FACTORS ASSOCIATED WITH HYPERTENSION: RESULTS FROM THE INDONESIAN FAMILY LIFE SURVEY-5 IN 2014

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ABSTRACT

Hypertension is still a serious global problem. In developing countries prevalence of hypertension increased from 18,8% in 2002 to 29,6% in 2014. Age, gender, Body mass index (BMI) and education can be the factors associated with hypertension. This study aimed to describe factors associated with hypertension in Indonesia from Indonesian Family Life Surveys (IFLS) wave 5 were conducted in 2014-2015. This crosssectional study analyzed data by using Chi2. Respondents aged > 40 years with complete information was 12.840, obtained from questionnaire-based interview and measurement. The result showed that the prevalence of hypertension was 5.426 (42,26%). The prevalence of hypertension on age 45-59 years old was 2.553 (47,05%), and women was higher 3.078 (56,73%) than men. Furthermore, the most prevalence of hypertension was on Body mass index (BMI) overweight 2.630 (48,47%). Respondents who had the higher level of education has the lowest prevalence of hypertension 425 (7,83%). All these results were statistically significant (P<0,001). The study found that middle-aged people, women, overweight, and lower level of education can be the factors increasing the prevalence of hypertension. Future intervention should emphasize to improve the promotion of healthy life style, education and inspire the population to maintain the ideal body weight.

KEYWORDS Hypertension, age, gender, BMI, level of education, IFLS 5

INTRODUCTION

Hypertension is one of 10 leading contributors to the global burden of disease. It is the most important modifiable risk factor for cardiovascular disease (CVD) and an independent risk factor for mortality worldwide (Owolabi, Goon, Adeniyi, & Seekoe, 2017). Moreover, it has been described as a silent killer due to its asymptomatic nature among the sufferers. About 9 million people die from hypertension annually (Gao et al.,

2013). Furthermore, in low-income countries hypertension is increasingly affecting young people less than 50 years, many of whom die prematurely as compared to the developed country. It also contributes to half of the coronary heart disease and approximately two-thirds of the cerebrovascular burden disease. As observed in most countries, there is still lack of awareness about growing problem of hypertension (Musinguzi & Nuwaha, 2013). The awareness of hypertension was significantly associated with a higher educational level and BMI (Wu et al., 2015). Unfortunately, the lack of awareness is often coupled with the absence of a clear policy framework for prevention and management (Musinguzi et al., 2018). Reliable informations about the worldwide prevalence of hypertension is essential to the development of international health policies for prevention and control of this condition (Jinwei Wang, Zhang, Wang, Liu, & Wang, 2014). Therefore, effective prevention especially primary prevention, remains the best strategy for reducing the burden of the disease (Fu Liang Zhang et al., 2017).

The problem of hypertension every year cannot be resolved even tends to increase (Sembiring & Utari, 2019). China has experienced a rapid increase in hypertension over the past decades. The prevalence increased from 18,8% in 2002 to 25,2% in 2012 and was reported to be as high as 29,6% in a survey in 2014 (Qin et al., 2018). In Indonesia, the prevalence of hypertension is still high, 47,8% among adults > 40 years old. (Hussain, Mamun, Peters, Woodward, & Huxley, 2016; Peltzer & Pengpid, 2018).

There are so many factors that associated with hypertension. Wang et al (2014) reported that high body mass inde (BMI) is one lifestyle factors besides habitual drinking, physical inactivity and nonsteroidal anti-inflammatory drugs (Jinwei Wang et al., 2014). Furthermore, age, gender, and level of education are the important factors associated with hypertension. The prevalence of hypertension increased with increasing of age, higher in women and low education (Hao Wang et al., 2013).

Recent studies showed that the aged specific prevalence of hypertension was 13.0%, 36,7% and 56,5% among persons aged 20 to 44 years, 45 to 64 years, and >65 years respectively(Gao et al., 2013). Men were higher than women (30,1% in men and 28,2% in women), respectively (Hu et al., 2017). The prevalence of hypertension increased with age and decreased with educations level. Body mass index was higher in hypertensive people.The study showed statistically significant P<0,001 (Yang et al., 2016). The risk of BMI for hypertension increased dramatically in middle-aged, especially for men with drinking and smoking habits (Yu et al., 2018). The comparison study of prevalence and awareness about hypertension in China and United States revealed that China has a lower prevalence of hypertension than United Stated. The body mass index was also significantly lower in China than United States(Lu et al., 2018)

In Indonesia, the three top causes of death are stroke (21,2%), ischaemic heart disease (8,9%) and diabetes mellitus (6,5%). Major adult non-communicable disease (NCD) risk factors in Indonesia include current tobacco smoking in 2011 was 35% (67% in men and 3 % in women), high blood pressure or hypertension in 2008 was 27,8% (29,1 % in men and 26,5% in women), and obesity in 2008 was 4,8% (2,6% in men and 6,0% in women) (World Health Organization, 2018). In the Indonesian family life surveys-5 in 2014-2015, the prevalence of hypertension in Indonesia was 33,4%. Significant linear relationship of hypertension were found with age and BMI (P <0,001). It was concluded that the prevalence of hypertension was high and the awareness was low, and treatment and control were very low (Peltzer & Pengpid, 2018). The other study from IFLS 5 showed the majority of respondents were female (53.8%) and aged <60 years (71.1%). The prevalence of low awareness of hypertension treatment was 87.1% (51.8% in women and 48.2% in men). Being an elderly (OR: 1.60, 95%CI 1.36–1.88), being irregularly blood pressure control (OR: 4.40, 95% CI 3.78–5.13), having depressive symptoms (OR: 1.35, 95% CI

1.12–1.62), having insomnia (OR: 1.31, 95% CI 1.11–1.53), and having low satisfaction with health care (OR: 1.28, 95% CI 1.08–1.51) were associated with low awareness of hypertension treatment. Surprisingly, respondents with strong religiosity (OR: 1.62; 95% CI 1.25–2.09) were more likely to display low awareness of hypertension treatment (Khoiry, Alfian, & Abdulah, 2022). The more study of IFLS 5 reported the prevalence of hypertension in Indonesia was 26.1%, and only 26.9% of those with hypertension were aware of their condition. Approximately 22.5% of hypertensive patients received treatment, but only 28.2% had controlled blood pressure and reached the therapeutic goal. Low socioeconomic groups were more prone to hypertension (CI = −0.047 in urban and CI = −0.075 in rural). In contrast, awareness, treatment, and control of hypertension were more concentrated in higher socioeconomic groups'(Mashuri, Ng, & Santosa, 2022).

Although there is some evidence of the prevalence of hypertension in Indonesia, little is known regarding the age, gender, BMI, and education level. By using data from the fifth wave of IFLS conducted in 2014-2015, we report on the prevalence of hypertension and its factors (age, gender, BMI, and education level) in Indonesia.

RESEARCH METHOD

The design study was cross-sectional using secondary data from The Indonesian family life survey 5 (IFLS 5) conducted in 2014-2015. IFLS is a longitudinal socioeconomic and health survey, representing approximately 83% of the individuals living in 13 of 33 provinces in Indonesia. Ethics approval was obtained from the RAND Corporation. Informed consent was obtained from all respondents before data collection. Data from the IFLS are publicly available and can be accessed through their website (Strauss, Witoelar, & Sikoki, 2016).

Total respondents in the IFLS-5 survey was 58,325 individuals. The sample size was 12.840 individuals restricted age >40 years old with complete information. The independent variable was hypertension. The measurement of blood pressure was using spygnomanometer. The result was the average of the second and third measurement of blood pressure. Hypertensive respondent was obtained if the blood pressure was >=140 mmhg systolic and >=90 mmhg diastolic. Dependent variables included age, gender, body mass index, and education level. Body mass index (BMI) was obtained from the division of body weight (kg) by height squared (m^2). Then classified as thin or underweight (BMI <18,5 kg/m^2), normal (BMI 18,5-23,9 kg/m^2), overweight (BMI 24-30 kg/ m^2) and obese (BMI >30 kg/ m^2). Education level was obtained from questionnaire-based interview then classified as no educational level, primary school level, high school level, and diploma/bachelor/post graduate level.

Univariate and bivariate were analyzed using STATA software version 15.0 (Stata corporation, College station, Texas, USA).

RESULT AND DISCUSSION

The total sample included 12.840 individuals 40 years and older. The general characteristics of the study population were illustrated in Table 1. The variables were age, gender, BMI, and education level.

Table 1. General characteristics of the study population variables

Variable	Frequency	Percent
Ages		

40- <45	3055	23.79
45-59	6309	49.14
>=60	3476	27.07
Gender		
Male	6137	47.80
Female	6703	52.20
BMI		
Underweight	1364	10.62
Normal	4662	36.31
Overweight	5698	44.38
Obese	1116	8.69
Education level		
No school	1413	11.00
Primary school	6039	47.03
High school	4273	33.28
Diploma/ Bachelor/Postgraduate	1115	8.68

The study found that the characteristics most frequent were the aged 45-59 (49.14%), female (52.20%), BMI overweight (44.38%), and education level primary school (47.03%). Furthermore, the prevalence of hypertension was 42.26%, described in Figure 1.

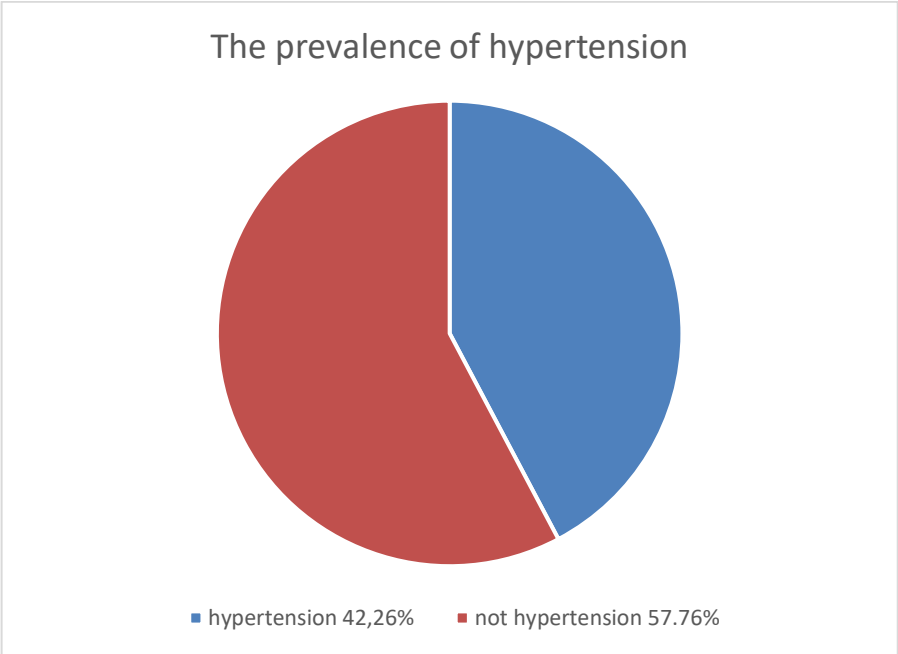

Figure 1. The prevalence of Hypertension

The prevalence of hypertension is still high. The result was in line with the recent study (Shah et al., 2015). The high burden of hypertension is caused by low treatment and control (Lamptey et al., 2017), high consumption of sodium or high salt condiments added during cooking (Bi et al., 2014), according to the nutrition

transision theory, increasing wealth is often associated with shifts in dietary and physical activity patterns, which may lead to the predominance of nutrition-telated to hypertension and NCDs (Williams et al., 2018). The prevalence of hypertension in this study 42.26 % was lower than the study conducted by Hussain 47.8% (Hussain et al., 2016), but higher than the investigation by Peltzer 33.4% (Peltzer & Pengpid, 2018).

Our finding of prevalence of hypertension was consistent with those of other studies in Indonesia (Herningtyas & Ng, 2019). Increases in risk factors such as tobacco consumption, sedentary lifestyles, and unhealthy diets,including salt intake, may be associated with the rise of hypertension (Mashuri et al., 2022).

The factors associated with hypertension were vary. The risk of hypertension increase in male, BMI more than 25 kg/m^2, poor psychological condition, and unhealthy food (Sembiring & Utari, 2019). The results of this study illustrated in Table 2.

Table 2. Association between age, gender, BMI, and education level with hypertension

Variable	Hypertension				P
	Yes		No		
	Frequency	Percent	Frequency	Percent	
Ages					
40- <45	767	14.14	2288	30.86	<0.001
45-59	2553	47.05	3756	50.66	
>=60	2106	38.81	1370	18.48	
Gender					
Man	2348	43.27	3789	51.11	<0.001
woman	3078	56.73	3625	48.89	
BMI					
Underweight	481	8.86	883	11.91	
Normal	1686	31.07	2976	40.14	<0.001
Overweight	2630	48.47	3068	41.38	
Obese	629	11.59	487	6.57	
Education level					
No school	787	14.50	626	8.44	
Primary school	2719	50.11	3320	44.78	<0.001
High school	1495	27.55	2778	37.47	
Diploma/ Bachelor/Postgraduate	425	7.83	690	9.31	

The results showed that middle-aged was highly risk for the increasing of hypertension. It was in line with the explanation of the study that age was a predictor of having hypertension (Lamptey et al., 2017). The sosio-demographic factors among 24-74 -year-old citizens in Yangoon Myanmar showed the higher prevalence of hypertension in 2004 was in 49.9 years old, while in 2014 was lowering in 47.6 years old (Htet et al., 2017). The changing of prevalence in age could be caused by the chancing of lifestyle. Sedentary life style, central obesity and metabolic disease are also increasing in middle-age group (Peng Zhang et al., 2016).

The prevalence of women was higher than men. It was in line in Uganda, higher in women 37% (Musinguzi et al., 2018). However, our finding was not in line with many studies in other countries. In korea men were higher (Lim et al., 2017), also in China (Forouzanfar et al., 2017), in Ghana (Sanuade, Boatemaa, & Kushitor, 2018) and in Africa (Mittal & Singh, 2010). It showed that the prevalence of women were higher than men in Indonesia (Peltzer & Pengpid, 2018), correlated with the obesity that higher in women in Indonesia (Hussain et al., 2016; Peltzer & Pengpid, 2018; Sembiring & Utari, 2019) which increased the risk of hypertension (Chen et al., 2015; Vinjerui et al., 2020).

Overweight was the highest prevalence of hypertension in our finding. In many studies, obese was the highest prevalence of hypertension (Shen et al., 2019; Zhao et al., 2013). Overweight and obese were the risk factor of increased prevalence of hypertension. Moreover, the central or abdominal obesity was also essential to increase the risk of hypertension (Jovic, Marinkovic, & Vukovic, 2016).

Additionally, the education level was also associated with hypertension. The higher of the level of education, the risk of hypertension was decreased. The results was in aligned to the many studies (Jovic et al., 2016; Shen et al., 2019; Hao Wang et al., 2013; Zhao et al., 2013) revealed that low of education level was found to be predictor of hypertension.

Our findings of factors associated with hypertension were statistically significant with P<0,001.

Several limitations exist in our study. First, as a limitation of the data, we cannot provide more data. Second, the study was from 2014, but Indonesia's sosio-demographic are still very much changing, and an update study should continue to pay attention and to implement the evidence-based policy.

CONCLUSION

This study has shown the prevalence of hypertension is still high (42,26%). In addition, the middle-aged group, women, overweight and lower level of education could be the risk factors to rise the prevalence of hypertension. Future intervention should emphasize to improve the promotion of healthy lifestyle, education and inspire the population to maintain the ideal body weight.

REFERENCES

Bi, Zhenqiang, Liang, Xiaofeng, Xu, Aiqiang, Wang, Linghong, Shi, Xiaoming, Zhao, Wenhua, Ma, Jixiang, Guo, Xiaolei, Zhang, Xiaofei, Zhang, Jiyu, Ren, Jie, Yan, Liuxia, Lu, Zilong, Wang, Huicheng, Tang, Junli, Cai, Xiaoning, Dong, Jing, Zhang, Juan, Chu, Jie, Engelgau, Michael, Yang, Quanhe, Hong, Yuling, & Wang, Yu. (2014). Hypertension prevalence, awareness, treatment, and control and sodium intake in shandong province, China: Baseline results from shandong-ministry of health action on salt reduction and hypertension (SMASH), 2011. *Preventing Chronic Disease*, *11*(5), 1–15. https://doi.org/10.5888/pcd11.130423

Chen, Lixing, Zong, Yuan, Wei, Tao, Sheng, Xun, Shen, Wei, Li, Jun, Niu, Zhiqiang, Zhou, Hua, Zhang, Yang, Yuan, Yuansheng, Chen, Qin, & Zhong, Hua. (2015). Prevalence, awareness, medication, control, and risk factors associated with hypertension in Yi ethnic group aged 50 years and over in rural China: The Yunnan minority eye study. *BMC Public Health*, *15*(1). https://doi.org/10.1186/s12889-015-1687-4

Forouzanfar, Mohammad H., Liu, Patrick, Murray, Christopher J. L., et al. (2017). Global burden of hypertension and systolic blood pressure of at least 110 to 115mmHg, 1990-2015. *JAMA - Journal of the American Medical Association*, *317*(2), 165–182. https://doi.org/10.1001/jama.2016.19043

Gao, Yun, Chen, Gang, Tian, Haoming, Lin, Lixiang, Lu, Juming, Weng, Jianping, Jia, Weiping, Ji, Linong, Xiao, Jianzhong, Zhou, Zhiguang, Ran, Xingwu, Ren, Yan, Chen, Tao, & Yang, Wenying. (2013). Prevalence of Hypertension in China: A Cross-Sectional Study. *PLoS ONE*, *8*(6). https://doi.org/10.1371/journal.pone.0065938

Herningtyas, Elizabeth Henny, & Ng, Tian Sheng. (2019). Prevalence and distribution of metabolic syndrome and its components among provinces and ethnic groups in Indonesia. *BMC Public Health*, *19*(1), 1–12. https://doi.org/10.1186/s12889-019-6711-7

Htet, Aung Soe, Bjertness, Marius B., Oo, Win Myint, Kjøllesdal, Marte Karoline, Sherpa, Lhamo Y., Zaw, Ko Ko, Ko, Ko, Stigum, Hein, Meyer, Haakon E., & Bjertness, Espen. (2017). Changes in prevalence, awareness, treatment and control of hypertension from 2004 to 2014 among 25-74-year-old citizens in the Yangon Region, Myanmar. *BMC Public Health*, *17*(1). https://doi.org/10.1186/s12889-017-4870-y

Hu, Lihua, Huang, Xiao, You, Chunjiao, Li, Juxiang, Hong, Kui, Li, Ping, Wu, Yanqing, Wu, Qinhua, Bao, Huihui, & Cheng, Xiaoshu. (2017). Prevalence and risk factors of prehypertension and hypertension in Southern China. *PLoS ONE*, *12*(1), 1–15. https://doi.org/10.1371/journal.pone.0170238

Hussain, Mohammad Akhtar, Mamun, Abdullah Al, Peters, Sanne A. E., Woodward, Mark, & Huxley, Rachel R. (2016). The burden of cardiovascular disease attributable to major modifiable risk factors in Indonesia. *Journal of Epidemiology*, *26*(10), 515–521. https://doi.org/10.2188/jea.JE20150178

Jovic, D., Marinkovic, J., & Vukovic, D. (2016). Association between body mass index and prevalence of multimorbidity: a cross-sectional study. *Public Health*, *139*(5), 103–111. https://doi.org/10.1016/j.puhe.2016.05.014

Khoiry, Qisty A., Alfian, Sofa D., & Abdulah, Rizky. (2022). Modifiable and Non-modifiable Factors Associated with Low Awareness of Hypertension Treatment in Indonesia: A Cross-Sectional Population-Based National Survey. *Global Heart*, *17*(1). https://doi.org/10.5334/gh.1143

Lamptey, Peter, Laar, Amos, Adler, Alma J., Dirks, Rebecca, Caldwell, Aya, Prieto-Merino, David, Aerts, Ann, Pearce, Neil, & Perel, Pablo. (2017). Evaluation of a community-based hypertension improvement program (ComHIP) in Ghana: data from a baseline survey. *BMC Public Health*, *17*(1), 1–16. https://doi.org/10.1186/s12889-017-4260-5

Lim, Man Sup, Park, Bumjung, Kong, Il Gyu, Sim, Songyong, Kim, So Young, Kim, Jin Hwan, & Choi, Hyo Geun. (2017). Leisure sedentary time is differentially associated with hypertension, diabetes mellitus, and hyperlipidemia depending on occupation. *BMC Public Health*, *17*(1), 278. https://doi.org/10.1186/s12889-017-4192-0

Lu, Yuan, Wang, Pei, Zhou, Tianna, Lu, Jiapeng, Spatz, Erica S., Nasir, Khurram, Jiang, Lixin, & Krumholz, Harlan M. (2018). Comparison of prevalence, awareness, treatment, and control of cardiovascular risk factors in China and the United States. *Journal of the American Heart Association*, *7*(3), 1–17. https://doi.org/10.1161/JAHA.117.007462

Mashuri, Yusuf Ari, Ng, Nawi, & Santosa, Ailiana. (2022). Socioeconomic disparities in the burden of hypertension among Indonesian adults - a multilevel analysis. *Global Health Action*, *15*(1). https://doi.org/10.1080/16549716.2022.2129131

Mittal, Bharati V., & Singh, Ajay K. (2010). Hypertension in the Developing World: Challenges and Opportunities. *American Journal of Kidney Diseases*, *55*(3), 590–598. https://doi.org/10.1053/j.ajkd.2009.06.044

Musinguzi, Geofrey, Anthierens, Sibyl, Nuwaha, Fred, Van Geertruyden, Jean Pierre, Wanyenze, Rhoda K., & Bastiaens, Hilde. (2018). Factors Influencing Compliance and Health Seeking Behaviour for Hypertension in Mukono and Buikwe in Uganda: A Qualitative Study. *International Journal of Hypertension*, *2018*. https://doi.org/10.1155/2018/8307591

Musinguzi, Geofrey, & Nuwaha, Fred. (2013). Prevalence, Awareness and Control of Hypertension in Uganda. *PLoS ONE*, *8*(4). https://doi.org/10.1371/journal.pone.0062236

Owolabi, Eyitayo Omolara, Goon, Daniel Ter, Adeniyi, Oladele Vincent, & Seekoe, Eunice. (2017). Social epidemiology of hypertension in Buffalo City Metropolitan Municipality (BCMM): Cross-sectional study of determinants of prevalence, awareness, treatment and control among South African adults. *BMJ Open*, *7*(6), 1–12. https://doi.org/10.1136/bmjopen-2016-014349

Peltzer, Karl, & Pengpid, Supa. (2018). The Prevalence and Social Determinants of Hypertension among Adults in Indonesia: A Cross-Sectional Popu. *International Journal of Hypertension*, *2018*. https://doi.org/10.1155/2018/5610725

Qin, Wenzhe, Xu, Lingzhong, Li, Jiajia, Sun, Long, Ding, Gan, Shao, Hui, & Xu, Ningze. (2018). Estimating benefit equity of government health subsidy in healthcare Services in Shandong Province, China: A cross-sectional study. *International Journal for Equity in Health*, *17*(1), 1–9. https://doi.org/10.1186/s12939-018-0775-3

Sanuade, Olutobi Adekunle, Boatemaa, Sandra, & Kushitor, Mawuli Komla. (2018). Hypertension prevalence, awareness, treatment and control in Ghanaian population: Evidence from the Ghana demographic and health survey. *PLoS ONE*, *13*(11), 1–18. https://doi.org/10.1371/journal.pone.0205985

Sembiring, Lydia Gresari Br, & Utari, Diah Mulyawati. (2019). *Prevalence and Risk Factors of Hypertension among Adolescents Aged 18 to 21 Years in Indonesia*. 90–90. https://doi.org/10.26911/the6thicph.01.67

Shah, Syed M., Loney, Tom, Sheek-Hussein, Mohamud, El Sadig, Mohamed, Al Dhaheri, Salma, El Barazi, Iffat, Al Marzouqi, Layla, Aw, Tar Ching, & Ali, Raghib. (2015). Hypertension prevalence, awareness, treatment, and control, in male South Asian immigrants in the United Arab Emirates: A cross-sectional study. *BMC Cardiovascular Disorders*, *15*(1), 1–11. https://doi.org/10.1186/s12872-015-0024-2

Shen, Chi, Zhou, Zhongliang, Lai, Sha, Tao, Xingxing, Zhao, Dantong, Dong, Wanyue, Li, Dan, Lan, Xin, & Gao, Jianmin. (2019). Urban-rural-specific trend in prevalence of general and central obesity, and association with hypertension in Chinese adults, aged 18-65 years. *BMC Public Health*, *19*(1), 1–8. https://doi.org/10.1186/s12889-019-7018-4

Strauss, John, Witoelar, Firman, & Sikoki, Bondan. (2016). The Fifth Wave of the Indonesia Family Life Survey: Overview and Field Report: Volume 1. *The Fifth Wave of the Indonesia Family Life Survey: Overview and Field Report: Volume 1*, (April 2009). https://doi.org/10.7249/wr1143.1

Vinjerui, Kristin Hestmann, Vinjerui, Kristin Hestmann, Bjerkeset, Ottar, Bjerkeset, Ottar, Bjorngaard, Johan H., Bjorngaard, Johan H., Krokstad, Steinar, Krokstad, Steinar, Douglas, Kirsty A., Sund, Erik R., Sund, Erik R., & Sund, Erik R. (2020). Socioeconomic inequalities in the prevalence of complex multimorbidity in a Norwegian population: Findings from the cross-sectional HUNT Study. *BMJ Open*, *10*(6), 1–9. https://doi.org/10.1136/bmjopen-2020-036851

Wang, Hao, Zhang, Xinwei, Zhang, Jie, He, Qingfang, Hu, Ruying, Wang, Lixin, Su, Danting, Xiao, Yuanyuan, Pan, Jin, & Ye, Zhen. (2013). Factors Associated with Prevalence, Awareness, Treatment and Control of Hypertension among Adults in Southern China: A Community-Based, Cross-Sectional Survey. *PLoS ONE*, *8*(5). https://doi.org/10.1371/journal.pone.0062469

Wang, Jinwei, Zhang, Luxia, Wang, Fang, Liu, Lisheng, & Wang, Haiyan. (2014). Prevalence, awareness, treatment, and control of hypertension in China: Results from a national survey. *American Journal of Hypertension*, *27*(11), 1355–1361. https://doi.org/10.1093/ajh/hpu053

Williams, Julianne, Allen, Luke, Wickramasinghe, Kremlin, Mikkelsen, Bente, Roberts, Nia, & Townsend, Nick. (2018). A systematic review of associations between non-communicable diseases and socioeconomic status within low- and lower-middle-income countries. *Journal of Global Health*, *8*(2). https://doi.org/10.7189/jogh.08.020409

WorldHealthOrganization. (2018). *NCDs Country Profiles 2018 WHO*. 224. Retrieved from https://www.who.int/nmh/publications/ncd-profiles-2018/en/

Wu, Lei, He, Yao, Jiang, Bin, Sun, Dongling, Wang, Jianhua, Liu, Miao, Yang, Shanshan, & Wang, Yiyan. (2015). Trends in prevalence, awareness, treatment and control of hypertension during 2001-2010 in an Urban elderly population of China. *PLoS ONE*, *10*(8), 1–13. https://doi.org/10.1371/journal.pone.0132814

Yang, Li, Yan, Jing, Tang, Xinhua, Xu, Xiaoling, Yu, Wei, & Wu, Haibin. (2016). Prevalence, Awareness, Treatment, Control and Risk Factors Associated with Hypertension among Adults in Southern China, 2013. *PLoS ONE*, *11*(1), 1–14. https://doi.org/10.1371/journal.pone.0146181

Yu, Jianxing, Tao, Yuchun, Dou, Jing, Ye, Junsen, Yu, Yaqin, & Jin, Lina. (2018). The dose-response analysis between BMI and common chronic diseases in northeast China. *Scientific Reports*, *8*(1), 1–8. https://doi.org/10.1038/s41598-018-22551-y

Zhang, Fu Liang, Guo, Zhen Ni, Wu, Yan Hua, Liu, Hao Yuan, Luo, Yun, Sun, Ming Shuo, Xing, Ying Qi, & Yang, Yi. (2017). Prevalence of stroke and associated risk factors: A population based cross sectional study from northeast China. *BMJ Open*, *7*(9), 1–11. https://doi.org/10.1136/bmjopen-2016-015758

Zhang, Peng, Wang, Rui, Gao, Chunshi, Jiang, Lingling, Lv, Xin, Song, Yuanyuan, & Li, Bo. (2016). Prevalence of central obesity among adults with normal BMI and its association with metabolic diseases in northeast China. *PLoS ONE*, *11*(7), 1–10. https://doi.org/10.1371/journal.pone.0160402

Zhao, Yaling, Yan, Hong, Marshall, Roger J., Dang, Shaonong, Yang, Ruihai, Li, Qiang, & Qin, Xueying. (2013). Trends in Population Blood Pressure and Prevalence, Awareness, Treatment, and Control of Hypertension among Middle-Aged and Older Adults in a Rural Area of Northwest China from 1982 to 2010. *PLoS ONE*, *8*(4). https://doi.org/10.1371/journal.pone.0061779