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Logistic Regression Analysis of Factors Affecting Medication Adherence in Hypertensive Patients at a Private Hospital in Jakarta

Farida Tuahuns[1], Alifa Sabrina[2], Fitri Savitri[3], Benjamin Atta Owusu[4], Nitinun Pongsiri[5], Mira Nurhalizah[6]
[1,2,3,6]Pharmacy Study Program, IKIFA College of Health Sciences, East Jakarta, Indonesia
[4]University of Exeter, Exeter Collaboration for Academic Primary Care, University of Exeter, Exeter, United Kingdom
[5]National Health Foundation, Reoriented Holistic Health Service Delivery Institution, Bangkok, Thailand
faridatuahuns@gmail.com, alifasabrina@ikifa.ac.id, fitrisavitri@ikifa.ac.id , benteeta@gmail.com, pnitinun@gmail.com, miranurhalizah3@gmail.com

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ABSTRACT

Hypertension is one of the Non-Communicable Diseases (NCD) that can lead to serious conditions such as heart disease, stroke, or death. It can't be cured; patients need lifelong medication. That is why adherence to treatment is a must for hypertensive patients. This study aims to investigate the relationship between sociodemographic, clinical factors and medication adherence among hypertension patients at a private hospital in Jakarta. This study is a pilot study using a cross-sectional method with 97 hypertensive patients. Patient medication adherence was assessed using the validated ProMAS questionnaire. The patients' scores were then divided into two categories: good and poor adherence, based on 80% of the total score. Binary logistic regression was used to identify factors associated with adherence, with model selection based on the Akaike Information Criterion (AIC). The Pseudo-R^2 by Nagelkerke was used in this study for the model's goodness-of-fit, with a value of 0.232 (23.2%). The results showed that 74 (76.3%) patients had poor adherence, while 23 (23.7%) patients had good adherence. Among all the socioeconomic and clinical variables, only the education variables showed a significant correlation with medication adherence. Patients with college and junior high school education levels were more likely to be compliant compared to those with senior high school education (OR = 10.42 and OR = 8.75, respectively). The results of this study show that medication adherence among hypertensive patients in private hospitals varies based on patients' backgrounds. The findings highlight the need for hospital policies, such as health education programs based on the patients' education levels, in order to improve the effectiveness of long-term hypertension management.

ABSTRAK

Hipertensi merupakan salah satu penyakit tidak menular yang seringkali terabaikan dan menyebabkan penyakit sepeti jantung dan stroke, bahkan menyebabkan kematian. Kepatuhan dalam pengobatan merupakan hal penting dikarenakan hipertensi memerlukan pengobatan sepanjang hidup. Penelitian ini bertujuan untuk mengetahui hubungan antara faktor sociodemografi dan klinis dengan kepatuhan minum obat pasien hipertensi di salah satu rumah sakit swasta di Jakarta. Penelitian ini berbentuk *pilot study* dengan menggunakan *metode cross sectional* dengan sampel 97 pasien. Kepatuhan pasien diukur menggunakan kuesioner ProMAS yang telah divalidasi dan dikategorikan kedalam dua kategori, yaitu *good* dan *poor* berdasarkan 80% dari skor total. Uji *binary logistic regression* digunakan untuk mengetahui faktor-faktor yang berhubungan dengan kepatuhan,

dimana seleksi model berdasarkan *Akaike Information Criterion* (AIC). Penelitian ini menggunakan Pseudo-R^2 by Nagelkerke untuk menguji kelayakan model dengan nilai sebesar 0,232 (23,2%). Hasil penelitian menemukan bahwa 74 (76,3%) menunjukkan kepatuhan rendah dan 23 (23,7%) memiliki kepatuhan baik. Pada penelitian ini, hanya variable pendidikan yang berkorelasi secara significant dengan kepatuhan. Pasien yang memiliki tingkat pendidikan *college* dan *junior high school* memiliki peluang lebih besar untuk patuh dibandingkan yang memiliki pendidikan *senior high school* (OR = 10,42 dan OR = 8,75). Hasil penelitian ini menunjukkan adanya perbedaan dalam kepatuhan pengobatan pada pasien hipertensi di rumah sakit swasta yang berkaitan dengan karakteristik pasien. Perlu adanya kebijakan internal rumah sakit pada pengembangan program edukasi kesehatan yang dapat disesuaikan dengan tingkat pendidikan pasien, sebagai strategi untuk meningkatkan efektivitas manajemen hipertensi dalam jangka panjang.

A. INTRODUCTION

Hypertension or high blood pressure is one of Non-Communicable Diseases (NCD) which often appeared without complaints. It has become major cause of heart disease, kidney failure, stroke and leads to death (Mills et al., 2020). The World Health Organization (WHO) estimates, there are 1.28 billion adults aged 30-79 years have hypertension, which is 46% of them unaware of their condition (World Health Organization, 2023). In Indonesia, the Riskesdas survey reported a hypertension prevalence of 34.1% among adults, with only 36.7% receiving treatment (Departemen Kesehatan RI, 2018). Low adherence with treatment not only worsens health but also increases the medical costs that must be paid by patients (Burnier & Egan, 2019). Most patients who have low adherence with treatment mainly due medication side effects, complexity of drug regiments, difficulty in accessing health facilities, and lack of the knowledge (Wahyuni et al., 2019).

Factors that can influence medication adherence of hypertensive patients are divided into five categories, such as patient-centered factors (age, ethnicity gender, education and knowledge, marital status, patients' belief and motivation of therapy, smoking or alcohol intake); therapy-related factors (duration of treatment periode); healthcare system factors (lack of accessibility); social and economic factors (cost and income) and disease factors (severity of the disease) (Alefan et al., 2019; Fauziani et al., 2024; Gutierrez & Sakulbumrungsil, 2021; Jin et al., 2008; Prihatin et al., 2022; Soesanto et al., 2021). Based on the previous research, it showed that medication adherence influence by combination of socioeconomics and clinical factors. Socioeconomics factors such as level of education and job status related to the incidence of the hypertension, where reducing the socioeconomics inequality can control it (Benu et al., 2023; Bhattarai et al., 2021; Luo et al., 2024; Mashuri et al., 2022; Wicaksono et al., 2021; Yuliyana et al., 2018). Aside of the socioeconomics factor, the WHO has identified evidence of long-term therapy also impact of medical adherence (World Health Organization, 2003).

Although many studies have examined the determinants of hypertension and medication adherence in Indonesia, most of these studies have either focused on Public Health Centres

(Puskesmas) (Fauziani et al., 2024; Prihatin et al., 2022; Wicaksono et al., 2021) or used National Survey Data (Mashuri et al., 2022). However, studies on medication adherence using hospital-based data in Indonesia remain limited, highlighting the need for further analysis in such settings. This study uses data from one of private hospitals in Jakarta, where the data was collected directly by researchers based on patient medical records and questionnaires distributed directly to patients. Patients' medication adherence was assessed using the validated ProMAS questionnaire. As a pilot study, this research aims to explore the relationship between medication adherence with demography and socioeconomic factors (age, gender, level of education, employment status) and therapy-related factors (duration of hypertension and comorbidities). The results of this research can be directly applied in the hospital where the research was conducted.

B. METHODS

This is a pilot cross-sectional quantitative study on medication adherence of hypertensive patients at a private hospital in Jakarta, April to May 2024. The aim of this pilot study for initial exploration to identify key factors in a hospital environment collection that can be use for further research. The target population in this study was hypertensive patients who were undergoing treatment at the hospital. A sample of 97 patients were selected by convenience sampling based on the inclusion criteria. The following inclusion criteria are aged 19 years or older with hypertension diagnosed; had complete medical records including treatment history (age, gender, education level, occupational status, duration of hypertension treatment, and comorbidities) and had filled out the ProMAS questionnaire; and at least three times regular treatment. This study used a convenience sampling technique, which is particularly appropriate for pilot studies focused on initial exploration (Hulley et al., 2013). By involving all patients who met the inclusion criteria during the study period, this approach ensured a representative sample within this clinical setting, regarding the local patient population. The minimum sample (n) size was calculated using equation 1 below (Wolfgang Viechtbauer et al., 2015), at 95% confidence.

$$n = \frac{\ln(1-y)}{\ln(1-\pi)} = \frac{\ln\,(1-0{,}95)}{\ln(1-0{,}05)} = \frac{\ln\ 0{,}05}{\ln\ 0{,}95} = 58{,}40 \approx 59$$

Where y is desired confidence level 95% confidence level and π is assumed probability of the problem/event occurring in any one participant (e.g. 0.05 if we expect 5% chance). Based on the equation 1, the minimum size for this pilot study is 59 participants. However, in this study, 97 patients were used as samples to increase the opportunity to analyze factors related to medication adherence.

Hypertensive patients who were eligible were invited to participate in the study. Upon agreement to participate in the study, informed consent forms were signed. This study was approved by the Ethics Committee from the hospital itself (No. 250/VIII/E.4/2024) before the data collection. For illiterate patient or older patients, the researcher read the question items word by word exactly as the appeared on the questionnaires. This study collected demographic and adherence data from the participants.

1. Demographic Questionnaire

The demographic data included age, gender, occupation and education status. Also, clinical information such as the existence of comorbidities, and years since hypertension diagnosis were collected. These data were used as independent variables in the analysis, while the ProMAS adherence score was used as the dependent variable.

2. Medication Adherence Questionnaire

ProMAS questionnaire was used to measure the medication adherence of hypertensive patients. The ProMAS questionnaire, originally written in English, translation into Bahasa Indonesia has done together with validity and reliability test (Ardeliani et al., 2021). It consists of eighteen questions with answer options Yes and No. Each question is scored 1 point, and the total possible score is 18 points. Based on the research, ProMAS questionnaire cover wider range of adherence behaviours of the patients compare to the widely used Medication Adherence Report Scale (MARS) developed by Horne and Winman (Kleppe et al., 2015). Categorical of the ProMAS score are below:

Table 1. Categories of ProMAS Score

Categories	Score
Low	0-4
Medium-Low	5-9
Medium-High	10-14
High	15-18

However, in this study, the adherence score was categorized as good adherence or poor adherence using a threshold of 14/18 (Burnier et al., 2013). This threshold corresponds to 80% of the total score, which is an empirically recognized level in clinical research. This binary categorization to accommodate the binary logistic regression to assess the association between medication adherence and sociodemographic and clinical factors. A stepwise backward elimination method base on the Akaike Information Criterion (AIC) was then used to refine the model, where the results were presented as Odd Ratios (OR) with 95% confidence intervals. The Pseudo-R^2 by Nagelkerke was used to determine model goodness-of-fit (Hua et al., 2025). Statistical analysis in this study was performed using R software, where descriptive statistics served to summarize the patients' sociodemographic and clinical characteristics.

C. RESULT AND DISCUSSION

1. Result

In order to identify which demographic and clinical factors were significantly associated with medication adherence, there some series of statistical analyses. These steps are outlined below.

a. Descriptive Analysis

Before the analysis, the variables age and number of comorbidities were changed into categories (factors). Also, medication adherence was categorized into two levels: poor and good adherence. The study sample contained 97 hypertensive patients aged between 29 and 59 years, with the mean and median of age are 49.36 and 50 years, respectively. There were 68 (70.1%) women and 29 men (29.9%). The description of the data is summarised in Table 2 below.

Table 2. Description of the data

Variable	Categories	Adherence = 0 (Poor)	Adherence = 1 (Good)	Test Statistic	P-Value
Total		**74**	**23**		
Age	40-49	24 (32.4%)	12 (52.2%)	Chi-sq (2	0.214
	50-59	43 (58.1%)	10 (43.5%)	df) = 3.09	
	Below 40	7 (9.5%)	1 (4.3%)		
Gender	Female	48 (64.9%)	20 (87%)	Chi-sq (1	0.043
	Male	26 (35.1%)	3 (13%)	df) = 4.09	
Education	Senior High School	50 (67.6%)	8 (34.8%)	Fisher's exact test	<0.001
	College	3 (4.1%)	5 (21.7%)		
	Elementary School	16 (21.6%)	3 (13%)		
	Junior High School	5 (6.8%)	7 (30.4%)		
Occupation	Employed	22 (29.7%)	3 (13%)	Chi-sq (1	0.11
	Unemployed	52 (70.3%)	20 (87%)	df) = 2.55	
Years with Hypertension	< 5	42 (56.8%)	13 (56.6%)	Chi-sq (1	0.984
	≥ 5	32 (43.2%)	10 (43.5%)	df) =0	
Number of Comorbidities	> 2	8 (10.8%)	1 (4.3%)	Fisher's	0.681
	$0 - 2$	66 (89.2%)	22 (95.7%)	exact test	

There were 74 patients (76.3%) have a poor adherence (Score <14) and 23 patients (23.7%) have a good adherence (Score ≥14). Most of the hypertensive patients were female 68 (70.1%), had a high school education 58 (59.8%), were unemployed 72 (74.2%), and had been on medication for less than 5 years 55 (56.7%). There are 88 patients (90.7%) with 0 or 1 comorbidities and only 9 patients (9.3%) who have 2 or more comorbidities, such as Diabetes Mellitus, Dyspepsia, Gout, and Cholesterol. Most of the comorbid they have related to Diabetes Mellitus. Table 2 shows that using the Chi-square for the gender variable and the Fisher test for the education variable show the significant correlation with medication adherence because the p-value < 0.05.

b. Logistic Regression

A binary logistic regression was used in this study to assess the association between sociodemographic and clinical factors with medication adherence, as shown in Table 3 below.

Table 3. Logistic Regression Analysis of Medication Adherence Predictors

Variable	Estimate	Std. Error	Z Value	p-value
(Intercept)	-0.7324	1.6729	-0.438	0.6615
Gender Male	-1.2847	0.8624	-1.490	0.1363
Age 50-59	-1.0859	0.6234	-1.742	0.0815
Age Below 40	-1.5801	1.4515	-1.089	0.2764
Education College	2.3326	0.9408	2.479	0.0132
Education Elementary School	-0.0367	0.8010	-0.046	0.9634
Education Junior High School	2.0194	0.7823	2.581	0.0098
Occupation Unemployed	0.3294	0.9485	0.347	0.7283
Year with Hypertension ≥5	-0.4772	0.5938	-0.804	0.4216
Number of Comorbidities 0-2	-0.1338	1.1967	-0.112	0.9110

Bivariate analysis on the table 3, showed that gender and education were significantly associated with medication adherence. However, by using the binary logistic regression, the results show that only the education variable was significant. Then a stepwise backward elimination based on Akaike Information Criterion (AIC) was used to refine the model, including all variables. The AIC for the full model with all variables was 102.46, where only education showed significant results. A lower AIC value means that the model fits better with fewer unnecessary variables, where the AIC dropped to 97.998, and only included the education variable.

c. Model Interpretation

According to sociodemographic and clinical factors, there is only the education variable have the significant correlation with medication adherence. Table 4 below shows the odds ratio of the education variable.

Table 4. Odds Ratio (OR) of Education Level on Medication Adherence

Education Level	OR	95% CI (Lower-Upper)	p-value
College	10.42	2.07-52.33	0.004
Elementary School	1.17	0.28-4.95	0.829
Junior High School	8.75	2.23-34.40	0.002

Patients with college education and junior high school education were 10.42 and 8.75 times more likely to have good medication adherence than those with senior high school education (as a reference category), respectively.

2. Discussion

The data preparation was done before the analysis, such us regrouping the age variable, number of comorbidities, and medication adherence. Although ProMAS questionary was using four categories (low, medium-low, medium-high, and high), in this study, it was dichotomized into two categories (poor and good adherence) for using logistic regression. The cut-off point was determined based on a total score threshold of 14/18 (Burnier et al., 2013). According to the results in Table 3, it shows that there is a significant association between education and medication adherence. Based on the Health Belief Model (HBM) and the Theory of Planned Behavior (TPB), medication adherence is driven by a patient's beliefs and intentions, both of which are significantly influenced by their level of knowledge. This is further supported by research findings demonstrating a strong correlation between health beliefs and treatment adherence among patients with hypertension (Laili et al., 2023) and diabetes (Harun & Chandra, 2025; Maulidah et al., 2023). However, the gender variable showed a significant correlation in the bivariate analysis using chi-square; however, it was no longer significant in the logistic regression. This shift indicates that the effect of gender is likely confounded by education level or other socio-economic factors.

The study found that hypertensive patients who have college degrees (OR = 10.42) were about 10 times more likely to have good adherence compared to patients who have senior high school degrees. Patients with junior high school degrees (OR = 8.75) show similar results; they were about 9 times more likely to be adherent than patients with senior high school degrees. This may be explained by the fact that patients with a higher education level

are more likely to understand the importance of adhering to prescribed treatments (Lahdji et al., n.d.). This result is supported by the previous study that showed that patients with higher education tend to follow the medication instructions (Andala et al., 2024). The Pseudo-R^2 by Nagelkerke was used in this study for the model's goodness-of-fit, with a value of 0.232 (23.2%). In a clinical study, a Pseudo-R2 value above 0.15 is generally considered "good." (Hua et al., 2025).

This study used hospital-based data, which can be used for policy-making in the hospital itself. The study's results indicate that education is the strongest predictor of patient adherence. Higher levels of education correlate with increased consistency in following treatment plans (AO et al., 2020). These findings imply that successful hypertension management depends on improving health literacy through patient education. These findings suggest that hospitals may enhance medication adherence by adopting simplified visual aids in patient education, based on the specific educational levels of the patients.

The used of the validated ProMAS questionnaire strengthens the reliability of the findings. However, this study has a small sample size and used a convenience sampling technique, which may limit the generalization of the results beyond this specific study population. Furthermore, there are other unmeasured factors, such as patient motivation or the quality of doctor-patient communication, that could also influence medication adherence behavior."

D. CONCLUSION AND SUGGESTIONS

The shift in significance correlates for gender, shows importance of considering the confounding factors in the medication adherence study. Among the several variables, education was significantly associated with medication adherence in hypertensive patients. It implies that healthcare providers can focus more on educational interventions to improve the medication adherence of patients. The study results indicate that effective hypertension treatment within a hospital environment is significantly reliant on addressing disparities in health literacy. Consequently, the findings emphasize the necessity for hospitals to develop internal policies that go beyond standard patient education, specifically by implementing interventions based on different education levels. Therefore, hospitals could provide simple pictures and check the patient's understanding directly to help those with lower education follow their treatment plan correctly.

For upcoming research, it is suggested to utilize either a longitudinal or mixed-method design. A longitudinal method would be beneficial for tracking the evolution of adherence patterns over time, whereas a mixed-method approach could offer richer qualitative insights into patient motivation and the sociocultural factors that this study did not adequately address. Such investigations are essential for creating a more thorough and sustainable approach to enhancing long-term medication adherence.

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