



Determinants of Medication Non-Adherence among Productive-Aged Hypertensive Patients in Indonesia: A Secondary Data Analysis of Basic Health Research Database 2018

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Abstract

Background: Medication non-adherence in hypertensive patients induced disease progressivity. Several factors contribute to non-adherence to treatment, such as multidrug prescription, the relationship between doctors and patients, and barriers in health services. We aimed to analyze determinants of medication non-adherence in productive-aged hypertensive patients in Indonesia.

Methods: A cross-sectional study was conducted among 58,148 respondents across Indonesia. Covariates are gender, age, education, occupation, residence, smoking status, family member, and history of stroke, cardiovascular and diabetes mellitus. Chi-square and Binary Logistic were performed using SPSS version 21.

Results: More than half of the 58,148 hypertension patients in Indonesia (53.9%) are not taking their medication regularly. Chi-square analysis found that male gender, age groups (25 to 34, 35 to 44, 45 to 55, 56 to 64), graduated senior high school, employed workers, living in urban, smokers, four family members, and disease history correlated with non-adherence to treatment. However, Binary Logistic is obtained that age groups age groups (25 to 34, 35 to 44, 45 to 55 and 56 to 64; AOR=1.251, 1.609, 2.179, 2.424, respectively), employed workers (AOR=0.912), urban lived (AOR=1.085), smokers (AOR=0.853), more than four family members (AOR=1.146), stroke history (AOR=1.793), cardiovascular history (AOR=1.623), and diabetes mellitus history (AOR=1.489) found their significance level at 0.00. Two variables, gender and education, are not of significant.

Conclusion: Medication non-adherence in hypertensive patients has multifactorial aspects, such as in this study, including age, employed workers, living in urban areas, smokers, more prominent family members, and the history of the disease.

Keywords: Medication non-adherence; Hypertension; Indonesia; Riset kesehatan dasar (RISKESDAS)

Introduction

As a significant premature mortality in the adult population, hypertension in productive-aged 18-50-year-olds has recently raised concern worldwide (1,2). The adult population is estimated at

1.28 billion diagnosed with hypertension, and two-thirds live in low-middle-income countries (2). In a similar concern in Indonesia, the Indonesia Family Life Support (IFLS) database in



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2015 reported that among 4790 adult population 18 yr old and above, 441 were diagnosed with hypertension (3,4). According to the WHO Global Health Observatory, age-standardized hypertensive patients were 32.4 (20 to 46.3) and 28.7 (17.3 to 41.9) in 1993; 43.6 (36.9 to 50.7) and 35.5 (29 to 42.5) in 2018 among female and male respectively (5). This condition burdens hypertensive patients with complications that affect their quality of life. Increasing hypertension cases in the productive aged were likely due to treatment compliance.

Medication non-adherence affected 39% of patients prescribed medicine in hypertensive patients in Malaysia with several predictors, such as educational level, complementary medication, and non-usage of calcium channel blockers (6). Medication non-adherence has been associated with several issues, including low education level, pharmaceutical complexity, side effects, cost, time, and a poor patient-doctor relationship (7). Determinants of adherence therapy in arterial hypertensive patients were associated with the healthcare system and a few healthcare workers (8). Another study evaluated non-adherence to antihypertensive drugs in four hospitals in Ethiopia, ranging from 29% to 37% (9). Though adherence to medication in Mekonnen et al.'s study was higher than non-adherence, several factors affected these phenomena, such as educational background, less comorbidity, treatment duration, and medical cost (9). A somewhat different viewpoint presented, productive-aged respondents who live in urban areas and have strong knowledge contribute significantly to medication adherence in hypertension (10).

The study of medication non-adherence in hypertensive patients in Indonesia was proposed by Sulistiyowatiningsih and Herawati (11). Their study descriptively analyzed adherence to hypertension drugs among 289 adults, which inferred low adherence results. A similar report showed that hypertensive patients in Indonesia had low adherence at 11% compared to the highest rate in Australia at 85% (8). Medication adherence to hypertensive drugs study in Indonesia is limited. Driven concern about the impact of hypertension

in the productive-aged population, a comprehensive study is warranted to disclose determinants of medication non-adherence. Using a database from Basic Health Survey or Riset Kesehatan Dasar (RISKESDAS) provided by the Ministry of Health Republic Indonesia, medication non-adherence provided actual and complete data from a large number population across 38 provinces. Since the productive-aged population is productively working, living with hypertension poses them with morbidity such as stroke (12), kidney failure (13), and cardiovascular disease (14). Our study objective was to observe determinants of medication non-adherence among productive-aged hypertensive patients in Indonesia using RISKESDAS data. This study is impactful in providing insight and recommendations to the policymakers to handle and control non-compliance hypertension treatment, particularly among the young adult population, to prevent its harmful effects in the early stage of life.

Methods

Study design

A cross-sectional study to observe exposure and events at a point in time in a large population (15). Given the concern about design, a cross-sectional study will be conducted to highlight medication non-adherence among productive-aged hypertensive patients in Indonesia using the RISKESDAS database 2018.

This study's ethical approval was embedded in the RISKESDAS study under number LB 02.01/2/KE.267/2017.

Sampling method

The sampling method was linear systematic sampling with two-stage random sampling using census blocks selected from every district. The first stage was implicit stratification from all census blocks. According to the master frame in the census, 720,000 census blocks were found, and 180,000 census blocks (25%) were selected. The total number of census blocks selected was 30,000. The second stage was systematically

choosing ten households in every census block. According to the 2018 RISKESDAS data, 653,113 persons aged 15 to 64. Of these, 362,243 (44.5%) have checked their blood pressure be-

fore. There were 58,148 people whose exam results revealed hypertension or diagnosed with hypertension by a doctor (Fig. 1).

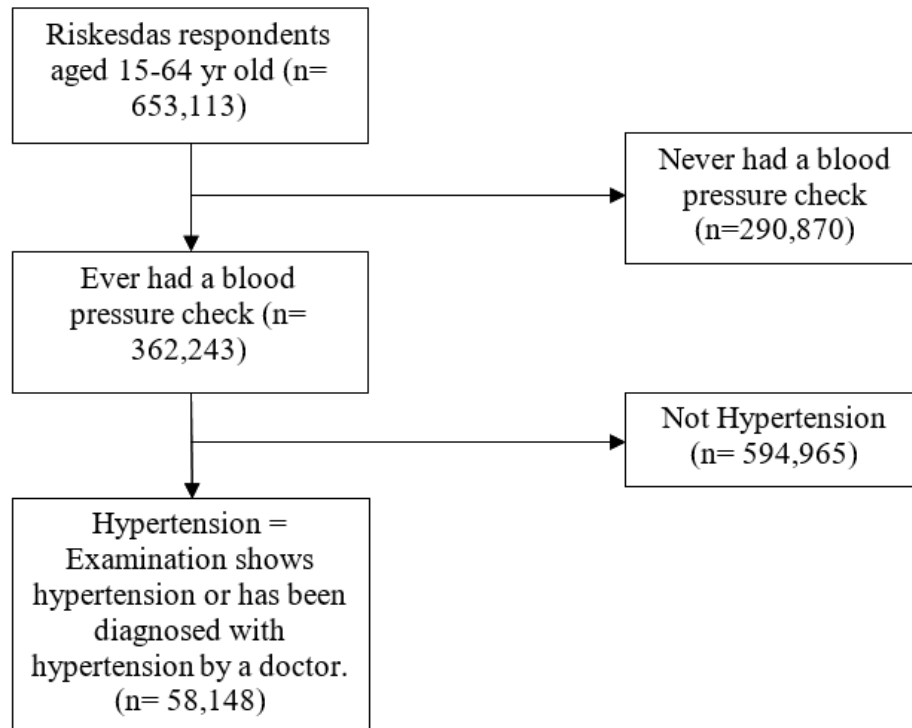


Fig. 1: Flowchart of sampling selection in participants

Data sources

Data sources this study derived from a national survey, a non-interventional cross-sectional study, and households across 38 provinces in Indonesia in urban or rural areas based on modified H.L Blum theory of determinants of health, namely Basic Health Research or Riset Kesehatan Dasar (RISKESDAS). Indicators from RISKESDAS were health accessibility, traditional health services, mental health disorders, environmental health, communicable disease, non-communicable disease, dental health, disability, behavior, mother health and reproductive, nutrition, and child health (16). Data collection from the RISKESDAS survey was conducted through interviews, measurements, examinations at both levels, and household and individual assessments. This survey was conducted in 2007, 2010, 2013,

and the latest in 2018 to arrange health policy recommendations for national development. The RISKESDAS data is beneficial and commonly published in several journals related to non-communicable disorders (17–19).

Variables

The RISKESDAS data provided a proportion of adherence to hypertension drugs routinely based on prescription or consuming antihypertensive drugs daily divided by more than 18-year-old population diagnosed with hypertension. According to the calculation, 54.40% adherence to hypertension drugs and 32.27% non-adherence among adults diagnosed with hypertension in Indonesia (16). The survey asked the respondents whether they have consumed antihypertensive drugs daily. Medication non-adherence was not

consuming antihypertensive drugs daily and vice versa. Thus, the dependent variable was medication non-adherence.

Independent variables were obtained from baseline data from the RISKESDAS data, consisting of age, gender, educational background, employment status, residence, smoking status, number of family members, and disease history.

Statistical analysis

A descriptive study was analyzed with a distribution and frequency table. Stratification was performed by age distribution, education level, and occupational status. Chi-square and Binary Logistic assessed relationships between variables to adjust confounding factors. The statistical data were set at a 95% confidence interval (CI), and data <0.05 was statistically significant. Overall

data were analyzed using SPSS ver. 21 (IBM Corp., Armonk, NY, USA).

Results

We collected data from 58,148 participants from the RISKESDAS database, 33% male and 67% female. This study found that most respondents were 45-54 yr old (35.6%), graduated from elementary school (29.8%), had unemployment status (35.4%), lived in a rural area (53.7%), never smoked (74.1%), had family members more than four (71.2%), and nothing has stroke (94.4%), cardiovascular disease (94.6%) and diabetes mellitus history (92.6%). Detailed baseline characteristic data is presented in Table 1.

Table 1: Baseline characteristic respondents (n=58,148)

Variable	n (%)
Gender	
Male	19,214 (33.0)
Female	38,934 (67.0)
Age (yr)	
15-24	1,322 (2.3)
25-34	4,336 (7.5)
35-44	12,094 (20.8)
45-54	20,687 (35.6)
55-64	19,709 (33.9)
Education	
No education	4,159 (7.2)
Not graduated from elementary school	9,893 (17.0)
Graduated elementary school	17,331 (29.8)
Graduated junior high school	8,974 (15.4)
Graduated senior high school	12,437 (21.4)
Diploma	1,609 (2.8)
Graduated under graduated	3,745 (6.4)
Occupation	
Unemployed	20,578 (35.4)
Students	478 (0.8)
Civil servants	3,519 (6.1)
Official private sector	3,067 (5.3)
Unofficial private sector	8,638 (14.9)
Farmer	13,614 (23.4)
Fisherman	545 (0.9)
Labor/driver/household assistant	3,565 (6.1)

Table 1: Continued ...

Others	4,144 (7.1)
Residence	
Urban	26,950 (46.3)
Rural	31,198 (53.7)
Smoking	
Yes	15,062 (25.9)
No	43,086 (74.1)
Family members	
>4 people	41,377 (71.2)
1-4 people	16,711 (28.8)
Stroke history	
Yes	3,271 (5.6)
No	54,877 (94.4)
Cardiovascular disease history	
Yes	3,124 (5.4)
No	55,024 (94.6)
Diabetes Mellitus	
Yes	4,288 (7.4)
No	53,860 (92.6)

Fig. 2 summarizes the prevalence of medication adherence to hypertensive agents. Briefly, patients having diseases such as diabetes, stroke, and cardiovascular disease were higher obedience, around 60%. Family members above four, smoking, living in urban areas, employed work-

ers, 15-44 yr old, low education, and male respondents were adhering to treatment at 47%, 42.3%, 47.8%, 55.5%, 37.4%, 46.9%, and 43.6%, respectively. The highest percentage obeying the treatment was having diseases, and the lowest one was 15-44 yr-old groups.

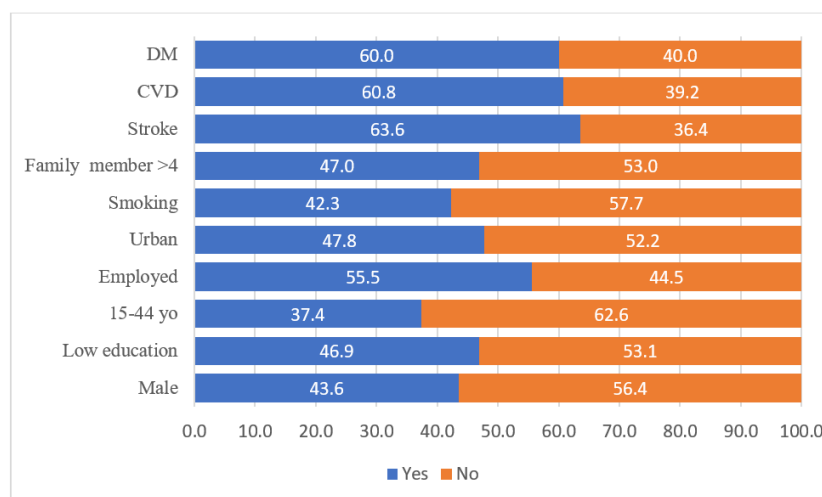


Fig. 2: Medication adherence (blue) vs non-adherence (orange) hypertensive agents based on baseline characteristics

Of the 58,148 hypertension patients in Indonesia, 31,348 (53.9%) were not taking their medication regularly (Based on primary data in the RISK-ESDAS). The prevalence of medication non-adherence in every province concluded that Jam-

bi and West Sumatra are the most nonadherent, followed by Bali, South Kalimantan, and Yogyakarta, respectively. On the other hand, the lowest prevalence is Gorontalo. Fig. 3 mentions the de-

tailed prevalence of medication non-adherence in every province in Indonesia.

The association between baseline characteristics and medication adherence among hypertensive patients is cited in Table 2.

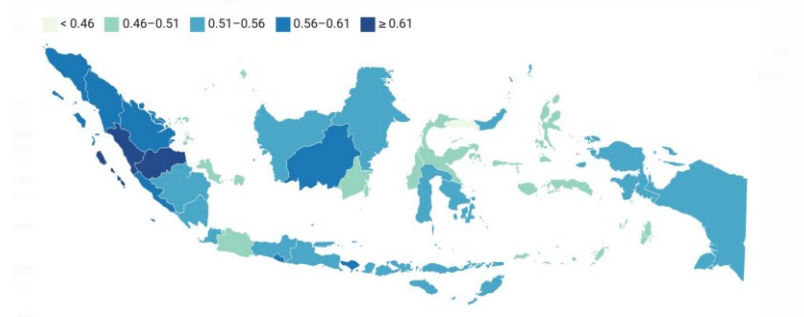


Fig. 3: Description of percentages of medication non-adherence in hypertensive patients across 38 provinces

Table 2: Determinants of medication non-adherence among hypertensive patients (n=58,148)

Variable	Medication adherence		OR (CI95)	AOR (CI95)
	No	Yes		
Gender				
Male	10841	8373	1.16 (1.12-1.20)	0.95 (0.90-1.00)
Female	20507	18427	1	1
Age (years old)				
15-24	950	372	1	1
25-34	2891	1445	1.27 (1.11-1.46)	1.25 (1.09-1.43)
35-44	7279	4815	1.68 (1.49-1.91)	1.60 (1.41-1.82)
45-54	10729	9958	2.37 (2.09-2.68)	2.17 (1.92-2.46)
55-64	9499	10210	2.74 (2.42-3.10)	2.42 (2.13-2.74)
Education				
No education	2177	1982	1.04 (0.95-1.13)	0.92 (0.84-1.01)
Not graduated from elementary school	5146	4747	1.05 (0.97-1.13)	0.97 (0.90-1.05)
Graduated elementary school	9213	8181	1.00 (0.94-1.08)	0.98 (0.91-1.05)
Graduated junior high school	4942	4032	0.93 (0.86-1.00)	0.98 (0.90-1.06)
Graduated senior high school	7013	5424	0.88 (0.82-0.95)	0.94 (0.87-1.01)
Diploma	858	751	1.00 (0.89-1.12)	1.00 (0.89-1.13)
Graduated under graduated	1999	1746	1	1
Employment status				
Employed	20864	16706	1.20 (1.16-1.24)	0.91 (0.87-0.94)
Unemployed	10484	10094	1	1
Residence				
Urban	14078	12872	0.88 (0.85-0.91)	1.08 (1.04-1.12)
Rural	17270	13928	1	1
Smoking				
Yes	8693	6369	1.23 (1.18-1.27)	0.85 (0.80-0.89)
No	22655	20431	1	1
Family members				
>4 people	21944	19433	0.88 (0.85-0.91)	1.14 (1.10-1.18)
1-4 people	9404	7367	1	1
Stroke history				
Yes	1192	2079	0.47 (0.43-0.50)	1.79 (1.66-1.93)
No	30156	24721	1	1
Cardiovascular disease history				
Yes	1226	1898	1.87 (1.74-2.01)	1.62 (1.50-1.75)
No	30122	24902	1	1
Diabetes mellitus				
Yes	1715	2573	1.83 (1.72-1.95)	1.48 (1.39-1.58)
No	29633	24227	1	1

OR is odds ratio; AOR is adjusted odds ratio; 1 is references; bold indicates statistically significant level at <0.000.

Discussion

The large-scale RISKESDAS data on medication non-adherence in hypertensive patients illustrates that age stratification over 25 yr old, urban residential location, employment status, smoking status, over four family members, stroke, cardiovascular disease, and stroke history correlate with non-adherence. In the United States of America, among insured adults prescribing antihypertensive drugs, adherence was 41.9% for 18 to 34 yr-old groups, compared to 75.6% for the 65 to 74 yr-old group (20). Another report from South Korea found that adherence to antihypertensive treatment among adults less than 40 yr old was < 40% (21). Similarly, in Japan, medication adherence to antihypertensive agents in younger patients was lower than in the elderly (22). Our study found that over 25-yr-old adults were significantly associated with non-adherence to treatment. Age stratification 15 to 44 yr old denoted 37.4% medication adherence compared to 45 to 66 yr old groups. Though statistically significant in all age groups, we noticed that young adults have higher disobedience taking drugs than the elderly, as mentioned in previous studies in the USA, Japan, and South Korea. The lower rate of hypertensive treatment adherence existed due to low awareness in young adults (21).

Our study demonstrated that living in urban areas is associated with non-adherence to medication. In urban areas, 47.8% obeyed the treatment, likely due to socioeconomic, educational background, and financial conditions between rural and urban areas in Indonesia. A contradicting result in a previous study in China was that those living in rural areas were likelier to disobey the treatment than those in urban areas (23). Additionally, employed status is correlated with non-compliance with taking medication for hypertension. Workers' medication adherence is higher than jobless at 55.5%. About 67% of participants were farmers and the private sector (16). Workers have permanent occupations and fixed salaries to spend money on disease treatment. However, potential confounding between job status and

treatment adherence was likely due to health insurance ownership not being covered in this study. A different perspective was proposed by Kim et al. in their study, which stated that working status was vulnerable to medication adherence for metabolic diseases. Workers felt relieved symptoms, forgot, distrusted with the prescription, side effects, and no effective treatment (24). In this study, smoking emerged as a protective factor. Among those completed treatment, 23.7% were smokers, and 76.2% were non-smokers. Smokers had potentially low adherence to treatment in chronic disease patients for several reasons (25). First, smokers may avoid contact with a doctor to ignore the pressure of halting smoking during the interaction. Second, smokers may avoid the harmful effects of smoking communicated by doctors. Third, smokers were more compliant with unhealthy performance (25). We assumed that smoking is a protective factor in this study due to the socioeconomic status of participants. Smokers in this study are more likely to not adhere to treatment at 42.3% than non-smokers. Lower obedience in smokers requires simultaneous intervention, including health-promoting behavior, literacy, and knowledge about smoking-induced diseases, which is vital to prevent the harmful effects of tobacco (26).

Family members are correlated with medication non-adherence in hypertensive patients, with 47% of the adherence group having more than four family members. Supporting the family of chronic disease patients is essential for successful medication. Family members are not the only ones; family support and function are also warranted (27-29). A family member of more than four people living in poverty is the primary obstacle to continuing the treatment. Though National Health Insurance covered the treatment, nonmedical costs were not. Thus, non-compliance to medication in hypertensive patients existed. Three disease history of stroke, cardiovascular and diabetes mellitus obtained their significance to medication non-adherence. However, patients with stroke, cardiovascular disease, and diabetes accounted for around 60% of those who adhered to treatment, respectively.

Chronic diseases, such as diabetes mellitus, cardiovascular, depression, and dementia, were associated with treatment non-compliance (30). Chronic diseases require multiple drugs that cause non-adherence. The assumption has been made that multiple drug prescriptions impose medication non-adherence in chronic disease patients.

Nevertheless, two studies lost their significance after adjustment in the multivariate analysis, gender, and educational level. Of the respondents, 67.0% were female, and 69.4% had a low educational level (from no education to junior high school). Females face complicated social problems in society, such as a lack of income, support from family and society, social norms, and perception compared to males (31). A study noticed a potential mediation effect of level education on medication adherence in chronic diseases (32). Our study found that most respondents had a lower education, and we did not analyze the potential mediation effect of education. Gender and educational level were not associated with medication non-adherence in this study due to the characteristics of respondents that could not be elaborated on comprehensively. Further assessment should be done to disclose these phenomena.

This study has several limitations. First, we could not evaluate the causal relationship between covariates and medication non-adherence. Cross-sectional design is a vulnerable design that exposes causal relationships. Further study, such as a prospective cohort, is warranted with the robust effect on the outcome. Second, in-depth assessment is essential, as it involves conducting interviews or focused group discussions to explore exciting phenomena that should be exposed with qualitative methods. Beyond the limitation, this is the largest study reporting medication non-adherence in productive-aged hypertensive patients from Indonesia using RISKESDAS data. The survey was conducted on a large sample scale across 38 provinces in Indonesia. Thus, this data has a robust method and sample size to reproduce for the forthcoming study.

Conclusion

Medication non-adherence in productive-aged hypertensive patients in Indonesia is associated with age over 25 yr old, employed status, living in urban, prominent family members, and a history of stroke, cardiovascular disease, and diabetes mellitus. Adherence to hypertension medication is still low for numerous variables, ranging from 37.4% for those 15-44 yr-old groups to 63.6% for those having stroke. Moreover, the prevalence of non-adherence to hypertension treatment is evenly across provinces, emphasizing West Sumatra and Jambi provinces in Sumatra Island. The treatment of hypertension is crucial to prevent complications and thus increases the risk of mortality. This result could give the government an insight into treating non-compliance and preventing the adverse effects of chronic diseases.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflicts of Interest

The authors declare that non conflict of interest

References

1. Bloch MJ (2016). The worldwide prevalence of hypertension exceeds 1.3 billion. *J Am Soc Hypertens*, 10(10):753-754.
2. PAHO. Measure your blood pressure accurately, control it, live longer! [internet]. [Cited 2023

- May 12]. Available from: <https://www.paho.org/en/events/measure-your-blood-pressure-accurately-control-it-live-longer>
3. Khasanah DN (2022). The risk factors of hypertension in Indonesia (Data study of Indonesian family life survey 5). *Journal of Public Health Research and Community Health Development*, 5(2):80-89.
4. Kurnianto A, Kurniadi D, Ruluwedrata F, et al (2020). Prevalence of hypertension and its associated factors among Indonesian adolescents. *Int J Hypertens*, 2020:4262034.
5. WHO. Prevalence of hypertension among adults aged 30-79 yr [Internet]. [cited 2023 Sep 16]. Available from: <https://www.who.int/data/gho/data/indicators/indicator-details/GHO/prevalence-of-hypertension-among-adults-aged-30-79-years>
6. Thew HZ, Ching SM, Lim HM, et al (2022). Prevalence and determinants of medications non-adherence among patients with uncontrolled hypertension in primary care setting in Sarawak, Malaysia: A cross-sectional study. *Malays Fam Physician*, 17(3):128-136.
7. Kleinsinger F (2018). The unmet challenge of medication non-adherence. *Perm J*, 22:18-033.
8. Carvalho AS, Santos P (2019). Medication adherence in patients with arterial hypertension: The relationship with healthcare systems' organizational factors. *Patient Prefer Adherence*, 13:1761-1774.
9. Mekonnen HS, Gebrie MH, Eyasu KH (2017). Drug adherence for antihypertensive medications and its determinants among adult hypertensive patients attending in chronic clinics of referral hospitals in Northwest Ethiopia. *BMC Pharmacol Toxicol*, 18(1):27.
10. Getenet A, Tesfa M, Ferede A (2019). Determinants of adherence to antihypertensive medications among adult hypertensive patients on follow-up in Hawassa Referral Hospital: A case-control study. *JRSM Cardiovasc Dis*, 13(8):204800401989275.
11. Sulistiyowatiningsih E, Herawati M (2017). A multicenter study treatment adherence of hypertension focused on primary health care in Indonesia. *Asian Journal of Pharmaceutical and Clinical Research*, 10:24-27.
12. Fishman B, Bardugo A, Zloof Y, et al (2023). Adolescent hypertension is associated with stroke in young adulthood: a nationwide cohort of 1.9 million adolescents. *Stroke*, 54(6):1531-1537.
13. Tsur AM, Akavian I, Derazne E, et al (2022). Adolescent blood pressure and the risk for early kidney damage in young adulthood. *Hypertension*, 79(5):974-983.
14. Nwabuo CC, Appiah D, Moreira HT, et al (2021). Long-term cumulative blood pressure in young adults and incident heart failure, coronary heart disease, stroke, and cardiovascular disease: The CARDIA study. *Eur J Prev Cardiol*, 28(13):1445-1451.
15. Wang X, Cheng Z (2020). Cross-Sectional Studies: Strengths, Weaknesses, and Recommendations. *Chest*, 158(1S):S65-S71.
16. Badan Penelitian dan Pengembangan Kesehatan. Laporan Nasional RISKESDAS 2018. [Cited 2023 May 12]. <https://repository.badankebijakan.kemkes.go.id/id/eprint/3514/1/Laporan%20Risikesdas%202018%20Nasional.pdf>
17. Nurwanti E, Hadi H, Chang JS, et al (2019). Rural-urban differences in dietary behavior and obesity: Results of the riskesdas study in 10-18-year-old Indonesian children and adolescents. *Nutrients*, 11(11):2813.
18. Arifin H, Chou KR, Ibrahim K, et al (2022). Analysis of modifiable, non-modifiable, and physiological risk factors of non-communicable diseases in Indonesia: evidence from the 2018 Indonesian Basic Health Research. *J Multidiscip Healthc*, 15:2203-2221.
19. Azam M, Sulistiana R, Fibriana AI, et al (2021). Prevalence of mental health disorders among elderly diabetics and associated risk factors in Indonesia. *Int J Environ Res Public Health*, 18(19):10301.
20. Chang TE, Ritchey MD, Park S, et al (2019). National rates of nonadherence to antihypertensive medications among insured adults with hypertension. *Hypertension*, 74:1324-1332.
21. Kim HC, Cho HC (2018). Korean Society Hypertension (KSH); Hypertension Epidemiology Research Working Group. Korea hypertension fact sheet 2018. *Clin Hypertens*, 24:13.
22. Nishimura S, Kumamaru H, Shoji S, et al (2020). Adherence to antihypertensive medication and its predictors among non-elderly adults in Japan. *Hypertens Res*, 43(7):705-714.

23. Pan J, Yu H, Hu B, et al (2022). Urban-rural difference in treatment adherence of chinese hypertensive patients. *Patients Prefer Adherence*, 16:2125-2133.
24. Kim H, Lee W, Koo JW (2022). Status and risk of noncompliance of adherence to medications for metabolic diseases according to occupational characteristics. *J Clin Med*, 11(12): 3484.
25. Sherman BW, Lynch WD (2014). The association of smoking with medical treatment adherence in the workforce of a large employer. *Patient Prefer Adherence*, 8:477-486.
26. Celebi C, Calik-Kutukcu E, Saglam M, et al (2021). Health-promoting behaviors, health literacy, and levels of knowledge about smoking-related diseases among smokers and non-smokers: a cross-sectional study. *Tuberc Respir Dis*, 84(2):140-147.
27. Lutfian L, Azizah A, Wardika IJ, et al (2024). The role of family support in medication adherence and quality of life among tuberculosis patients: A scoping review. *Jpn J Nurs Sci*, 22(1):e12629.
28. Rindayati R, Nasir A, Rizal C (2022). The relationship of family roles to medication adherence in schizophrenia patients. *Journal of Vocational Nursing*, 2(2):113-118.
29. Ni H, Lin Y, Peng Y, et al (2022). Relationship between family functioning and medication adherence in Chinese patients with mechanical heart valve replacement: a moderated mediation model. *Front Pharmacol*, 13:817406.
30. Reading SR, Black MH, Singer DE, et al (2019). Risk factors for medication non-adherence among atrial fibrillation patients. *BMC Cardiovasc Disord*, 19(1):38.
31. Rao P (2020). Poor medication adherence in women—the tip of a gender inequity iceberg? *Indian Journal of Cardiovascular Disease in Women*, 5:313-314.
32. Zhu X, Wen M, He Y (2023). The relationship between level of education, cognitive function and medication adherence in patients with schizophrenia. *Neuropsychiatr Dis Treat*, 19:2439-2450.