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The Correlation between Intensification of Antihypertensive Regimens and Therapeutic Adherence with Blood Pressure Control and Lipid Profiles in Patients with Chronic Hypertension at Ben Mboi General Hospital in Kupang.

Korelasi antara Intensifikasi Regimen Antihipertensi dan Kepatuhan Terapi terhadap Kontrol Tekanan Darah serta Profil Lipid pada Pasien Hipertensi Kronis di Rumah Sakit Umum Ben Mboi Kupang

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Abstract

Hypertension is a major public health issue with a high prevalence in Indonesia and is often accompanied by dyslipidemia, which increases cardiovascular risk. This study aims to analyze the relationship between the intensification of antihypertensive regimens and treatment adherence, and their effects on blood pressure control and lipid profiles in patients with chronic hypertension at Ben Mboi General Hospital in Kupang. The subjects were predominantly female (61%) and under 60 years old (66%). The study used a retrospective cohort design based on medical record data of chronic hypertension patients from January to December 2025 and The research sample consisted of 100 patients. All subjects (100%) were classified as compliant with a mean Medication Possession Ratio (MPR) of 0.84±0.02; 88% of patients received therapy intensification (mean Therapeutic Intensity Score 0.08±0.27). The mean blood pressure was 128.00 ± 1.64/79.86 ± 2.12 mmHg, and all subjects had their blood pressure under control. Meanwhile, 12% of subjects had cholesterol levels within the normal range, and all subjects had triglyceride levels within the normal range. The Spearman test showed no significant relationship between MPR or TIS and systolic blood pressure, diastolic blood pressure, total cholesterol, and triglycerides (p-values ranged from 0.340 to 0.808). There was no significant relationship between adherence and therapy intensification and blood pressure control or lipid profiles, likely due to a ceiling effect, as all subjects were already in a controlled condition. The ceiling effect occurs when nearly all subjects fall into the same category for both variables (100% compliant and 100% controlled), resulting in very low data variability that prevents the correlation test from detecting a relationship, regardless of whether such a relationship exists clinically.

***Keywords*: chronic hypertension, dyslipidemia, lipid profile, treatment adherence, treatment intensification**

Abstrak

Hipertensi adalah masalah kesehatan yang sering terjadi di masyarakat Indonesia dengan angka kasus yang tinggi dan biasanya terjadi bersamaan dengan dislipidemia, sehingga meningkatkan kemungkinan terkena penyakit kardiovaskular. Penelitian ini bertujuan untuk menganalisis hubungan antara intensifikasi rejimen antihipertensi dan kepatuhan pengobatan, serta pengaruhnya terhadap kontrol tekanan darah dan profil lipid pada pasien hipertensi kronis di Rumah Sakit Umum Ben Mboi, Kupang. Subjek penelitian sebagian besar perempuan (61%) dan berusia di bawah 60 tahun (66%). Penelitian menggunakan desain kohort retrospektif berdasarkan data rekam medis pasien hipertensi kronis periode Januari–Desember 2025 dan sampel penelitian terdiri atas 100 pasien. Semua subjek (100%) diklasifikasikan sebagai patuh dengan rata-rata Rasio Kepemilikan Obat (MPR) sebesar 0,84±0,02; 88% pasien menerima intensifikasi terapi (rata-rata Skor Intensitas Terapi 0,08±0,27). Rata-rata tekanan darah adalah 128,00 ± 1,64/79,86 ± 2,12 mmHg dan semua subjek memiliki tekanan darah terkontrol. Sementara itu, 12% subjek memiliki kadar kolesterol dalam kisaran normal, dan semua subjek memiliki kadar *trigliserida* dalam kisaran normal. Uji Spearman menunjukkan tidak ada hubungan yang signifikan antara MPR atau TIS dengan tekanan darah sistolik, tekanan darah diastolik, kolesterol total, dan *trigliserida* (nila p value 0.340 - 0.808). Tidak ada hubungan yang signifikan antara kepatuhan dan intensifikasi terapi dengan kontrol tekanan darah atau profil lipid, kemungkinan karena ceiling effect, karena semua subjek sudah terkontrol. Ceiling effect terjadi ketika hampir semua subjek jatuh ke dalam kategori yang sama untuk kedua variabel (100% patuh dan 100% terkontrol), yang mengakibatkan variabilitas data yang sangat rendah yang mencegah tes korelasi mendeteksi hubungan, terlepas dari apakah hubungan tersebut ada secara klinis.

***Kata Kunci*: hipertensi kronis, dislipidemia, profil lipid, kepatuhan pengobatan, intensifikasi pengobatan.**

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Introduction

Hypertension is one of the noncommunicable diseases with the highest prevalence worldwide and is a major risk factor for cardiovascular disease. The World Health Organization estimated that 1.28 billion adults aged 30–79 years have hypertension, with two-thirds of them living in low- and middle-income countries [1]. In Indonesia, the 2023 Indonesian Health Survey (SKI)[2] reported that the prevalence of hypertension among residents age 60 and older reached 10.8%, an increase from the 9.8% recorded in the 2018 Basic Health Research (Riskesdas)[3] based on measurement results. East Nusa Tenggara (NTT) Province alone was recorded to have a hypertension prevalence of 7.2%, equivalent to 76,130 cases, making hypertension the chronic disease with the fourth-highest contribution to morbidity in the province[2]. This high figure makes hypertension a priority public health issue requiring a comprehensive therapeutic approach.

The local context of hypertension management in East Nusa Tenggara (NTT) [1] provides an important rationale for this study. Hypertension remains a major chronic disease requiring continuous monitoring and long-term pharmacological management. Provincial health data indicate that 261,670 patients with hypertension received standardized healthcare services in NTT in 2023, demonstrating the substantial burden of hypertension and the need for sustained management at the health-system level. In addition, the provincial health system identifies hypertension care as an important component of essential health services, including routine blood pressure monitoring, lifestyle education, dietary management, physical activity, and pharmacological treatment. These services are particularly relevant in NTT, where geographical characteristics and differences in healthcare accessibility may influence continuity of care and patients' ability to obtain regular treatment. Previous provincial health planning documents have also identified accessibility to healthcare services in remote, border, and island areas as an important challenge in NTT.

Within this regional context, RSUP Dr. Ben Mboi Kupang represents an important setting for evaluating the management of chronic hypertension because it provides specialist and hospital-based healthcare services for patients in Kupang and the surrounding region. The hospital provides outpatient services and 24-hour pharmacy services, supporting the continuity of pharmacological treatment for patients requiring long-term therapy. However, the availability of healthcare services does not necessarily ensure optimal treatment outcomes, as adherence to medication, therapeutic intensification, continuity of follow-up, and other patient- and health-system-related factors may influence blood pressure control. Therefore, evaluating the relationship between antihypertensive regimen intensification, medication adherence, and clinical outcomes in patients receiving chronic hypertension care at RSUP Dr. Ben Mboi Kupang is important for understanding how pharmacological management is implemented in the local healthcare context. This study may provide locally relevant evidence to support more comprehensive and sustainable hypertension management in NTT.

Uncontrolled hypertension contributes to endothelial dysfunction, accelerates the atherosclerosis process, and increases the risk of coronary heart disease, stroke, chronic kidney disease, and other vascular disorders [4] These cardiovascular risks increase further when hypertension is accompanied by dyslipidemia, a condition characterized by abnormal lipid profiles marked by elevated total cholesterol, low-density lipoprotein (LDL), triglycerides, and/or reduced high-density lipoprotein (HDL) levels [5]. The combination of these two conditions accelerates the formation of atherosclerotic plaques and substantially increases cardiovascular morbidity and mortality [6,7]. Therefore, the management of hypertension in patients with comorbid dyslipidemia requires a therapeutic strategy that focuses on blood pressure control while also regularly monitoring lipid profiles.

The success of chronic hypertension therapy depends on two key factors, namely the appropriateness of the regimen prescribed by the clinician and the patient's adherence to the treatment. From the clinician's perspective, intensification of the antihypertensive regimen involves adjusting doses or adding medications

to achieve blood pressure targets, and can be objectively measured using the Therapeutic Intensity Score (TIS), which accounts for the number of medications and the ratio of actual doses to the maximum recommended dose [8,9]. From the patient's perspective, adherence to the treatment regimen can be assessed using the Medication Possession Ratio (MPR), which is the ratio of the number of days the patient possesses the prescribed medication to the observation period. An MPR value of ≥0.80 is generally categorized as compliant [10]. These two indicators complement each other, with TIS reflecting clinician prescribing intensity, and MPR reflecting the continuity of patient access to and consumption of medication.

Several previous studies have linked adherence to blood pressure control [11,12] and treatment intensification to clinical outcomes of hypertension [13]. However, most of these studies analyzed MPR and TIS separately, evaluated only blood pressure outcomes without accounting for lipid profiles, and were conducted in regions with sociodemographic characteristics different from those observed in eastern Indonesia. Evidence regarding the simultaneous relationship between therapy intensification and adherence to blood pressure control as well as lipid profiles in patients with chronic hypertension in Eastern Indonesia, particularly East Nusa Tenggara, remains very limited. In fact, population characteristics, access to healthcare services, and prescribing patterns in this region may influence treatment outcomes differently compared to the more extensively studied population on Java Island. To address the gap described above, this study aims to analyze the relationship between the intensification of antihypertensive therapy (TIS) and treatment adherence (MPR) with blood pressure control and lipid profiles in patients with chronic hypertension at Ben Mboi General Hospital in Kupang, East Nusa Tenggara. The research hypothesis is that There is an association between MPR and TIS with blood pressure control and lipid profiles. Ben Mboi General Hospital in Kupang was selected as the study site because it is the primary referral hospital in East Nusa Tenggara Province, classified as a Type B hospital and a teaching hospital, offering integrated care for chronic disease patients, making it an ideal representative of hypertension management practices in Eastern Indonesia. The results of this study are expected to provide a scientific basis for clinicians and pharmacists to optimize pharmacotherapy strategies for hypertension and the prevention of cardiovascular complications, particularly in patient populations in regions with similar characteristics.

Methods

Research Design

This study is an analytical observational study with a retrospective cross-sectional design that utilizes secondary data from patient medical records. This study used secondary data obtained retrospectively from medical records of patients with chronic hypertension who received outpatient care at Ben Mboi General Hospital in Kupang during the study period. No direct contact or intervention involving patients was conducted. The data were anonymized prior to analysis, and no personally identifiable information was accessed or reported by the researchers. Because the study involved the secondary use of anonymized medical record data and posed no more than minimal risk to patients, individual informed consent was not required. Patient privacy and confidentiality were maintained throughout data collection, processing, analysis, and reporting. The study was conducted in accordance with applicable institutional ethical requirements and was approved by the relevant ethics committee.

The study was conducted at the Outpatient Department of Ben Mboi General Hospital in Kupang, East Nusa Tenggara Province, and using data on patients with chronic hypertension from January 1 to December 31, 2025. Data collection was carried out from January to March 2026 after obtaining ethical approval from the Ben Mboi Kupang General Hospital Health Research Ethics Committee under number PP.06.02/D.XXIX.2.3/2/2026.

Population and Sample

The target population consisted of all patients with chronic hypertension receiving treatment at the Outpatient Clinic of Ben Mboi General Hospital in Kupang during the study period. The study used a retrospective cross-sectional design based on medical records of patients with chronic hypertension who received outpatient care at Ben Mboi General Hospital in Kupang during the period from January 1 to December 31, 2025. Data collection and sampling were conducted from January to March 2026. During this period, eligible medical records were identified and reviewed sequentially based on the predefined inclusion and exclusion criteria. A total of 500 medical records were initially identified, of which 218 met the eligibility

criteria. From these eligible records, 100 patients were included as the final study sample using consecutive sampling.

Consecutive sampling was selected because eligible medical records could be included sequentially according to the predefined eligibility criteria until the required sample size was reached. However, this non-probability sampling method may introduce selection bias because the final sample may not fully represent the broader population of patients with chronic hypertension treated at the hospital or in the NTT region. In particular, the requirement for at least three outpatient visits and complete medical records may preferentially include patients who had more regular follow-up and better documented treatment histories, while patients with irregular follow-up, incomplete records, or discontinuation of care may be underrepresented. This selection process may also contribute to the limited variability in medication adherence and blood pressure control observed in the study. Therefore, the generalizability of the findings should be interpreted cautiously and primarily limited to patients with characteristics similar to those included in the study.

The inclusion criteria were: (1) patients aged ≥18 years diagnosed with hypertension (ICD-10 codes I10–I15) with or without comorbid dyslipidemia (E78); (2) receiving antihypertensive therapy during the study period; (3) having at least three outpatient visits during the study period; and (4) having complete medical records including blood pressure, lipid profile (total cholesterol and triglycerides), and history of antihypertensive medication prescriptions.

The exclusion criteria were: (1) pregnant or breastfeeding patients; (2) patients with decompensated heart failure (NYHA Class III–IV), a history of myocardial infarction within the past 6 months, acute stroke, or stage 4–5 chronic kidney disease; (3) patients who died during the study period; and (4) patients with incomplete medical records.

Variables and Operational Definitions

The independent variables in this study were the intensity of the antihypertensive therapy regimen, measured using the Therapeutic Intensity Score (TIS), and treatment adherence, and measured using the Medication Possession Ratio (MPR). The dependent variables were blood pressure control (systolic and diastolic) and lipid profile (total cholesterol and triglycerides). Controlled confounding variables included age and comorbidities through inclusion-exclusion criteria, while uncontrolled confounding variables included duration of hypertension, lifestyle, physical activity, and smoking status. The operational definitions of each variable are presented in **Table 1.**

Table 1. Operational definitions of research variables

Variable	Operational Definition	Scale	Category
MPR	The ratio of days on antihypertensive medication to the observation period	Ratio → Nominal	Adherence → ≥0,80) Non-adherence → <0,80 [10]
TIS	Therapy intensification score based on the number of medications and the ratio of the actual dose to the maximum recommended dose	Ratio → Nominal	There is intensification → >0–1 There is no intensification→ (−1)–0 [8]
Blood pressure	Average systolic and diastolic blood pressure (mmHg) over the last three visits	Ratio → Nominal	Age <65 years: Controlled → TD <130/80 Uncontrolled → TD ≥130/80 Age ≥65 years: Controlled → TD 130–139/<90 Uncontrolled → TD ≥140/90 [14]
Total cholesterol	Total serum cholesterol level (mg/dL)	Ratio → Nominal	Normal → <200 High → ≥200 [15]
Triglyceride	Serum triglyceride level (mg/dL)	Ratio → Nominal	Normal → <150 High → ≥150 [15]

Data Collection

The data were obtained from a review of electronic medical records and prescription histories at the Pharmacy Department of Ben Mboi General Hospital in Kupang. The collected data included demographic characteristics (gender, age, education, occupation, smoking status), clinical data (blood pressure, lipid profile, comorbidities), and pharmacotherapy data (type and dose of antihypertensive medication, date of medication collection, and frequency of visits). The extracted data were reviewed for completeness, consistency, and conformity with the predefined study variables, and incomplete records were excluded before analysis. No

formal training or inter-rater reliability assessment of data collectors was conducted because this study used retrospective secondary medical record data. Therefore, potential data extraction or classification errors should be acknowledged as a limitation.

The Medication Possession Ratio (MPR) is calculated using the formula [10]:

$$MPR = \frac{\text{(Total days supply obtained)}}{\text{(Number of days in observation period)}}$$

The Therapeutic Intensity Score (TIS) is calculated using the formula [8]:

$$TIS = \frac{frequency\ of\ observed\ treatment\ changes - frequency\ of\ medication\ changes\ based\ on\ the\ specified\ standards}{frequency\ of\ clinic\ visits}$$

The TI score, which ranges from −1 to +1, is obtained by dividing the difference between the frequencies of observed medication changes and expected medication changes (according to given standards) by the frequency of clinic visits. A 0 score implies perfect responsiveness, −1 implies complete negligence, and +1 indicates excessive aggression.

Data Analysis

In this study, which involved secondary data from medical records, patient confidentiality was maintained through coding (anonymization) prior to data analysis. The data were analyzed using IBM SPSS Statistics version 23 (IBM Corp., Armonk, NY). Univariate analysis was performed to describe the characteristics of the study subjects in the form of frequencies and percentages for categorical data, and means ± standard deviations (mean ± SD) for numerical data.

The normality of the distribution of numerical data (MPR, TIS, systolic and diastolic blood pressure, total cholesterol, triglycerides) was determined using the Kolmogorov-Smirnov test because the sample size was greater than 50. Therefore, Spearman's rho non-parametric correlation test was selected because it does not require the data to follow a normal distribution and is appropriate for assessing the monotonic relationship between variables when the assumption of normality is not met. Spearman's rho was used to assess the relationship between MPR and TIS with systolic and diastolic blood pressure, total cholesterol, and triglycerides. Medical records with incomplete data were excluded during the selection process; therefore, no missing data were included in the final dataset of 100 subjects. The test results showed that most variables were not normally distributed ($p<0.05$); as a result, bivariate analysis was performed using Spearman's rho non-parametric correlation test to assess the relationship between MPR and TIS with systolic and diastolic blood pressure, total cholesterol, and triglycerides. The significance level was set at $p < 0.05$ with a 95% confidence level. The strength of the relationship was interpreted based on [16] criteria: very weak (0.00–0.199), weak (0.20–0.399), moderate (0.40–0.599), strong (0.60–0.799), and very strong (0.80–1.000).

Results and Discussion

During the study period, 500 patients' medical records were identified at the Outpatient Department of Ben Mboi General Hospital in Kupang with a history of hypertension, with or without comorbid dyslipidemia. A total of 218 patients met the inclusion criteria and 118 patients were excluded, resulting in the selection of 100 patients as the final sample through consecutive sampling (**Figure 1**). The demographic characteristics of the subjects are presented in **Table 2.**

The study subjects were predominantly women (61%) in the <60 age group (66%). This predominance of women aligns with the findings of [17] and data from the 2023 Indonesian Health Survey [2], which reported a higher prevalence of hypertension among women, particularly during the postmenopausal period due to declining estrogen levels that previously provide a protective effect on blood vessels. The age characteristics of the subjects, dominated by the productive adult group, differ from the general profile of the hypertensive population, which tends to be older. This age composition is clinically relevant because it influences clinicians' decision-making patterns regarding therapy intensification [18].

The observed age distribution may also be related to the retrospective sampling process. In this study, only patients with at least three documented outpatient visits and sufficiently complete medical records were eligible for inclusion. Thus, the final sample may not represent patients with less frequent healthcare utilization or incomplete documentation. Because consecutive sampling was used, the age distribution of the

final sample may also reflect the characteristics of patients who met the eligibility criteria during the data collection period rather than the age distribution of the entire hypertensive population served by the hospital. This possibility is important when interpreting the predominance of patients aged <60 years and limits the generalizability of this demographic finding.

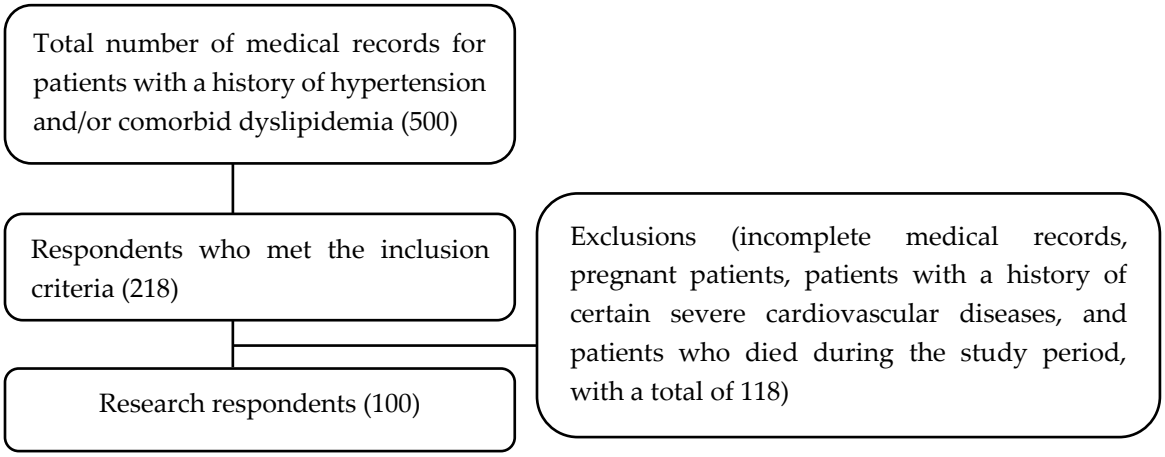


Figure 1. Chart of Criteria for Hypertension Patients

Table 2. Characteristics of the Research Participants (n=100)

Characteristics	n (%) or mean ± SD
Gender	
Male	39(39%)
Female	61(61%)
Age (Years)	
>60	34(34%)
<60	66(66%)
Education Level	
Higher Education	37(37%)
Secondary-Primary (High school/Primary School/ not graduating elementary school)	63(63%)
Occupation	
Government Employee	17(17%)
Private-Sector Employee	3(3%)
Entrepreneur	8(8%)
Police Officer	1(1%)
Farmer	5(5%)
Pastor	3(3%)
University Student	1(1%)
Housewives	42(42%)
Retiree	13(13%)
Not working	4(4%)
Laborer	3(3%)
Smoking Status	
Active Smoker	27(27%)
Non-smoker	73(73%)
Antihypertensive Therapy	
Monotherapy	38(38%)
Combination	62(62%)

The predominance of patients aged <60 years may reflect the characteristics of the patients receiving chronic hypertension care at the study hospital during the study period. However, the available data do not allow us to determine whether this distribution reflects the broader population served by Ben Mboi General Hospital or resulted from the study's eligibility criteria and consecutive sampling procedure. The requirement for at least three outpatient visits and complete medical records may have influenced the composition of the final sample by preferentially including patients with more regular follow-up and sufficiently documented

clinical information. Therefore, the predominance of the <60-year age group should not be interpreted as representative of the age distribution of all patients with hypertension in Kupang or NTT. Future prospective studies should record menopausal status and other age-related factors and use broader sampling strategies to determine whether the observed age distribution reflects the underlying patient population.

The majority of participants had a low level of education (63%), with the largest occupational group being full-time housewives (42%). Such socioeconomic factors are generally associated with lower adherence due to limited understanding of the disease and access to treatment [19,20]. However, the findings of this study actually showed high adherence among all subjects, possibly influenced by the availability of integrated pharmacy services with a periodic medication pickup program at Ben Mboi General Hospital in Kupang, facilitating medication adherence regardless of patients' educational and occupational backgrounds.

Therapy Adherence

The mean MPR score of the study subjects was 0.84 ± 0.02, with all subjects (100%) classified as compliant (MPR ≥ 0.80) (**Table 3**). This adherence rate is significantly higher than that reported in the study by [21] in Bandung, which found compliance of only 33% among hypertensive patients in primary care, or the study by [11] which reported 60%. The high MPR in this study should be interpreted with caution because the sample consisted of patients who had made at least three routine visits over the course of one year. Non-adherent patients tend not to return and are automatically excluded from the sample pool, resulting in selection bias that yields a patient population with high adherence. In other words, the MPR in this study does not reflect the adherence of the general hypertensive population but rather the adherence of a subgroup of patients with consistent treatment-seeking behavior.

Table 3. Distribution of adherence, treatment intensification, and clinical outcomes (n=100)

Variable	n (%) or Mean ± SD
MPR	0,84±0,02
Adherence	100(100%)
Non-adherence	0(0%)
TIS	0,08±0,27
There is an intensification (>0 s/d 1)	88(88%)
There is no intensification (-1 s/d 0)	12(12%)
Blood pressure (TD)	
Controlled	100(100%)
Uncontrolled	0(0%)
Systolic Blood Pressure	128±1,64
Diastolic Blood Pressure	79,86±2,12
Cholesterol (mg/dL)	220,56±69,50
Normal (≤200)	12(12%)
High (>200)	88(88%)
Triglycerides (mg/dL)	144,56±13,7
Normal (≤150)	100(100%)
High (>150)	0

Therapy Intensification (TIS)

The mean TIS score was 0.08 ± 0.27, with 88 subjects (88%) classified as receiving treatment intensification (TIS >0–1) and 12 subjects (12%) not (TIS −1–0). This high pattern of intensification contrasts with the study by [13] in Malaysia, which reported treatment intensification in only 29.8% of patients, with 38.6% experiencing therapeutic inertia. This difference can be explained by two factors. First, the age characteristics of the subjects, dominated by the <60-year-old group (66%), tend to prompt clinicians to be more aggressive in therapy intensification for the sake of long-term protection of target organs [18]. Demonstrated that in younger patients, clinicians tend to perform proactive intensification to optimize cardiovascular outcomes, whereas in very elderly patients, de-intensification is performed to avoid the risk of orthostatic hypotension. Second, the majority of subjects (62%) received combination therapy from the outset (**Table 2**). Among the 62 patients receiving combination antihypertensive therapy, the most frequently used regimen was the combination of a calcium channel blocker (CCB) and an angiotensin-converting enzyme inhibitor (ACE inhibitor), prescribed in 23 patients (37.1%). This was followed by the combination of a CCB and an angiotensin receptor blocker (ARB), used in 20 patients (32.3%). Other combinations included ARB plus beta-blocker in 5 patients (8.1%), CCB plus diuretic in 4 patients (6.5%), ARB plus diuretic in 4 patients

(6.5%), CCB plus beta-blocker in 3 patients (4.8%), ACE inhibitor plus beta-blocker in 2 patients (3.2%), and diuretic plus beta-blocker in 1 patient (1.6%). Studies showed that patients who started therapy with a two-drug combination tended to reach blood pressure targets faster and demonstrated better adherence. This pattern of prescribing combinations aligns with the latest AHA/ACC ESC guideline recommendations, which advocate for early combination therapy in stage 2 hypertension [22–24].

Blood Pressure Control and Lipid Profile

The participants' mean systolic blood pressure was 128.00 ± 1.64 mmHg and diastolic blood pressure was 79.86 ± 2.12 mmHg, with all participants (100%) classified as having controlled blood pressure based on the 2019 InaSH criteria. The triglyceride lipid profile in the participants was within normal limits, while the cholesterol lipid profile showed that 12 individuals fell into the normal category and 88 into the high category (**Table 3**). The achievement of 100% controlled blood pressure in this population was better than that reported in the study by [13] in Malaysia and the average achievement of blood pressure targets in previous studies in Indonesia. This can be explained by a combination of three factors: (1) high patient adherence (average MPR of 0.84); (2) proactive intensification of therapy by clinicians (88% of patients) and (3) the selection of combination therapy as the initial strategy for the majority of patients (62%). This combination of factors indicates that the integrated care model at Ben Mboi General Hospital in Kupang is effective in achieving clinical targets for hypertension.

The Relationship between MPR and TIS with Blood Pressure Control and Lipid Profile

The results of the Spearman correlation test between MPR and TIS, and clinical outcomes are presented in **Table 4**. The correlation test showed no significant association between MPR and systolic blood pressure (ρ = 0.096; p = 0.340), diastolic blood pressure (ρ = 0.087; p = 0.387), total cholesterol (ρ = −0.033; p = 0.742), or triglycerides (ρ = 0.079; p = 0.435). Similarly, there was no significant association between TIS and systolic blood pressure (ρ = −0.067; p = 0.510), diastolic blood pressure (ρ = −0.075; p = 0.458), total cholesterol (ρ = 0.025; p = 0.808), or triglycerides (ρ = 0.096; p = 0.343). All correlation coefficients ($|\rho| < 0.2$) fell into the very weak category with p-values > 0.05.

Table 4. Results of the Spearman correlation test between MPR and TIS, and blood pressure and lipid profile

Independent Variable	Dependent Variable	Correlation Coefficient (ρ)	p-value	Interpretation
MPR	Systolic Blood Pressure	0,096	0,340	Very weak, not significant
MPR	Diastolic Blood Pressure	0,087	0,387	Very weak, not significant
MPR	Total Cholesterol	−0,033	0,742	Very weak, not significant
MPR	Triglyceride	0,079	0,435	Very weak, not significant
TIS	Systolic Blood Pressure	−0,067	0,510	Very weak, not significant
TIS	Diastolic Blood Pressure	−0,075	0,458	Very weak, not significant
TIS	Total Cholesterol	0,025	0,808	Very weak, not significant
TIS	Triglyceride	0,096	0,343	Very weak, not significant

Note: Spearman's correlation test; significance level $p < 0.05$; interpretation of correlation strength based on [16].

These results contradict the initial hypothesis and differ from the study by [25], which reported a strong correlation between adherence and blood pressure control (ρ = 0.756; p = 0.001), as well as that by [12]. The absence of a significant relationship in this study can be explained by the ceiling effect, which occurs when nearly all subjects fall into the same category for both variables (100% compliant and 100% controlled), resulting in very low data variability that prevents the correlation test from detecting a relationship, regardless of whether such a relationship exists clinically. This condition is an inherent methodological limitation in a homogeneous population and does not indicate that MPR/TIS is irrelevant to blood pressure control.

The ceiling effect occurs when most or all respondents are at a very high level or reach the upper limit of a variable, resulting in very little variation among respondents. This condition causes the instrument or statistical analysis to be less able to distinguish one respondent from another. In correlation analysis, restricted range can cause the observed correlation to be smaller than the actual relationship present in a more diverse population. The absence of a significant association between TIS and blood pressure control can also be interpreted in the context of appropriate non-intensification [13]. In patients whose BP is already controlled on the current regimen, a prudent clinician need not further increase the dose. This decision is clinically sound and actually results in low TIS in patients with good outcomes. Thus, low TIS in this population is not a sign

of therapeutic inertia, but rather a reflection of sound clinical practice in maintaining a regimen that is already effective.

The results of the Spearman correlation test showed no significant association between MPR or TIS and blood pressure or lipid profile outcomes. The correlation coefficients were very weak, with all absolute ϱ values below 0.20 and p-values greater than 0.05. These findings should be interpreted in consideration of the limited variability of the study variables. In particular, all participants were classified as adherent (100% with MPR ≥0.80), and all participants had controlled blood pressure. This concentration of observations within a single category represents a ceiling effect and substantially reduces the variability required to identify a statistical association.

In this study, the absence of non-adherent patients and uncontrolled blood pressure cases means that the analysis had limited contrast between exposure and outcome groups. Consequently, a non-significant Spearman correlation ($p > 0.05$) cannot be interpreted as evidence that MPR or TIS has no clinical relationship with blood pressure control. The possibility of a non-linear relationship should also be considered. Spearman's rho evaluates the strength of a monotonic relationship, meaning that the outcome is expected to generally increase or decrease as the predictor changes. However, the relationship between medication adherence or treatment intensification and clinical outcomes may not necessarily follow a simple monotonic pattern. For example, increasing adherence may produce substantial clinical benefit among patients with poor adherence but progressively smaller benefits once adequate adherence has been achieved.

Therefore, the non-significant correlation observed in this study should be interpreted primarily within the context of the study population and design rather than as evidence of the absence of a clinical relationship. Future studies with a larger and more heterogeneous sample, including both adherent and non-adherent patients as well as controlled and uncontrolled blood pressure groups, would provide greater variability and improve the ability to evaluate the relationship between MPR, TIS, and clinical outcomes. Where the sample size and distribution of outcome categories are adequate, additional analyses such as multivariable logistic regression may be considered to estimate the association between adherence or treatment intensification and achievement of blood pressure control while adjusting for potential confounders.

The absence of a significant association between MPR/TIS and lipid profiles (total cholesterol and triglycerides) has its own conceptual explanation. In this study, MPR and TIS measured only antihypertensive regimens, not lipid-lowering medications (statins/fibrates). Data on the use of concomitant lipid-lowering medications, including statins and fibrates, were not consistently available in the medical records included in this retrospective study and therefore could not be reliably quantified or incorporated into the analysis. Consequently, the distribution of participants receiving or not receiving lipid-lowering therapy could not be presented. This limitation is particularly relevant to the interpretation of lipid outcomes, as the observed total cholesterol and triglyceride levels may have been influenced by concomitant lipid-lowering treatment in addition to antihypertensive therapy.

The interpretation of the lipid profile findings requires consideration of concomitant lipid-lowering therapy. In the present study, 88% of participants had elevated total cholesterol, whereas triglyceride levels were within the normal range in all participants. However, information regarding the use, type, dose, and duration of lipid-lowering medications, particularly statins and fibrates, was not sufficiently available to determine their distribution among the study participants. This is an important limitation because lipid-lowering therapy may directly influence total cholesterol and triglyceride concentrations and could therefore confound the observed relationship between antihypertensive treatment variables and lipid outcomes. Patients' lipid profiles are more influenced by specific dyslipidemia therapies, diet, physical activity, and other metabolic comorbidities that were not directly measured [5,26]. Therefore, the absence of correlation is conceptually understandable and consistent with the pharmacological framework of hypertension therapy.

Clinical Implications

These findings suggest that the integrated pharmacy service model at Ben Mboi General Hospital may contribute to high adherence and blood pressure control, although further research is needed to confirm its effectiveness. From a clinical perspective, the findings suggest that successful blood pressure control in patients with chronic hypertension may not be determined solely by medication adherence and therapeutic intensification. Contextual factors that were not directly assessed in this study, such as geographical access to healthcare facilities, family support, and local healthcare policies, may also influence the continuity and effectiveness of hypertension management. Geographical barriers, including distance to healthcare facilities and transportation availability, may affect patients' ability to attend routine follow-up visits and obtain medications consistently. Family support may facilitate medication-taking behavior, follow-up attendance,

and lifestyle modification, particularly among patients requiring long-term treatment. In addition, local healthcare policies and service arrangements, including medication availability, referral systems, and chronic disease management programs, may influence continuity of care and access to antihypertensive treatment. Therefore, clinical management of chronic hypertension should consider not only pharmacological factors but also patient- and health-system-level determinants. Although these factors were not measured in the present study, their potential contribution should be considered when interpreting the findings and should be investigated in future prospective or qualitative studies.

The findings of this study have several practical implications. First, the achievement of 100% blood pressure control in the outpatient hypertensive population through high adherence and proactive intensification indicates that the integrated pharmacy service model at Ben Mboi General Hospital in Kupang is functioning effectively and can serve as a model for other referral hospitals in Eastern Indonesia. Second, the role of pharmacists in supporting adherence through periodic medication counseling and monitoring of clinical outcomes needs to be maintained and expanded. Third, the appropriate non-intensification approach needs to be disseminated to clinicians as part of prescribing rationality, so that the decision not to increase the dose in patients who are already controlled is not misinterpreted as therapeutic inertia.

Research Limitation

This study has several limitations that should be considered when interpreting the results. First, the retrospective cross-sectional design can only assess associations at a single point in time and cannot establish causal relationships. Second, there is substantial selection bias because the inclusion criteria required a minimum of three visits and complete medical records, meaning the study subjects were patients with consistent healthcare-seeking behavior and are not representative of all hypertensive patients at Ben Mboi General Hospital in Kupang. Third, the ceiling effect in the outcome variable (100% of patients were controlled) resulted in low data variability, which methodologically reduces the statistical test's ability to detect relationships. Fourth, confounding variables such as physical activity, dietary adherence, sleep duration, psychosocial status, and concurrent lipid-lowering therapy were not measured and thus unable to be controlled during analysis. Fifth, the validity of blood pressure measurements depends on the consistency of measurement techniques and the completeness of documentation in electronic medical records, which is an inherent limitation of using secondary data.

For future studies, adherence assessment could be strengthened by combining MPR with additional methods, such as pill counts, structured patient interviews, validated self-report questionnaires, or other measures of medication-taking behavior. Similarly, qualitative interviews with clinicians and patients could provide greater insight into the reasons underlying treatment intensification or non-intensification. Combining quantitative measures such as MPR and TIS with behavioral and clinical information would provide a more comprehensive assessment of medication adherence and the clinical decision-making process in chronic hypertension management.

Conclusions

Among patients with chronic hypertension, with or without comorbid dyslipidemia, at Ben Mboi General Hospital in Kupang, no significant association was found between treatment adherence (MPR) or treatment intensification (TIS) and blood pressure control or lipid profile (all $|\varrho| < 0.2$; $p > 0.05$). However, the absence of this association should not be interpreted as the irrelevance of these two indicators, but rather is due to a ceiling effect in the study population, in which all subjects (100%) were classified as compliant with a mean MPR of 0.84 ± 0.02, 88% received intensified therapy, and all participants achieved controlled blood pressure (systolic 128.00 ± 1.64 mmHg; diastolic 79.86 ± 2.12 mmHg), with 12% having cholesterol levels within normal limits and all participants with triglyceride levels within normal limits. These findings indicate that, among the studied sample, the combination of high adherence and appropriate intensification strategies was associated with achieving clinical targets. However, due to the ceiling effect and selection bias, these results should be interpreted with caution. Suggestions for more specific future research, such as prospective studies with control groups or qualitative research to explore factors influencing compliance.

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Conflict of Interest

The authors declare that they have no conflicting financial or non-financial interests that may be thought to affect the findings and interpretation of this research.

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