)	23.9(20.8-27.3)
Farmer/fisherman	1839	71.2(68.4-73.8)	28.8(26.2-31.6)
Informal worker	915	75.5(71.4-79.2)	24.5(20.8-28.6)
In school/not employed	2875	79.5(77.4-81.4)	20.5(18.6-22.6)
Educational level			
Graduated high school	2247	77.3(74.6-79.7)	22.7(20.3-25.4)
Never graduated high school	5661	75.6(74-77.1)	24.4(22.9-26)
Smoker			
Yes, daily	1552	72.1(69-75)	27.9(25-31)
Yes, not daily	629	72.8(67.1-77.8)	27.2(22.2-32.9)
Never	5727	77.5(75.9-79)	22.5(21-24.1)
Alcohol drinker			
Yes	198	69.5(61.2-76.7)	30.5(23.3-38.8)
No	7710	76.2(74.8-77.6)	23.8(22.4-25.2)
Physical activity			
Active	5335	74.8(73.2-76.4)	25.2(23.6-26.8)
Inactive	2573	78.6(76.3-80.6)	21.4(19.4-23.7)
Food consumption			
Vegetable			
≥ 5 portions/day	5592	76.9(75.3-78.4)	23.1(21.6-24.7)
< 5 portions/day	2316	74.1(71.5-76.5)	25.9(23.5-28.5)
Fruit			
≥ 5 portions/day	1609	80.8(78-83.2)	19.2(16.8-22)
< 5 portions/day	6299	74.8(73.3-76.4)	25.2(23.6-26.7)
Salty food			
Daily	1544	75.3(72-78.2)	24.7(21.8-28)
Not daily	6364	76.2(74.7-77.7)	23.8(22.3-25.3)
Instant food			
Daily	557	75.2(70.1-79.6)	24.8(20.4-29.9)
Not daily	7351	76.1(74.7-77.5)	23.9(22.5-25.3)
Preserved meat			
Daily	209	80.7(72.2-87)	19.3(13-27.8)
Not daily	7699	75.9(74.5-77.2)	24.1(22.7-25.5)
Seasoning			
Daily	5773	76(74.4-77.5)	24(22.5-25.6)
Not daily	2135	76.1(73.6-78.5)	23.9(21.5-26.4)

Table 2: Bivariate analysis between respondents' characteristics and undiagnosed hypertension.

Characteristics	Odds Ratio	*P*
Age group (years)		
19-29	Ref	< 0.001
30-39	0.649(0.457-0.923)	
40-49	0.428 (0.304-0.603)	
50-59	0.333 (0.238-0.467)	
60 or more	0.328 (0.234-0.461)	
Gender		
Male	1.262 (1.099-1.451)	0.001
Female	Ref	
Area of residence		
Urban	0.694 (0.596-0.809)	< 0.001
Rural	Ref	
Employment status		
Formal employee	1.248 (0.996-1.565)	< 0.001
Entrepreneur	1.217 (0.978-1.513)	
Farmer/fisherman	1.569 (1.319-1.867)	
Informal worker	1.253 (0.987-1.59)	
In school/not employed	Ref	
Educational level		
Graduated high school	Ref	0.260
Never graduated high school	1.099 (0.932-1.296)	
Smoker		
Yes, daily	1.334 (1.129-1.576)	0.003
Yes, not daily	1.286 (0.972-1.702)	
Never	Ref	
Alcohol drinker		
Yes	1.403 (0.968-2.033)	0.072
No	Ref	
Physical activity		
Active	Ref	0.006
Inactive	0.812 (0.699-0.942)	
Food consumption		
Vegetable		
≥ 5 portions/day	Ref	0.046
< 5 portions/day	1.164 (1.002-1.351)	
Fruit		
≥ 5 portions/day	Ref	< 0.001
< 5 portions/day	1.41 (1.17-1.699)	
Salty food		
Daily	1.055 (0.877-1.269)	0.571
Not daily	Ref	
Instant food		
Daily	1.053 (0.804-1.379)	0.707
Not daily	Ref	
Preserved meat		
Daily	0.755 (0.467-1.219)	0.249
Not daily	Ref	
Seasoning		
Daily	1.007 (0.861-1.177)	0.933
Not daily	Ref	

The majority of the hypertensive subjects in this study were between the age range of 50-59, female, not employed, and never graduated high school. Most of them are physically active and consume neither cigarettes nor alcohol. Their proportions based on the type of residency were almost the same between urban and rural. In contrast to fruit consumption, more than half of our subjects consume vegetables in at least 5 portions daily.

We found that almost a quarter (24%; 95%CI 22.6-25.3%) of the subjects had no prior diagnosis regarding their hypertension status. The prevalence of undiagnosed hypertension in this population is the highest among young adults and the lowest among the elderly. Undiagnosed hypertension is also more prevalent among those who never graduated high school, live in a rural area, are males, and work as farmers or fishermen (Table 1).

Except for educational level, the analyzed sociodemographic characteristics showed statistically significant associations ($p \leq 0.001$) with the diagnosis status of hypertension (Table 2). Educational level is also the only sociodemographic variable that was not included in the multivariate analysis since the p is higher than 0.2. Meanwhile, for lifestyle aspects, only the status of smoker and alcohol drinker, physical activity, as well as fruit and vegetable consumption were included in the multivariate analysis.

In the final model, it was found that age group, area of residence, fruit and vegetable consumption are the factors with significant associations with undiagnosed hypertension. Being older than 59 years has an odds ratio almost three times lower to get undiagnosed hypertension. Living in a rural area lowered the chance of having hypertension cases undiagnosed. Meanwhile, lower consumption of fruit and vegetable gave about a 20% increase in odds ratios for undiagnosed hypertension (Table 3).

Table 3: Multivariate analysis between respondents' characteristics and undiagnosed hypertension.

Characteristics	**aOR (95% CI)**	***P***
Age group (years)		
19-29	Ref	< 0.001
30-39	0.613 (0.43-0.873)	
40-49	0.414 (0.292-0.586)	
50-59	0.318 (0.226-0.448)	
60 or more	0.312 (0.221-0.441)	
Gender		
Male	1.11 (0.913-1.35)	0.294
Female	Ref	
Area of residence		
Urban	0.754 (0.64-0.89)	0.001
Rural	Ref	
Employment status		
Formal employee	1.087 (0.846-1.395)	0.055
Entrepreneur	1.096 (0.866-1.387)	
Farmer/fisherman	1.333 (1.101-1.613)	
Informal worker	1.151 (0.901-1.471)	
In school/not employed	Ref	
Smoker		
Yes, daily	1.194 (0.966-1.476)	0.198
Yes, not daily	1.212 (0.901-1.63)	
Never	Ref	
Alcohol drinker		
Yes	0.959 (0.662-1.389)	0.826
No	Ref	
Physical activity		
Active	Ref	0.17
Inactive	0.896 (0.766-1.048)	
Vegetable		
≥ 5 portions/day	Ref	0.035
< 5 portions/day	1.177 (1.012-1.37)	
Fruit		
≥ 5 portions/day	Ref	0.03
< 5 portions/day	1.239 (1.021-1.503)	

4 DISCUSSIONS

This study pursued to determine the prevalence and factors associated with undiagnosed hypertension among adults in Kalimantan, Indonesia. The prevalence of undiagnosed hypertension in low-and-middle-income countries ranges between 12-50% (Guerrero-díaz et al., 2021). Based on our analysis of secondary data from Riskesdas 2018, almost a quarter of the hypertension cases among adults in Kalimantan were undiagnosed (Table 2).

In Riskesdas, the data about hypertension is collected by measuring blood pressure and additionally, by interviewing the subject about whether or not they had been diagnosed with hypertension or taking blood pressure lowering medication. For all the five Indonesian provinces in Kalimantan, the differences between those two types of data are quite remarkable. The blood pressure measurement showed that only North Kalimantan had hypertension prevalence below the national level (Ministry of Health of Indonesia, 2018b). Nevertheless, the data showed that this newest province of Kalimantan has around 30% of hypertension among its population aged 15 and over. Overall, 1 in 3 people in Kalimantan had a blood pressure compatible with hypertension when surveyed in Riskesdas 2018 (Ministry of Health of Indonesia, 2018b). The high prevalence of hypertension in Kalimantan has been a persistent

trend at least since Riskesdas 2007 when South Kalimantan once more became the province with the highest prevalence of hypertension in the country (Ministry of Health of Indonesia, 2007).

However, the numbers are not as high if we look at the data on hypertension based on diagnosis history. We could only find about 10% of this same population who have been diagnosed as having hypertension (Ministry of Health of Indonesia, 2018b). In other words, most people who have hypertension were never been told by any health professional regarding their blood pressure condition.

The prevalence of hypertension in Indonesia had been reported by other researchers to increase with age (Rahajeng & Tuminah, 2009). When we disaggregated the data, we could see that the trend of undiagnosed hypertension in Kalimantan seems to decrease with age (Table 2). This contradicts the general trend of hypertension, where older age is known as a risk factor for high blood pressure (Vokonas et al., 1988). Nevertheless, this makes sense because at a young age, hypertension is usually still at the early stage and asymptomatic. No wonder people belonging to this age group do not likely to feel the need to check their blood pressure (Johnson et al., 2016). This may cause their hypertension to be uncontrollable because of the lack of awareness (Gooding et al., 2014).

Additionally, while hypertension in Indonesia has been known to be more prevalent in urban areas (Peltzer & Pengpid, 2018), our study showed that undiagnosed cases were more common in rural area. Awareness, treatment, and control of hypertension were reported to be higher in urban communities than in rural communities in low-and-middle-income countries (Chow et al., 2013). This could be reasoned by the limited availability of health care facilities and probably some geographical barriers the access to those facilities. To reach people with the least access to healthcare facilities, we advised deploying more healthcare professionals to the areas.

We also found that farmers and fishermen, followed by other informal workers, are less likely to know if they had high blood pressure. On the other hand, those who are not employed or in school are more likely to get a medical diagnosis when they have hypertension. This is probably because those agricultural workers are usually located in areas with less access to healthcare. In the United States, agricultural workers have been reported to be at greater risk for poor access to healthcare (Hoerster et al., 2011). Moreover, the informal workers usually have lower educational attainment and our results show that those who never graduated high school got a higher chance of getting undiagnosed hypertension, although the relationship is not statistically significant. A similar result about the relationship between educational level and undiagnosed hypertension had been found in a study on the Peruvian population (Guerrero-díaz et al., 2021). On the other hand, analysis of Indonesian Family Life Survey data showed that on the national level, higher education might reduce the chance of undiagnosed hypertension (Mahwati et al., 2022).

Gender is the only sociodemographic variable showing a similar trend with hypertension regardless of the diagnostic status, where the proportion of males with hypertension is higher than that of females (Gillis & Sullivan, 2016). Analysis of Riskesdas 2007 data reported that male has a higher risk of having high blood pressure (Rahajeng & Tuminah, 2009). The higher probability of having undiagnosed hypertension in men could be explained by their lower awareness of hypertension (Guerrero-díaz et al., 2021). In our study, we found that undiagnosed hypertension in Kalimantan is also more common among men than women. However, the relationship is not deemed statistically significant when it is analyzed in the multivariate logistic regression.

We found several lifestyle aspects to be associated with the difference in the prevalence of undiagnosed hypertension. However, consumption of risky food items that we analyzed here, was not found to be associated with undiagnosed hypertension (Table 2). Frequent consumption of salty foods, instant foods, preserved meat, and seasonings may influence the risk of having high blood pressure, at least theoretically. Nevertheless, our results show that the diagnosis status of hypertension is unrelated to the consumption behavior of such foods. Likewise, the status of being an alcohol drinker is also not related to undiagnosed hypertension.

It has been established that fruit and vegetable intake provides protective effects against hypertension (Pienovi et al., 2015). Our results show that undiagnosed hypertension is significantly more prevalent among subjects consuming lesser amounts of these fiber-rich foods. This is not supposed to explain causation, but this may imply that when people are aware of their hypertension after receiving the medical diagnosis, they are more willing to eat sufficient amounts of fruits and vegetables.

From other perspectives, it is also possible that people diagnosed with hypertension were more willing to adopt healthy behaviors than their peers who have the same condition but never received the diagnosis. This may explain why among our subjects, the proportion of people who consume fruits and

vegetables abundantly is bigger among those with diagnosed hypertension. Individuals with diagnosed hypertension are more likely to quit smoking and those at a younger age at diagnosis tended to work out regularly (Kim & Andrade, 2019).

Some community health centers (Puskesmas) in Kalimantan have area coverage that is too vast, causing some residents to live too far from the closest Puskesmas (Nisa et al., 2017). That may explain why a significant proportion of the population neglect to frequently check their health, particularly their blood pressure. In communities with these features of geo-locality, programs that promote early identification and treatment of hypertension are required to recognize and decrease the number of untreated patients.

Better tracking of blood pressure levels, raising awareness of the benefit of hypertension control, and promoting healthy behavioral modification can all improve health outcomes (Kim & Andrade, 2019). This can be accomplished by encouraging routine visits to medical care providers, providing information about recommended lifestyle choices, and better health monitoring.

Given the high prevalence of undiagnosed hypertension, governments in Kalimantan need to reinforce the prevention and control of high blood pressure in the community, especially by increasing the coverage of early detection since it can promote public health (Choo et al., 2014). For Kalimantan, it is recommended to prioritize the screening to those who are young adults, living in a rural area, have low educational levels, and are informal/agricultural workers; since undiagnosed hypertension is more common among those populations. In the meantime, efforts to increase fruit and vegetable intake are also suggested because undiagnosed hypertension is more common among those with low consumption of these food groups.

The main limitation of this study is being observational and cross-sectional due to the nature of Riskesdas data, thus precluding causal inferences. The self-reported data in Riskesdas is also another weakness of this study, where they are subject to bias due to under-reporting and measurement error. Nevertheless, this study provides some insights that can be considered in organizing public health attempts to reduce hypertension cases in Kalimantan.

5 CONCLUSIONS

These findings imply that a remarkable proportion of hypertension cases in Kalimantan are undiagnosed. The lack of awareness about blood pressure status suggests that there should be more efforts to strengthen for detecting undiagnosed hypertension. Such screening should be prioritized for those more vulnerable to undiagnosed hypertension, such as young adults and rural residents. Our results also indicate that without knowing their hypertension status, people might less likely to consume sufficient amounts of fruits and vegetables. Having a proper diagnosis of hypertension may not only help people to receive treatment but also control their blood pressure by adopting a healthy lifestyle.

REFERENCES

Choo, E. H., Ihm, S. H., Lim, S., Chang, K., & Seung, K. B. (2014). A simple screening score for undiagnosed hypertension. *International Journal of Cardiology*, *172* (3), e465–e467. https://doi.org/10.1016/j.ijcard.2014.01.040

Chow, C. K., Teo, K. K., Rangarajan, S., Islam, S., Gupta, R., Avezum, A., Bahonar, A., Chifamba, J., Dagenais, G., Diaz, R., Kazmi, K., Lanas, F., Wei, L., Lopez-Jaramillo, P., Fanghong, L., Ismail, N. H., Puoane, T., Rosengren, A., Szuba, A., … investigators, P. (Prospective U.R.E.S. (2013). Prevalence, Awareness, Treatment, and Control of Hypertension in Rural and Urban Communities in High-, Middle-, and Low-Income Countries. *JAMA*, *310*(9), 959–968. https://doi.org/10.1001/jama.2013.184182

Forouzanfar, M. H., Liu, P., Roth, G. A., Ng, M., Biryukov, S., Marczak, L., Alexander, L., Estep, K., Hassen Abate, K., Akinyemiju, T. F., Ali, R., Alvis-Guzman, N., Azzopardi, P., Banerjee, A., Bärnighausen, T., Basu, A., Bekele, T., Bennett, D. A., Biadgilign, S., … Murray, C. J. L. (2017). Global Burden of Hypertension and Systolic Blood Pressure of at Least 110 to 115 mm Hg, 1990-2015. *JAMA*, *317*(2), 165–182. https://doi.org/10.1001/jama.2016.19043

Gillis, E. E., & Sullivan, J. C. (2016). Sex Differences in Hypertension. *Hypertension*, *68*(6), 1322–1327. https://doi.org/10.1161/hypertensionaha.116.06602

Gooding, H. C., McGinty, S., Richmond, T. K., Gillman, M. W., & Field, A. E. (2014). Hypertension awareness and control among young adults in the National Longitudinal Study of Adolescent Health. *Journal of General Internal Medicine*, *29*(8), 1098–1104. https://doi.org/10.1007/s11606-014-2809-x

Guerrero-díaz, D. V., Hern, A., Montoya-rivera, W. C., Rojas-roque, C., & Alberto, M. (2021). *Heliyon Undiagnosed hypertension in Peru : analysis of associated factors and socioeconomic inequalities , 2019*. *7*(July). https://doi.org/10.1016/j.heliyon.2021.e07516

Hoerster, K. D., Mayer, J. A., Gabbard, S., Kronick, R. G., Roesch, S. C., Malcarne, V. L., & Zuniga, M. L. (2011). Impact of individual-, environmental-, and policy-level

factors on health care utilization among US farmworkers. *American Journal of Public Health*, *101*(4), 685–692. https://doi.org/10.2105/AJPH.2009.190892

Johnson, H. M., Warner, R. C., Lamantia, J. N., & Bowers, B. J. (2016). "I have to live like I'm old." Young adults' perspectives on managing hypertension: A multi-center qualitative study. *BMC Family Practice*, *17*(1), 1–9. https://doi.org/10.1186/s12875-016-0428-9

Kalehoff, J. P., & Oparil, S. (2020). The Story of the Silent Killer : A History of Hypertension: Its Discovery, Diagnosis, Treatment, and Debates. *Current Hypertension Reports*, *22*(9), 72. https://doi.org/10.1007/s11906-020-01077-7

Kim, H., & Andrade, F. C. D. (2019). Diagnostic status and age at diagnosis of hypertension on adherence to lifestyle recommendations. *Preventive Medicine Reports*, *13*(November 2018), 52–56. https://doi.org/10.1016/j.pmedr.2018.11.005

Mahwati, Y., Nurrika, D., & Latief, K. (2022). The Determinants of Undiagnosed Hypertension Among Indonesian Adults: A Cross-sectional Study Based on the 2014-2015 Indonesia Family Life Survey. *Journal of Preventive Medicine and Public Health*, *55*(1), 60–67. https://doi.org/10.3961/JPMPH.21.500

Ministry of Health of Indonesia. (2007). Laporan Nasional Riskesdas 2007. In *Laporan Nasional 2007*. http://kesga.kemkes.go.id/images/pedoman/Riskesdas 2007 Nasional.pdf

Ministry of Health of Indonesia. (2018a). *Hasil Utama Riset Kesehatan Dasar (RISKESDAS) 2018*. https://doi.org/10.1088/1751-8113/44/8/085201

Ministry of Health of Indonesia. (2018b). *Laporan Nasional Riskesdas 2018*.

Nisa, L. S., Siska, D., Maliani, Putryanda, Y., Noor, G. S., & Wajidi. (2017). Pemetaan Fasilitas Kesehatan pada Puskesmas di Kalimantan Selatan. *Jurnal Kebijakan Pembangunan*, *12*(2), 219–229.

Peltzer, K., & Pengpid, S. (2018). *The Prevalence and Social Determinants of Hypertension among Adults in Indonesia: A Cross-Sectional Population-Based National Survey*. https://doi.org/10.1155/2018/5610725

Pienovi, L., Lara, M., Bustos, P., & Amigo, H. (2015). Consumo de frutas, verduras y presión arterial. Un estudio poblacional [Fruit and vegetable intake, and blood pressure. A population research]. *Archivos latinoamericanos de nutricion*, *65*(1), 21–26.

Purnamasari, D. (2018). The Emergence of Non-communicable Disease in Indonesia. *Acta Medica Indonesiana*, *50*(4), 273–274.

Rahajeng, E., & Tuminah, S. (2009). *Penelitian Prevalensi Hipertensi dan Determinannya di Indonesia*. 580–587.

Vokonas, P. S., Kannel, W. B., & Cupples, L. A. (1988). Epidemiology and risk of hypertension in the elderly: the Framingham Study. *Journal of Hypertension. Supplement : Official Journal of the International Society of Hypertension*, *6*(1), S3—9. http://europepmc.org/abstract/MED/3216240

World Health Organisation (WHO). (2013). *A Global Brief on Hypertension: Silent Killer, Global Public Health Crisis*. https://doi.org/10.5005/ijopmr-24-1-2