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RESEARCH ARTICLE

Determinants of Blood Pressure Control and Prevalence of Hypertension in Adults in 2017: A Population-Based Study in West Jakarta

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Abstract:

Background:

The high prevalence of hypertension in developing countries underlines the need for accurate data on the prevalence of adult hypertension, as well as patient characteristics and determinants of blood pressure control. As this information is currently not available, our aim was to collect such data from a population of patients in the Tegal Alur Administrative Village, West Jakarta Indonesia.

Objective:

We conducted a case-control study (n = 152) to identify determinants of hypertension and a cross-sectional study (n = 3842) to determine hypertension prevalence and investigate determinants of blood pressure control in hypertensive adults (≥18 years old).

Methods:

The cross-sectional design involved the diagnosis of hypertension via home visits (active detection) and routine clinical examinations at the Tegal Alur II Community Health Center (passive detection). In the case-control design, the groups were sex-matched.

Results:

In 2017, the prevalence of hypertension in adults in Tegal Alur was 16.8% (n = 646), and the rate of uncontrolled hypertension was 89% (n = 572). A multivariate analysis showed that the adjusted prevalence ratio for comorbidities was 2.1 (95% confidence interval [CI]: 1.48–3.12; *p* = 0.005). A body mass index indicative of being overweight (≥23 kg/m^2) had an odds ratio of 2.25 (95% CI: 1.14–4.44; *p* = 0.016).

Conclusion:

Comorbidities were the strongest predictor of uncontrolled blood pressure in hypertensive adults of Tegal Alur. Being overweight (BMI ≥23 kg/m^2) was significantly associated with hypertension.

Keywords: Determinants, Blood pressure control, Prevalence of hypertension, Population-based study, West Jakarta, Indonesia.

1. INTRODUCTION

In 2008, approximately 40% of individuals worldwide over the age of 25 years were diagnosed with hypertension

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[1]. In the Southeast Asia region, 35% of adults were diagnosed with hypertension and 9.4% of all deaths were related to hypertension [2]. In 2013, the prevalence of hypertension in adults in Indonesia was reported to be 26.5% based on the National Health Survey conducted by Indonesia's Ministry of Health [3]. In Jakarta, the capital city of Indonesia, the prevalence of hypertension in adults was 20% [3]. In low-income countries, half of the patients with hypertension are not aware of the methods to control their blood pressure [4]. Uncontrolled blood pressure contributes to cardiovascular and cerebrovascular disease. In 2013, the World Health Organization (WHO) reported that hypertension accounted for 45% of cardiovascular-related deaths and 51% of stroke-related deaths [1].

There are known risk factors for hypertension such as high-fat, high-salt diets, low dietary intake of vegetables and fruits, being overweight, obesity, excessive alcohol consumption, physical inactivity, age, genetic factors, psychological stressors, and socioeconomic factors [4]. A study by Rahajeng [5] showed that biological factors, such as age, male sex, overall obesity, and abdominal obesity were significantly associated with hypertension in adults. With regard to psychosocial factors, a study by Xu [6] and Carvalho [7] showed that there was a significant association between hypertension and quality of life. Furthermore, a study by Cois [8] showed that there was a significant association between socioeconomic status (income bracket and education) and blood pressure in adults.

Currently, there is no population-based study available in Indonesia that has obtained data on the determinants of blood pressure control and the prevalence of hypertension in adults, specifically in areas comprising low socioeconomic populations like Tegal Alur Administrative Village. A previous study in Indonesia by Hussain [9] showed that there was a significant association between blood pressure control and abdominal circumference, but the subjects of that study were limited to adults aged ≥40 years. The effects of medication adherence, quality of life, and other determinants of blood pressure control in hypertensive adults of Jakarta remain unknown.

Owing to the high prevalence of hypertension in developing countries such as Indonesia, there is a need for accurate data regarding the annual prevalence of hypertension in adults, as well as knowledge of patient characteristics and determinants of blood pressure control in hypertensive adults. This study aimed to gain an accurate understanding of the characteristics of hypertensive adults in areas with low socioeconomic status.

2. MATERIAL AND METHODS

2.1. Study Designs

This study used two study designs: cross-sectional and case-control. The objective of the cross-sectional design was to determine the prevalence of hypertension and to identify determinants of blood pressure control as well as the characteristics of hypertensive adults in the Tegal Alur Administrative Village in 2017. The objective of the case-control design was to determine the relationship between risk factors (physical activity, smoking, comorbidities, and Body Mass Index [BMI]) and the prevalence of hypertension in adults in the Tegal Alur Administrative Village. The subjects in the case-control design were also interviewed to identify the differences in quality of life between hypertensive and normotensive adults.

2.2. Time and Location of the Study

The Tegal Alur II Community Health Center is located in the Tegal Alur Administrative Village, Kalideres Subdistrict, West Jakarta. The working area of Tegal Alur II Community Health Center consists of six neighborhoods: RW 04, RW 05, RW 10, RW 11, RW 15, and RW 16. Home visits to RW 04, RW 05, and RW 15 were conducted in 2017 by staff members of the Tegal Alur II Community Health Center. Secondary data from home visit reports (active detection) and routine clinical visits for 2017 (passive detection), including interviews and BMI measurements, were obtained from January to February 2018.

2.3. Sampling Methods

In the cross-sectional design, we used a total sampling approach for citizens residing in the RW 04, RW 05, and RW 15 neighborhoods. We included adult patients aged ≥18 years. The estimated minimum sample size required to obtain the prevalence of hypertension in our study population was 61.4 (rounded to 62). This number was based on the prevalence of hypertension in Jakarta in 2013, which was 20% [3], a 10% margin of error, and a critical value of 1.96. To identify blood pressure control determinants, we estimated that the minimum sample size required would be 571, assuming a standard effect of 0.8, based on a study by Menanga [10], and critical values of 1.96 and 0.84.

In the case-control design, a consecutive sampling approach was used for patients visiting the Community Health

Center. We included subjects aged ≥40 years and the groups were sex-matched. The minimum sample size needed to identify determinants of the prevalence of hypertension was 152, assuming an expected odds ratio (OR) of 2 and critical values of 1.96 and 0.84.

2.4. Procedures and Instruments

Home visits (active detection) were conducted in 2017. All blood pressure measurements were taken by trained Tegal Alur II Community Health Center staff members using the patient's right arm. Routine clinical visits (passive detection) of the hypertensive patients in 2017 were documented in their medical records. All hypertensive patients living in the RW 04, RW 05, and RW 15 neighborhoods were included in the study. The authors screened medical records for duplicate information, as some of the hypertensive patients were also examined in home visits.

In the case-control design, all patients who fulfilled the inclusion criteria were interviewed. Before the interviews, the patient's height and weight measurements were taken using a mechanical beam scale with a height rod. The measurements were performed by trained staff blinded to the study participants. Quality of life data of the patients were measured using the Health-Related Quality of Life Short Form-36 (HRQoLSF-36) which is a validated questionnaire containing 36 items with both physical and mental components.

2.5. Covariates

In the cross-sectional design, the following variables were considered to be risk factors for blood pressure control: sex, age, highest educational level achieved, income bracket, medication adherence, comorbidities, and the setting/location where hypertension was first diagnosed/detected. The patients were divided into three categories according to age: ≤49 years, 50-59 years, and ≥60 years. The categories of the highest educational level achieved comprised the following: Illiterate, elementary school, junior high school, senior high school, and college. Monthly income brackets were categorized based on the Provincial Monthly Wage (PMW) of Jakarta in 2017. The standard PMW was Rp 3,335,750. The income bracket categories included the following: below PMW, at PMW, and above PMW. Medication adherence categories comprised adherence and non-adherence. At our Community Health Center, antihypertensive agents were given for one week to all patients, based on the guidelines of Indonesia's National Health Insurance. Therefore, patients were considered adherent to the treatment regimen if they received the antihypertensive prescriptions from the physicians once a week, which was recorded in the medical records. Due to the low frequencies, the comorbidities were divided into two categories: Comorbidities (diabetes mellitus, cardiovascular disease, and cerebrovascular disease) and no comorbidities. The detection of hypertension was dependent on the location where the patient was first diagnosed and was divided into two categories: Community Health Center (passive detection) and home visit (active detection).

In case-control design, the following variables were considered to be risk factors for hypertension: Physical activity, smoking habits, comorbidities, and BMI. The physical activity categories comprised physically active and physically inactive. The criteria for physical activity included aerobic activity (running, walking, or cycling) performed three to four times a week for at least 30 minutes in each episode. Smoking habits were divided into two categories: smokers and non-smokers. The comorbidities were categorized into two groups: Comorbidities (presence of a history of diabetes mellitus, cardiovascular disease, and cerebrovascular disease) and no comorbidities (absent). Two categories of BMI were used in this study: Normoweight (BMI <23 kg/m^2) and overweight (BMI ≥23 kg/m^2).

2.6. Outcomes

In the cross-sectional design, the clinical outcomes were controlled blood pressure or uncontrolled blood pressure. To assess the patient's blood pressure control, the mean blood pressure measurements of three recent visits were obtained from the Community Health Center's medical records. During the home visits, the mean blood pressure of two measurements with a 5-minute interval was obtained to assess the patient's blood pressure control. The patient's self-reported history of uncontrolled blood pressure was also taken in both settings and included in the medical records and the home visit reports. In the case-control design, the groups were divided into hypertensive and normotensive groups. We adhered to the Joint National Committee (JNC) 2003 criterion for hypertension [11], which was defined as elevated blood pressure of ≥140/90 mmHg. Patients with blood pressure <140/90 mmHg were stratified into the controlled blood pressure (in the cross-sectional design) and normotensive (in the case-control design) groups. For patients with comorbidities, a blood pressure of <130/80 mmHg was defined as controlled blood pressure.

2.7. Data Analysis

For both the study designs, sociodemographic data are presented as frequencies and proportions. Numerical data are presented as means and standard deviations (±SD). In the cross-sectional design, chi-square test was used in the bivariate analyses of patients' characteristics (sex, age, highest educational level achieved, income bracket, medication adherence, comorbidities, and location/setting of hypertension detection/diagnosis) and blood pressure control. A post hoc bivariate analysis was performed for covariates with more than two categories. In the bivariate analysis, prevalence Ratios (PR), 95% Confidence Intervals (CI), and *p*-values for each independent variable were calculated, with *p*-values <0.05 indicating statistical significance. An arbitrary *p*-value of <0.25 was used as the criterion for including a variable in the multivariate analysis with logistic regression model. In the logistic regression model, adjusted prevalence ratios for each of the relevant covariates were calculated.

In the case-control design, paired categorical tests were performed. The independent variables included physical activity, smoking habits, comorbidities, and BMI. The dependent variables included hypertensive and normotensive status. The dimensions associated with quality of life were as follows: Physical Functioning (PF), role limitations due to physical health (RP), role limitations due to emotional problems (RE), Energy/Fatigue (EF), Emotional Well-Being (EWB), Social Functioning (SF), Pain (P), and General Health (GH). These dimensions are presented as means (±SDs). We performed a linear regression analysis in the hypertensive group to compare the characteristics of the patients as covariates and the quality of life dimensions as outcomes. The data analysis was performed using SPSS Statistics software version 20.0 (IBM Corp., Armonk, NY, USA).

3. RESULTS

3.1. Prevalence of Hypertension

In this study, 646 of 3842 patients living in the RW 04, RW 05, and RW 15 neighborhoods were diagnosed with hypertension. Thus, in 2017, the prevalence of hypertension in adults in the Tegal Alur Administrative Village was 16.8%.

3.2. Characteristics of Hypertensive Patients in the Cross-sectional Study Design

The mean age of the hypertensive patients was 53.05 (±10.91) years, and the mean systolic and diastolic blood pressures were 149.69 (±17.64) mmHg and 87.31 (±9.29) mmHg, respectively. The mean time since the diagnosis of hypertension was 2.08 (±4.25) years.

Table **1** summarizes the characteristics of the hypertensive patients in the cross-sectional study design.

Table 1. Characteristics of hypertensive adults in Tegal Alur Administrative Village (n = 646).

Variables	Number	Percentage (%)
sex		
Men	190	29.4%
Women	456	70.6%
Age		
≤49 years old	249	38.5%
50–59 years old	225	34.8%
≥60 years old	172	26.6%
Highest educational level achieved		
Illiterate	9	1.4%
Elementary school	337	52.2%
Junior high school	124	19.2%
Senior high school	162	25.1%
College	14	2.2%
Monthly income		
Below PMW (<Rp 3,335,750)	482	74.6%
PMW (Rp 3,335,750)	23	3.6%
Above PMW (>Rp 3,335,750)	141	21.8%
Comorbidities		

(Table 1) contd.....

Variables	Number	Percentage (%)
sex		
Present	28	4.3%
Absent	618	95.7%
Medication adherence		
Non-adherent	357	55.3%
Adherent	289	44.7%
Place of hypertension detection		
Community Health Center	157	24.3%
Home visit	489	75.7%

Of the 646 hypertensive patients, 70.6% (n = 456) were women. The majority of patients belonged to the age category ≤49 years, representing 38.5% of all hypertensive patients (n = 249). For slightly over half (52.2%) of the hypertensive patients, the highest educational level achieved was elementary school. The majority of the patients belonged to the below PMW (74.6%) monthly income bracket and did not have any comorbidities (95.7%). Over half (55.3%) of the hypertensive patients were non-adherent and the majority was diagnosed with hypertension during a home visit (75.7%).

3.3. Blood Pressure Control

Of the 646 hypertensive subjects, 89% had uncontrolled blood pressure (systolic blood pressure of ≥140 mmHg in hypertensive subjects without comorbidities and ≥130 mmHg in hypertensive subjects with comorbidities).

3.4. Determinants of Blood Pressure Control

Table **2** illustrates the results of the bivariate analysis of blood pressure control determinants in hypertensive subjects.

Table 2. Bivariate analysis of determinants of blood pressure control in hypertensive adults from the Tegal Alur Administrative Village.

Variables	Uncontrolled blood pressure n (%)	Controlled blood pressure n (%)	*P*-value	Prevalence ratio (95% CI)
Sex				
Male	172 (30.1%)	18 (24.3%)	0.307	0.96 (0.91–1.02)
Female	400 (69.9%)	56 (75.7%)		
Age				
≤49 years	226 (39.5%)	23 (31.1%)		
50–59 years	193 (33.7%)	32 (43.2%)	0.091	0.94 (0.88–1.01)
≥60 years	153 (26.7%)	19 (25.7%)	0.543	0.98 (0.91–1.04)
Level of education				
Illiterate	7 (1.2%)	2 (2.7%)	0.538	0.83 (0.57–1.22)
Elementary school	298 (52.1%)	39 (52.7%)	1.0	0.95 (0.81–1.10)
Junior high school	106 (18.5%)	18 (24.3%)	0.692	0.92 (0.78–1.08)
Senior high school	148 (25.9%)	14 (18.9%)	1.0	0.98 (0.84–1.14)
College	13 (2.3%)	1 (1.4%)		
Monthly income				
Below PMW (<Rp 3,335,750)	434 (75.9%)	48 (64.9%)	0.168	1.04 (0.97–1.12)
PMW (Rp 3,335,750)	17 (3.0%)	6 (8.1%)	0.213	0.86 (0.67–1.10)
Above PMW (>Rp 3,335,750)	121 (21.2%)	20 (27.0%)		
Comorbidities				
Present	18 (3.1%)	10 (13.5%)	**0.001**	**0.71 (0.54–0.94)**
Absent	554 (96.9%)	64 (86.5%)		
Medication adherence				
Non-adherent	351 (61.4%)	6 (8.1%)	**<0.001**	**1.28 (1.20–1.37)**
Adherent	221 (38.6%)	68 (91.9%)		
Place of hypertension detection				

(Table 2) contd.....

Variables	Uncontrolled blood pressure n (%)	Controlled blood pressure n (%)	P-value	Prevalence ratio (95% CI)
Home visit	460 (80.4%)	29 (60.8%)	**<0.001**	**1.31 (1.19–1.46)**
Community health Center	112 (19.6%)	45 (39.2%)	-	-

The following variables were not significantly associated with uncontrolled blood pressure (p >0.05): Sex, age, highest educational level achieved, and monthly income bracket. Comorbidities were significantly associated with uncontrolled blood pressure with a *p*-value of 0.001 (PR: 0.71; 95% CI: 0.54–0.94).

Non-adherence with physician's prescriptions was significantly associated with uncontrolled blood pressure (p <0.001). The proportion of adherent patients with uncontrolled blood pressure (38.6%) was lower than the proportion of non-adherent patients with uncontrolled blood pressure (61.4%). Hypertensive subjects who were non-adherent had 1.28-fold higher risk of uncontrolled blood pressure than hypertensive subjects who were adherent (PR: 1.28; 95% CI: 1.20–1.37).

The location/setting where hypertension was diagnosed was significantly associated with uncontrolled blood pressure (p <0.001). The proportion of patients with uncontrolled blood pressure whose diagnoses resulted from home visits (80.4%) was higher than that of patients whose diagnoses were detected at the Community Health Center (19.6%). Hypertensive patients diagnosed during home visits had a 1.31-fold higher risk of having uncontrolled blood pressure than those diagnosed at the Community Health Center (PR: 1.31; 95% CI: 1.19–1.46). Results of the multivariate analysis with logistic regression model are shown in Table **3**.

Table 3. Multivariate analysis of determinants associated with blood pressure control.

-	Coefficient	S.E.	Wald	Df	P- value	Adjusted PR	95% CI	
-							min	max
Comorbidities	1.287	0.459	7.845	1	0.005	2.1	1.48	3.12
Non-adherence	−2.337	0.479	23.827	1	<0.001	0.11	0.03	0.36
Home visit	−0.886	0.318	7.765	1	0.005	0.46	0.24	0.86
Income <PMW	0.041	0.322	0.016	1	0.899	1.03	0.94	1.07

Based on the logistic regression model, the presence of comorbidities was the strongest predictor of uncontrolled blood pressure in the Tegal Alur Administrative Village (adjusted PR: 2.1; 95% CI: 1.48–3.12).

3.5. Characteristics of Subjects in the Case-control Study Design

Table **4** summarizes the patient characteristics in the case-control study design.

Table 4. Characteristics of patients in the hypertensive and normotensive groups.

Variable	Hypertensive group N = 76	Normotensive group N = 76	P-value
Systolic pressure, mmHg, mean (±SD), n (%)	134.13 (±21.0)	107.58 (±12.42)	**<0.001**
Diastolic pressure, mmHg, mean (±SD), n (%)	81.71 (±10.11)	71.32 (±16.0)	**<0.001**
Sex, n (%)			
Male	22 (28.9%)	21 (27.6%)	0.157
Female	54 (71.1%)	55 (72.4%)	
Age, years,			
mean (±SD), n (%)	55.13 (±10.37)	48.82 (±8.79)	**<0.001**
≤49 years	21 (27.6%)	43 (56.6%)	
50–59 years	52 (68.4%)	32 (42.1%)	
≥60 years	3 (3.9%)	1 (1.3%)	
Level of education, n (%)			
Illiterate	10 (13.2%)	3 (3.9%)	**0.002**
Elementary school	35 (46.1%)	32 (42.1%)	
Junior high school	19 (25%)	16 (21.1%)	
Senior high school	12 (15.8%)	25 (32.9%)	
Marital status, n (%)			
Married	64 (84.2%)	67 (88.2%)	**0.011**

(Table 4) contd.....

Variable	Hypertensive group N = 76	Normotensive group N = 76	*P*-value
Single	12 (15.8%)	9 (11.8%)	
Monthly income, n (%)			
Below PMW (<Rp 3,335,750)	73 (96.1%)	58 (76.3%)	**<0.001**
PMR (Rp 3,335,750)	3 (3.9%)	12 (15.8%)	
Above PMW (>Rp 3,335,750)	0 (0%)	6 (7.9%)	
Physical activity, n (%)			
Yes	29 (38.2%)	29 (38.2%)	1.0
No	47 (61.8%)	47 (61.8%)	
Smoking status, n (%)			
Smoker	10 (13.2%)	14 (18.4%)	0.285
Non-smoker	66 (86.8%)	62 (81.6%)	
Comorbidities			
Present	9 (11.8%)	5 (6.6%)	0.25
Absent	67 (88.2%)	71 (93.4%)	
Body mass index, kg/m^2, n (%)			
Mean (SD)	25.55 (3.97)	23.67 (3.97)	**0.003**
Overweight ($\geq$23 kg/m^2)	57 (75%)	42 (55.3%)	See Table **5**
Normoweight (<23 kg/m^2)	19 (25%)	34 (44.7%)	

The mean ($\pm$SD) systolic and diastolic blood pressures in the hypertensive group (134.13 [$\pm$21.0] mmHg and 81.71 [$\pm$10.11] mmHg, respectively) were higher than the mean ($\pm$SD) systolic and diastolic blood pressures in the normotensive group (107.58 [$\pm$12.42] mmHg and 71.32 [$\pm$16.0] mmHg, respectively). There was no significant difference in blood pressure between the sexes in both groups ($p = 0.157$) as the patients were sex-matched. The mean ($\pm$SD) age in the hypertensive group (55.13 [$\pm$10.37] years) was higher than in the normotensive group (48.82 [$\pm$8.79] years). The majority of the patients in the hypertensive and normotensive groups were married (84.2% and 88.2%, respectively). Over half of the patients in the hypertensive and normotensive groups had monthly incomes below the PMW (96.1% and 76.3%, respectively). The mean ($\pm$SD) BMI in the hypertensive group (25.55 [$\pm$3.97] kg/m^2) was higher than that in the normotensive group (23.67 [$\pm$3.97] kg/m^2).

3.6. Determinants of Hypertension

There was no significant association between physical activity ($p = 1.0$), smoking ($p = 0.285$), or comorbidities ($p = 0.25$) and hypertension.

The results of the bivariate analysis between BMI and hypertension are shown in Table **5**. As for the other covariates believed to be associated with hypertension (physical activity, smoking, and comorbidities), the association between BMI and hypertension was tested using the McNemar test.

Table 5. Bivariate analysis between body mass index and hypertension.

-	-	Normotensive (Control)		-	-
-	-	Overweight ($\geq$23 kg/m^2) n (%)	Normoweight (<23 kg/m^2) n (%)	*P*-value	OR (95% CI)
Hypertensive (Case)	Overweight ($\geq$23 kg/m^2)	30 (19.6%)	27 (17.6%)	0.016	2.25 (1.14–4.44)
	Normoweight (<23 kg/m^2)	12 (7.8%)	7 (4.6%)		

In the bivariate analysis, hypertension was significantly associated with BMI ($p = 0.016$; OR: 2.25; 95% CI: 1.14–4.44). A multivariate analysis was not performed as the other covariates (physical activity, smoking, and comorbidities) did not fulfill the arbitrary *p*-value of <0.25.

3.7. Quality of Life

Table **6** reports the mean differences in each dimension between hypertensive and normotensive groups.

Table 6. Quality of life of hypertensive and normotensive groups.

Dimension	Hypertensive Group		Normotensive Group		P-value
	Mean	SD	Mean	SD	
PF	88.22	16.52	93.75	11.66	**0.042**
RP	64.14	47.66	67.76	46.69	0.704
RE	71.05	44.99	80.7	39.35	0.249
EF	72.5	17.01	72.57	17.26	0.244
EWB	82.51	16.06	82.75	17.26	0.835
SF	94.9	11.57	94.5	12.8	0.949
P	73.42	20.81	73.68	20.78	0.832
GH	66.92	20.09	70.65	22.23	0.080

PF: Physical Functioning, RP: Role limitations due to physical health, RE: Role limitations due to emotional problems, EF: Energy/Fatigue, EWB: Emotional Well-being, SF: Social Functioning, P: Pain, GH: General Health.

The only significant difference between the two groups was found in the PF dimension ($p = 0.042$). The mean PF dimension in the hypertensive group (88.22 [±16.52]) was lower than that in the normotensive group (93.75 [±11.66]).

Table **7** shows the results of the linear regression analysis to identify associations between the patient characteristics and quality of life.

Table 7. Linear regression model of the quality of life in the hypertensive and normotensive groups.

Characteristics	Dimension							
	PF Coeff. β	RP Coeff. β	RE Coeff. β	EF Coeff. B	EWB Coeff. β	SF Coeff. β	P Coeff. β	GH Coeff. β
Hypertension	−5.32*	1.04	−11.01	−2.21	0.74	0.42	4.18	−1.87
Women	2.07	11.66	−8.02	−0.64	−0.98	−4.24	4.42	6.85
Age ≥60 years	−5.16	11.54	10.92	0.92	0.49	−3.03	−14.04	2.27
Illiterate	5.27	−29.58*	8.81	5.09	3.98	4.40	−8.46	−3.11
Single	−4.60	23.50*	−5.33	−11.31*	−7.46	−5.31	6.59	0.89
Below PMW	−1.01	−23.49	−4.78	−5.77	−6.77	−3.94	−8.90	−8.07
Inactive	−0.88	−14.86	14.81*	0.94	2.88	1.12	−2.27	−5.59
Smoking	2.24	−10.0	−9.45	6.92	4.11	−1.13	3.97	5.89
Comorbidities	−8.36*	−1.85	−26.41*	0.66	0.30	−2.92	−3.35	−4.32
Overweight	2.26	6.79	10.64	2.73	2.25	2.81	−6.55	3.30
R^2	0.095	0.106	0.093	0.115	0.069	0.081	0.082	0.067
Adjusted R^2	0.031	0.042	0.029	0.053	0.003	0.016	0.017	0.001
F	1.487	1.667	1.445	1.838	1.044	1.241	1.255	1.01
Significance F	0.150	0.094	0.167	0.059	0.410	0.270	0.262	0.433

Coeff.: Coefficient, PF: Physical Functioning, RP: Role limitations due to physical health, RE: Role limitations due to emotional problems, EF: Energy/Fatigue, EWB: Emotional Well−Being, SF: Social Functioning, P: Pain, GH: General Health. (*) indicates *p*-value <0.05.

In the linear regression model, hypertension was significantly associated with PF ($p = 0.039$). Illiteracy had a significant association with the RP dimension ($p = 0.037$), while single marital status was significantly associated with both the RP ($p = 0.035$) and EF ($p = 0.005$) dimensions. Physical inactivity was significantly associated with the RE dimension ($p = 0.043$), while comorbidities were significantly associated with both the RE ($p = 0.028$) and the PF ($p = 0.042$) dimensions.

4. DISCUSSION

4.1. Prevalence of Hypertension in the Tegal Alur Administrative Village

In 2017, the prevalence of hypertension in adults (aged ≥18 years) in the Tegal Alur Administrative Village was 16.8%. This prevalence was lower than the prevalence of hypertension in Jakarta (20%) and the national prevalence of

hypertension in Indonesia (26.5%) in 2013 [3]. The prevalence of hypertension in this study was also lower than the prevalence of hypertension in Indonesia (21.2%) according to the 2014 WHO data [4].

4.2. Determinants of Blood Pressure Control in the Tegal Alur Administrative Village

The proportion of patients with uncontrolled blood pressure in this study was 89%, which was similar to the value of 91% reported by Hussain [9]. The percentage of patients with uncontrolled blood pressure in this study was higher than the value of 63.2% reported by Menanga *et al*. [10] and 49% reported by Posnenkova *et al*. [12].

In this study, the proportion of hypertension identified in female patients (70.6%) was higher than that in male patients (29.4%). This result was similar to the results of the study by Menanga *et al*. [10], according to which the percentage of female patients with hypertension was 63.6%. Our results were contrary to popular theories that men account for a higher proportion of the hypertensive patient population than do women [1]. Previous studies have suggested that the proportion of hypertensive men was greater than the proportion of hypertensive women until the age of 45 years, and after this age, the proportion of hypertensive women would slowly become equal to the proportion of hypertensive men [13, 14]. The percentage of the combined age group above 50 years of age in this study was 61.5%, and this majority may be the reason for the predominance of hypertensive female subjects in this study. A study by Gudmondsdottir *et al*. [15] suggested that decreased estrogen levels in older women could alter the hypertensive proportions due to the cardiovascular-protective properties of estrogens.

In the bivariate analysis, there was no significant association between sex and blood pressure control ($p = 0.307$). Studies by Hanus *et al*. [16] and Keyhani *et al*. [17] also showed that there was no significant difference in blood pressure control between hypertensive men and women. This result was contrary to the bivariate analysis results reported by Souza *et al*., [18], which indicated that hypertensive female patients had better blood pressure control compared with hypertensive male patients. However, no significant association was observed on multivariate model analysis.

In this study, based on bivariate analysis, there was no significant association between age group and blood pressure control. This result is in contrast to a study by Gu *et al*. [19] indicating a significant association between the two variables. A study by Zhao *et al*. [20] also showed that subjects aged 60 years and above showed more awareness in controlling blood pressure. This study showed that the proportion of subjects aged 60 years and above with uncontrolled blood pressure (89%) was greater than in the age group 50-59 years with uncontrolled blood pressure (85.8%). This result was similar to that of another study by Borzecki *et al*., [21] indicating that subjects aged 80 years and above had worse blood pressure control compared with subjects aged 40-59 years. The difference between our results and those of Gu *et al*., [19] and Zhao *et al*., [20] is likely attributable to the higher medication adherence of the patients in those studies, which is in contrast to the adherence levels of the patients in the present study, whereby 55.3% were non-adherent.

In the bivariate analysis, the association between socioeconomic factors (highest educational level achieved and monthly income bracket) and blood pressure control was insignificant. This result was in contrast to the results of a study by Paulsen *et al*. [22], which showed that there was a significant association between socioeconomic status and blood pressure control. A systematic review by Leng *et al*. [23] also showed there was a significant association between socioeconomic status and blood pressure control. However, for both the aforementioned studies [22, 23], the study subjects were from developed countries. In contrast, our results are supported by those of Satoh *et al*. [24], which indicated that there was a significant association between socioeconomic status and the prevalence of hypertension, but there was no significant association between socioeconomic status and blood pressure control in hypertensive patients.

The present study showed there was a significant association between comorbidities and blood pressure control. A clinical review by Schmieder and Ruilope [25] indicated that it was difficult for hypertensive patients with comorbidities to achieve their target blood pressures. Similarly, in our study, the proportion of hypertensive patients with comorbidities with controlled blood pressure was 35.7%. Similar results were also reported by Paulsen *et al*., [26], which showed that the proportion of hypertensive patients with comorbidities who were able to achieve their target blood pressures was 33.2%.

In our study, the percentage of hypertensive patients that adhered to their antihypertensive medication treatment was 44.7%. This value was higher than that reported in the study by Rahmawati and Bajorek [27], which showed an 11% medication adherence rate. Of the adherent patients, only 24% achieved their blood pressure targets. This percentage was similar to the value of 25% reported by Hussain *et al*. [9], but was lower than the percentages reported by Gu *et al*.

[19] and Piercefield *et al*. [28], who reported controlled blood pressure rates of 44% and 67.4%, respectively. In the present study, medication adherence was significantly associated with blood pressure control. This result was supported by the study by Gu *et al*. [19]. Although the proportion of adherent patients with uncontrolled blood pressure was high (76.5%), it was still lower than the proportion of non-adherent patients (98.3%). According to the National Stroke Association, adherence is defined as the act of routinely refilling prescriptions on time, while the definition of compliance is the act of routinely taking the prescribed drugs [29]. As the level of compliance was not recorded in this study, this could explain the higher proportion of uncontrolled blood pressure in adherent patients.

There was a significant association between location/setting of detection/diagnosis and blood pressure control. This may be explained by the level of medication adherence in our patients. Of the hypertensive patients who were diagnosed during home visits, 27.2% were adherent with their antihypertensive medications and had routine clinical visits outside the Tegal Alur II Community Health Center. That proportion was significantly lower than the proportion of hypertensive subjects diagnosed at the Tegal Alur II Community Health Center and who were adherent with their antihypertensive medication (99.4%).

The presence of comorbidities was the strongest predictor of blood pressure control in this study. This result was supported by Sarkar [30] who also showed that comorbidities were one of the strongest predictors of blood pressure control in a multivariate analysis, in addition to antihypertensive drugs, age, sex, and ethnicity.

From our clinical experience, the low adherence rate and low blood pressure target achievement are due to lower educational levels. Most of our patients are not aware that hypertension may exist even in the absence of symptoms and thus choose to neglect the disease and not adhere to the physician's recommendation. Due to cultural beliefs, patients may choose to visit non-medical service providers that present alternative choices of treatment. Furthermore, they are also reluctant to weekly visits to our Community Health Center to receive antihypertensive prescriptions. Our Community Health Center also offers a non-pharmacological program for patients with hypertension consisting of bimonthly aerobic training and group discussions. However, only two or three patients attended these activities. This could be a long-standing challenge for our country's battle against hypertension.

4.3. Determinants of Hypertension in the Tegal Alur Administrative Village

In this study, bivariate analysis showed that physical activity, smoking habits, and comorbidities were not significantly associated with hypertension. A study by Huai *et al*. [31] also showed that there was no significant association between physical activity and hypertension. Our results are also supported by studies by Li *et al*. [32] and Thuy *et al*. [33] showing the absence of a significant association between smoking habits and hypertension. However, our results contradict those of a case-control study by Pilakkadavath [34], which reported a significant association between comorbidities and hypertension. To our knowledge, there have been no studies to date describing comorbidities with results similar to those of our study.

The only significant determinant of hypertension in this study was BMI; similar results were reported by Wang [35], who showed that BMI had a significant association with hypertension. Furthermore, a prospective cohort study by Okumura [36], which reported that obesity could increase the incidence of hypertension, also supports our results. A linear relationship between BMI and blood pressure was also described in an Indonesian population by Tuan [37].

4.4. Health-related Quality of Life

The results from the present study indicate there was a significant difference between hypertensive and normotensive groups in the PF dimension of Health-Related Quality of Life (HRQoL) ($p = 0.042$). The mean value of the PF dimension in the normotensive group was higher than that of the hypertensive group. There was an insignificant difference between the two groups in the other HRQoL dimensions, but the mean value of each dimension was higher in the normotensive group, which was similar to the findings of Trevisol *et al*. [38].

In the linear regression model, hypertension was still significantly associated with the PF dimension. This result is supported by the study of Wang *et al*. [39], which showed that hypertension had a significant association with the PF dimension. These results suggest that hypertension affects the daily routines of hypertensive patients.

We found that hypertension had an insignificant association with bodily pain (P dimension). Hypertension is a silent disease, which could explain the lack of a significant association between hypertension and bodily pain [39]. We also showed the absence of a significant association between hypertension and emotions, which is consistent with the findings reported by Xu *et al*. [6].

In the linear regression model, the highest educational level achieved and income bracket were significantly associated with the RP dimension, a result also supported by Xu *et al*., [6]. In our study, marital status had a significant association with the RP and EF dimensions, which was also reported by Carvalho *et al*., [7]. Comorbidities were significantly associated with the PF and RE dimensions, which is consistent with the results of a study by Wang *et al*., [39].

In this study, we utilized a home visit approach to eliminate the possibility of white-coat-induced hypertension. However, no instrument was used to record the compliance of the hypertensive patients. In addition, the majority of patients visited various health care providers aside from the Tegal Alur II Community Health Center. Thus, the authors were not able to verify the true adherence to treatment by hypertensive patients.

CONCLUSION

The prevalence of hypertension in this study was high, with nearly two of ten adults in the Tegal Alur Administrative Village being affected. The uncontrolled blood pressure rate in this study was higher than that in high-income countries. Medication adherence in this study was lower than that in developed countries. Comorbidities were the strongest predictor of blood pressure control, and there was a significant association between BMI and hypertension.

FUNDING STATEMENT

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethical approval was issued by the Health Research Ethics Committee, Faculty of Medicine, Universitas Indonesia – Cipto Mangunkusumo Hospital.

HUMAN AND ANIMAL RIGHTS

No animals were used in this study. All research procedures followed the ethical standards of the committee responsible for human experimentation and the Helsinki Declaration of 1975 (http://www.wma.net/en/20activities/ 10ethics/10helsinki/).

CONSENT FOR PUBLICATION

All subjects provided their informed consent to participate in the study.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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