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Medication Adherence among Hypertensive Patients in Primary Care Clinics in Sarawak, Malaysia: An Explanatory Sequential Mixed-Methods Study

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ABSTRACT

Hypertension is a leading preventable risk factor for cardiovascular disease, yet medication non-adherence remains a primary barrier to achieving blood pressure control. This study assessed medication adherence rates and explored the multifaceted factors influencing medication adherence among hypertensive patients in primary care clinics in Sarawak, Malaysia. An explanatory sequential mixed-methods design was employed in which the quantitative predictors from Phase I directly informed the targeted purposive sampling and contextual exploration in Phase II across government health clinics. Phase I involved a cross-sectional survey of 601 adults with hypertension (≥18 years) using the validated modified Medication Adherence Scale. Phase II consisted of 24 semi-structured in-depth interviews to provide contextual depth to the quantitative findings. The quantitative results showed an adherence rate of 68.9%, with 58.5% of participants achieving controlled blood pressure. Medication adherence was significantly associated with blood pressure control (OR = 1.88, $p < 0.001$). Independent predictors of non-adherence included younger age (AOR = 0.97, $p = 0.01$), primary or lower education level (AOR = 2.24, $p = 0.02$), and polypharmacy (AOR = 1.91, $p = 0.01$). Interviews identified qualitative barriers (forgetfulness, the asymptomatic nature of the condition, fear of side effects, and misinformation) and facilitators (belief in medication effectiveness and family support) that helped explain these predictors. Approximately one-third of patients were non-adherent, associated with poorer blood pressure control. These findings suggest that medication adherence interventions should be tailored to younger patients and those with lower health literacy. Strategies focusing on regimen simplification, improved risk communication, and strengthening patient–provider partnerships are essential to reduce the long-term burden of cardiovascular disease in Sarawak.

Keywords: hypertension, medication adherence, mixed-methods, primary care

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INTRODUCTION

Hypertension remains the leading preventable risk factor for cardiovascular disease and premature mortality globally. As of early 2026, the World Health Organization (WHO) estimates that approximately 1.4 billion adults worldwide live with hypertension, a figure that continues to rise alongside ageing populations and shifting lifestyles (WHO, 2025). In Malaysia, the burden is particularly acute; according to the National Health and Morbidity Survey (NHMS) 2023, the prevalence of hypertension among adults aged 18 and above stands at approximately 29.2% (Mat Rifin *et al.*, 2025). This indicates that nearly one in three Malaysians is hypertensive, highlighting a public health crisis that places immense pressure on the national healthcare infrastructure (Mat Rifin *et al.*, 2025).

The consequences of uncontrolled hypertension are both clinically devastating and economically taxing. It serves as a major cause of ischaemic heart

disease, stroke, chronic kidney disease, and vascular dementia (WHO, 2025). Beyond individual health outcomes, the economic toll is staggering. Cardiovascular diseases are projected to cost low- and middle-income countries (LMICs), including Malaysia, trillions of Ringgit Malaysia in productivity losses and direct healthcare expenditures. For a developing nation, the rising cost of treating complications from poorly managed hypertension threatens the sustainability of universal health coverage (WHO, 2025).

Despite the widespread availability of effective pharmacological treatments, achieving blood pressure targets remains a significant clinical challenge. Globally, only about 20% of individuals with hypertension have their condition under control (WHO, 2025). In Malaysia, data indicate that fewer than 50% of patients diagnosed with hypertension achieve the recommended blood pressure target of < 140/90 mmHg (Institute for Public Health [IKU], 2024). Recent regional data from Sarawak echoes this trend, with studies suggesting that nearly half of the hypertensive population in primary care settings exhibits uncontrolled blood pressure, a phenomenon often linked directly to suboptimal self-management and non-adherence to treatment protocols (Ooi *et al.*, 2025).

Medication adherence is a cornerstone in the management of this condition. The WHO defines medication adherence as the degree to which an individual's behaviour aligns with the recommendations agreed upon with a healthcare provider. Medication adherence is increasingly recognised as a complex, multidimensional construct shaped by factors related to the patient, treatment regimen, disease characteristics, healthcare system, and socio-economic circumstances (Sabaté, 2003). In contemporary medical literature, a clear distinction is made between "compliance" and "adherence." While compliance is traditionally viewed as a passive behaviour where the patient follows a doctor's orders in a paternalistic, "top-down" relationship, medication adherence emphasises a collaborative partnership (Hugtenburg *et al.*, 2013). It suggests that the patient plays an active role in the decision-making process, implying that the treatment plan was mutually agreed upon to foster better long-term outcomes (Sabaté, 2003).

Medication non-adherence remains a primary barrier to achieving optimal blood pressure control, with global non-adherence rates estimated between 27% and 40% (Lee *et al.*, 2022). LMICs carry a significantly heavier weight of this burden. Based on a prescription refill analysis and current WHO statistics, this affects approximately 426 million individuals in LMICs, compared to 119 million in high-income nations (Lee *et al.*, 2022). While recent cross-sectional data from Malaysian primary care settings suggest self-reported medication adherence levels as high as 74.1%, corresponding blood pressure control remains suboptimal at approximately 51.4%, highlighting a significant gap between reported medication adherence and clinical outcomes (Suleiman *et al.*, 2024). Other local studies have reported adherence of 53.4% in primary care (Ramli *et al.*, 2012) and 60.7% among patients with uncontrolled hypertension (Thew *et al.*, 2022).

Medication non-adherence is often simplistically attributed to patient behaviour, yet it reflects a complex interaction of behavioural, sociocultural, and health system factors (Burnier & Egan, 2019). Patient-related barriers such as forgetfulness and fears of long-term side effects are better understood as consequences of disrupted routines, limited health literacy, and suboptimal risk communication, contributing to a paradox in which treatment is perceived as more harmful than asymptomatic disease. The silent nature of hypertension further weakens perceived necessity for medication, leading to intentional non-adherence (Burnier & Egan, 2019). System-level issues, including polypharmacy, complex regimens, and time-constrained, directive patient–provider communication, exacerbate treatment burden and limit meaningful engagement (Burnier & Egan, 2019). Additionally, the widespread use of complementary and alternative medicine and symptom-driven health beliefs in Malaysia further complicate medication adherence patterns (Ramli *et al.*, 2012). In Sarawak, these challenges are intensified by structural barriers such as geographic inaccessibility and associated costs, reframing non-adherence as an issue of access rather than solely behaviour. While existing studies have largely relied on quantitative approaches to estimate medication adherence rates and associated factors, these methods are insufficient to elucidate the underlying contextual, behavioural, and system-level drivers influencing medication adherence. Consequently, there remains a critical gap in understanding how these multidimensional factors interact within the local context. To address this gap, the present study employs a mixed methods design to both quantify medication adherence among patients with hypertension and explore the contextual factors influencing medication adherence behaviour in Sarawak, Malaysia. The integration of quantitative and qualitative data enables a more comprehensive understanding of medication adherence by using qualitative narratives to provide explanatory depth and contextual insight into the predictors of non-adherence identified through quantitative analysis. The research questions are: (1) What are the medication adherence rates and independent predictors of non-adherence? (2) What are the contextual barriers and facilitators influencing patient medication adherence? and (3) How do the qualitative findings explain the identified quantitative predictors?

MATERIALS & METHODS

This study utilised an explanatory sequential mixed-methods design, implemented in two phases. The study adopted a quantitative-dominant approach, followed by a qualitative component (Creswell & Guetterman, 2018). The quantitative phase generated data on medication adherence rates and the factors influencing them, while the qualitative phase offered in-depth insights to further explain and contextualise these factors. Data integration followed a connecting strategy within a quantitative-dominant (QUAN → qual) framework. The integration occurred at the intermediate stage of the study, where the quantitative findings from Phase I directly shaped the sampling framework and data collection protocol for Phase II. Specifically, the independent statistical predictors of medication non-adherence identified in the Phase I multivariable analysis served as the explicit criteria for the purposive selection of Phase II participants. Furthermore, these Phase I results were utilised to refine the semi-structured qualitative interview topic guide. This ensured that the subsequent qualitative data collection was deliberately directed at explaining, contextualising, and unpacking the underlying mechanisms driving the key statistical predictors observed in the quantitative phase.

Phase I

Phase I employed a cross-sectional survey in government health clinics in Kuching and Kota Samarahan, Sarawak. Participants were adults (≥18 years) with hypertension diagnosed for at least six months and prescribed ≥1 antihypertensive medication, who could understand English or Malay . Exclusion criteria were secondary hypertension, pregnancy, use of medications elevating blood pressure, and psychiatric conditions impairing comprehension. Systematic random sampling was applied. Following a random start, every third eligible patient presenting at registration was invited to participate. The sampling interval was based on the average daily number of hypertensive attendances to ensure unbiased, systematic distribution across the entire operating day. To reduce potential periodicity and selection bias associated with clinic attendance patterns, recruitment occurred Monday through Friday across alternating morning and afternoon blocks, referencing typical daily clinic flow rates, ensuring broader representation of the study population. The required sample size, calculated using the formula $(Z^2 \times p(1-p)) / d^2$ (Charan & Biswas, 2013) with $p = 0.5$, $d = 0.05$, and $Z = 1.96$, was 384; accounting for 20% non-response, the final target was 461.

Data were collected using a structured questionnaire comprising demographics, medication history, and adherence. Adherence was assessed using the validated modified Medication Adherence Scale (Ramli *et al.*, 2012). The modified Medication Adherence Scale proved to be a reliable instrument in this local setting, achieving a Cronbach's α of 0.782, which indicates good internal consistency. The assessment consists of seven questions, each utilising a four-point Likert-type scale for responses. Scoring is weighted inversely to frequency: "none of the time" earns 4 points, "some of the time" earns 3 points, "most of the time" earns 2 points, and "all the time" earns 1 point (score range: 7–28); scores ≤26 indicate non-adherence (Ramli *et al.*, 2012). Completion time was approximately 10 minutes.

Data were collected from April to July 2023. Recruitment occurred at clinic registration, with eligible patients approached, informed consent obtained, and office blood pressure recorded by a researcher prior to questionnaire administration. Blood pressure was measured using a standardised protocol with participants in the same arm and position. Two readings were obtained at one-minute intervals. If the difference between the initial readings exceeded 10 mmHg, a third measurement was performed. The final blood pressure value was defined as the mean of the last two readings (Quinn *et al.*, 2010). Controlled blood pressure is defined as blood pressure < 140/90 mmHg. The questionnaire was self-completed using printed hardcopy forms under researcher supervision and stored securely. No incentives were provided.

Data were analysed using IBM SPSS Statistics Version 28.0, IBM Corp., Armonk, NY, USA. Descriptive statistics summarised participant characteristics. Pearson's chi-square test assessed categorical associations, and logistic regression identified independent predictors of medication adherence. Significance was set at $p < 0.05$.

Phase II

For phase II, semi-structured in-depth interviews (IDIs) were conducted to generate complementary perspectives and enable data triangulation. IDIs allowed for exploration of individual experiences and contextual factors influencing medication adherence.

Participants were purposively sampled (not from Phase I samples) and recruitment continued until data saturation. Data saturation was monitored concurrently during data collection through ongoing transcript review, and a formal saturation check was conducted by dual-coding new transcripts until no new codes or themes were generated. A topic guide was developed to explore barriers, facilitators, and strategies related to medication adherence, with the quantitative findings from Phase I informing both the qualitative sampling criteria and the refinement of interview questions.

Interviews were conducted in private settings, with written informed consent obtained prior to participation. Each IDI lasted approximately 45 minutes. Sessions were audio-recorded, supplemented by field notes documenting verbal and non-verbal cues. Two researchers facilitated each session, one leading the interview and the other recording

observations. Participants received monetary compensation.

Data were transcribed verbatim, anonymised, and managed using NVivo 14. Thematic analysis was applied, with two researchers independently coding transcripts, developing categories, and generating themes iteratively. Discrepancies were resolved by consensus or consultation with a third senior researcher (Maguire & Delahunt, 2017). Reflexivity was maintained throughout to ensure analytical credibility (Houghton *et al.*, 2013). The research team consisted of family medicine physicians, public health researchers, and primary care medical officers from academic institutions and the Ministry of Health in Sarawak, Malaysia. Their roles within the local healthcare system provided valuable insider knowledge of clinical workflows, healthcare delivery structures, and geographical challenges affecting patients. This familiarity facilitated access to study sites and enhanced understanding of participants' experiences. However, the researchers acknowledged that their professional identities as healthcare providers could influence participant responses and contribute to power imbalances during interviews.

To address potential bias, several reflexive strategies were implemented. Interviews were conducted in private, non-clinical settings, and researchers' emphasised their role as learners seeking to understand patients' experiences rather than evaluating medication adherence. Interviewers reflected on, and sought to set aside, their clinical assumptions to encourage open discussion of non-adherence without judgement. During data analysis, an iterative dual-coding process, supported by field notes and consensus discussions, was used to enhance analytical rigour and ensure that interpretations remained grounded in participants' perspectives.

Ethical approval was obtained from the National Medical Research Register and the Medical Research and Ethics Committee Malaysia (NMRR ID-22-02967-IBO [IIR]). The study followed the Declaration of Helsinki and Malaysian Good Clinical Practice Guidelines. Participation was voluntary, with the right to withdraw or decline questions at any time. Risks were minimal as no intervention was involved, and while there was no direct benefit to participants, their contributions were expected to enhance understanding of medication adherence.

RESULTS

Phase I: Quantitative Findings

A total of 601 hypertensive patients participated in the study. Recruitment exceeded the target because of high patient volume and a high response rate across the selected primary care clinics during the designated data collection window. The mean age was 58.2 ± 11.3 years, ranging from 23 to 87 years. The majority were female (59.2%), and the largest ethnic group was Bidayuh (40.2%), followed by Malay (37.3%), Chinese (13.5%), and Iban (9.0%). The largest group had primary or lower education (46.6%). Most were married (87.9%) and had comorbid dyslipidaemia (62.9%) or diabetes mellitus (31.9%). More than half (53.1%) were prescribed only one antihypertensive medication, while 46.9% were taking two or more. In addition, 61.1% were taking one or fewer other medications, while the rest were on two or more types of non-antihypertensive drugs. The mean duration of medication use was 7.7 ± 6.4 years, with a range of 1 to 38 years (Table 1).

Table 1. Characteristics of participants in Phase I (N = 601)

Characteristic	N (%)
Gender	
Male	245 (40.8)
Female	356 (59.2)
Age (mean±SD) (range)	58.2 ± 11.3 (23.0 - 87.0)
Ethnicity	
Bidayuh	242 (40.2)
Malay	224 (37.3)
Chinese	81 (13.5)
Iban	54 (9.0)
Education level	
Primary and below	280 (46.6)
Secondary	252 (41.9)
Tertiary	69 (11.5)
Marital status	
Married	528 (87.9)
Non-married	73 (12.1)

Characteristic	N (%)
Diabetes	192 (31.9)
Dyslipidaemia	378 (62.9)
Types of antihypertensive medications	
1	319 (53.1)
≥ 2	282 (46.9)
Other types of medications	
≤ 1	367 (61.1)
≥ 1	234 (38.9)
Years taking medications (mean±SD) (range)	7.7 ± 6.4 (1.0 – 38.0)

SD, standard deviation.

Among the 598 participants with complete data on medication adherence and blood pressure control, 68.9% were adherent to their prescribed antihypertensive medications, while 31.1% were non-adherent. Overall, 58.5% of participants achieved controlled blood pressure. Figure 1 illustrates the relationship between blood pressure control and medication adherence, indicating that participants with uncontrolled blood pressure tend to be non-adherent to their medications. There was a statistically significant association between medication adherence and blood pressure control (χ^2 (1) = 12.61, $p < 0.001$). Patients who were adherent to their medications were nearly twice as likely to have controlled blood pressure compared to those who were non-adherent (OR = 1.88, 95% CI: 1.32–2.67).

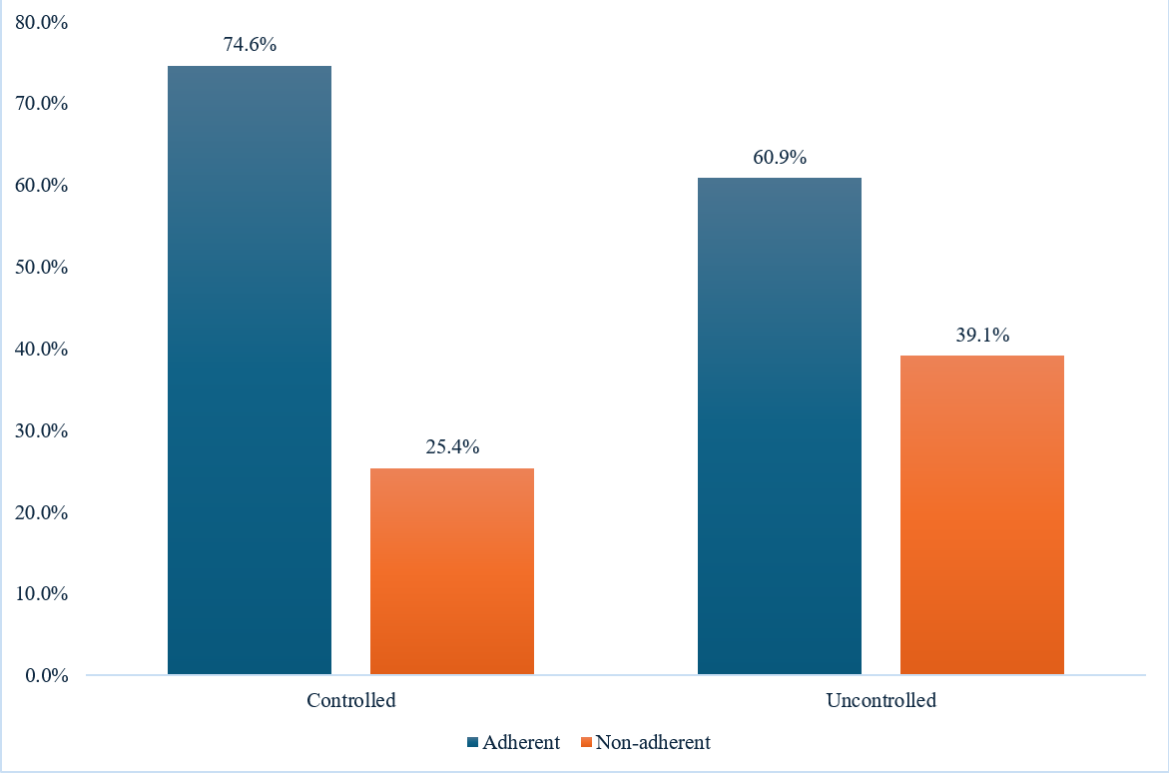


Figure 1. Blood pressure control and medication adherence

Table 2 presents the logistic regression analysis of factors associated with medication non-adherence. In the multivariable model, younger age, lower education level, and taking more types of medications were independently associated with non-adherence. Specifically, each additional year of age was associated with a 3% reduction in the odds of non-adherence (AOR = 0.97, 95% CI: 0.96–0.99, $p = 0.01$). Participants with primary or lower education were more than twice as likely to be non-adherent compared to those with tertiary education (AOR = 2.24, 95% CI: 1.15–4.38, $p = 0.02$). In addition, patients taking two or more other types of medications (apart from antihypertensives) had nearly twofold higher odds of non-adherence (AOR = 1.91, 95% CI: 1.20–3.04, $p = 0.01$). Gender, ethnicity, marital status, presence of diabetes or dyslipidaemia, number of antihypertensive medications, and duration of treatment were not significantly associated with adherence after adjustment.

Table 2. Factors associated with non-adherence to antihypertensive medications by logistic regression analysis

Variable	Crude OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Gender				
Male	1.26 (0.89-1.79)	0.19	1.30 (0.90-1.88)	0.16
Female			1	
Age	0.99 (0.98-1.01)	0.32	**0.97 (0.96-0.99)**	**0.01**
Ethnicity				
Bidayuh	1		1	
Malay	0.81 (0.55-1.21)	0.30	0.96 (0.63-1.45)	0.84
Chinese	0.99 (0.58-1.69)	0.98	1.22 (0.69-2.18)	0.50
Iban	0.76 (0.40-1.47)	0.42	0.77 (0.39-1.52)	0.45
Education level				
Primary and below	1.50 (0.82-2.73)	0.20	**2.24 (1.15-4.38)**	**0.02**
Secondary	1.40 (0.76-2.57)	0.29	1.70 (0.90-3.20)	0.11
Tertiary	1		1	
Marital status				
Married	0.80 (0.18-1.34)	0.39	0.71 (0.42-1.22)	0.22
Non-married	1		1	
Diabetes				
Yes	**1.85 (1.30-2.67)**	**0.001**	1.27 (0.79-2.03)	0.32
No	**1**		1	
Dyslipidaemia				
Yes	1.21 (0.85-1.74)	0.30	1.02 (0.69-1.53)	0.91
No	1		1	
Types of antihypertensive medications				
1	**1**		1	
≥ 2	**1.64 (1.16-2.31)**	**0.01**	1.40 (0.95-2.04)	0.09
Other types of medications				
≤ 1	**1**		**1**	
≥ 2	**2.22 (1.56-3.15)**	**< 0.001**	**1.91 (1.20-3.04)**	**0.01**
Years taking medications (mean, 95%CI)	1.02(0.99-1.04)	0.27	1.02 (0.99-1.05)	0.31

OR, odds ratio; AOR, adjusted odds ratio; CI, confidence interval.

Phase II: Qualitative Findings

The qualitative phase explored participants' experiences, perceptions, and behaviours regarding medication adherence. A total of 24 participants were interviewed, including 10 males and 14 females, aged between 33 and 77 years. Most participants were of Malay ethnicity, followed by Bidayuh and Chinese, and the majority had attained a secondary school education (Table 3). Table 4 presents the key barriers and facilitators influencing medication adherence.

Integration of Quantitative and Qualitative Findings

The qualitative insights provided explanatory depth to the quantitative predictors of non-adherence identified in Phase I, as presented in Table 5.

Table 3. Characteristics of participants in Phase II (N = 24)

Characteristic	N (%)
Age	
30 – 49	6 (25.0)
50 – 69	16 (66.7)
≥ 70	2 (8.3)
Ethnicity	
Bidayuh	9 (37.5)
Malay	12 (50.0)
Chinese	2 (8.3)
Iban	1 (4.2)
Education level	
Primary and below	6 (25.0)
Secondary	15 (62.5)
Tertiary	3 (12.5)
Marital status	
Married	20 (83.3)
Non-married	4 (16.7)

Table 4. Barriers and facilitators to medication adherence

Main Theme	Sub-theme	Quote
Barriers	Limited understanding of hypertension	*High blood pressure only happens when we are stressed. (P5, Male, 56 y/o)*
	Forgetfulness and competing responsibilities	*I take care of my grandchildren and have many chores, so sometimes I forget to take my medicine. (P8, Female, 67 y/o)*
	Perceived stability and absence of symptoms	*"I don't have any symptoms, that's why I don't feel giddy, so I don't eat (medicine)." (P8, Female, 67 y/o)*
	Side effects and medication fatigue	*After I started the medicine, my eyes became blurry. (P22, Female, 67 y/o)* *Sometimes I just get tired of taking medicine every day. (P7, Male, 67 y/o)*
	Scepticism and misinformation	*People say the medicine can damage kidneys. (P9, Female, 54 y/o)* *I saw on Facebook that natural herbs can cure it. (P8, Female, 67 y/o)*
	Psychological and system-related issues	*I feel uncertain when the doctor changes my medicine. (P22, Female, 67 y/o)* *The pills look different every time; I get confused. (P22, Female, 67 y/o)*
	Low health literacy and younger age	*I'm still young; I don't really need to take medicine. (P21, Male, 33 y/o)* *Even if the doctor explains, I still don't understand. (P7, Male, 67 y/o)*
Facilitators	Belief in medication effectiveness	*Medicine helps to control my blood pressure. (P4, Male, 73 y/o)*
	Fear of complications	*I take my medicine because I'm afraid of stroke like my sister. (P5, Male, 56 y/o)*
	Trust in healthcare providers and system	*All the doctors here are very good. (P18, Female, 68 y/o)* *Government medicine is good and free. (P3, Female, 54 y/o)*
	Routine and reminder strategies	*I always take it at the same time every day. (P11, Female, 55 y/o)* *When I opened my pillbox, I realised I didn't take it on Sunday, so I took it today. (P10, Female, 49 y/o)*
	Family and social support	*My husband and I also talk on the phone, he'll say, "Have you taken your medicine?" (P8, Female, 67 y/o)*
	Personal responsibility and self-motivation	*It's my responsibility to take care of my health for my family. (P4, Male, 73 y/o)*
	Awareness of lifestyle role	*Even if I take medicine, I must also control my diet and lifestyle. (P4, Male, 73 y/o)*

Table 5. Joint display of the integration of qualitative and quantitative findings

Quantitative Findings (Phase I)	Qualitative Themes & Explanations (Phase II)	Representative Quotes (Phase II)	Mixed-Methods Integration Insights
Younger Age Predicts Non-Adherence Each additional year of age was associated with a 3% reduction in the odds of non-adherence (AOR = 0.97, 95% CI: 0.96–0.99, p = 0.01).	**Perceived Invulnerability and Low Perceived Necessity** Younger individuals frequently underestimate the severity of hypertension due to its asymptomatic nature and a cognitive bias of being "too young to be sick". Older patients exhibit better compliance due to higher health awareness and habituation to chronic illness.	"*I'm still young and healthy; I don't really need to take medicine.*" (P21, Male, 33 y/o) "*As you get older, taking medicine becomes easier as you'll get used to it as health issues become more common.*" (P12, Male, 53 y/o)	Qualitative findings explain the statistical trend by demonstrating that age operates through a cognitive framework of "perceived necessity vs. perceived risk". Younger patients lack the habituation and symptom-driven prompts that naturally drive medication adherence in older cohorts.
Lower Education Predicts Non-Adherence Participants with a primary or lower education level were over twice as likely to be non-adherent compared to those with tertiary education (AOR = 2.24, 95% CI: 1.15–4.38, p = 0.02).	**Low Health Literacy and Susceptibility to Misinformation** Lower educational attainment correlates with poor comprehension of the pathology of hypertension and treatment longevity. This limited literacy makes patients highly vulnerable to medical hearsay, social media myths, and unfounded fears.	*"I don't really understand why I need to take medicine every day.*" (P12, Male, 53 y/o, Secondary school) "*People say this medicine can damage the kidneys*." (P9, Female, 54 y/o, Primary school)	The qualitative data expands the quantitative risk profile by identifying low health literacy and structural misinformation (e.g., fear of kidney damage from pharmaceutical pills) as the explicit mechanisms driving intentional non-adherence among less-educated patients.
Polypharmacy Predicts Non-Adherence Patients taking two or more non-antihypertensive medications alongside their regimen had nearly twofold higher odds of non-adherence (AOR = 1.91, 95% CI: 1.20–3.04, p = 0.01).	**Pill Burden, Confusion, and Medication Fatigue** Managing multi-drug regimens increases overall treatment burden. Patients encounter profound physical pill fatigue and administrative confusion when taking multiple medications concurrently.	"*If I mix them (the medications), I get confused*." (P22, Female, 67 y/o) "*Too many pills, it gets tiring*." (P7, Male, 67 y/o)	The quantitative association is validated qualitatively by showing that non-adherence in polypharmacy is a mixture of unintentional errors (regimen confusion) and intentional choices arising from severe medication fatigue and physical exhaustion from swallowing multiple daily pills.
Medication adherence Associated with Blood Pressure Control Adherent patients were nearly twice as likely to achieve controlled blood pressure compared to non-adherent patients (OR = 1.88, 95% CI: 1.32–2.67, p < 0.001).	**Positive Outcome Expectancy and System Trust** Patients who experience or recognise tangible improvements in their health possess higher outcome expectancy, reinforcing their confidence in clinical instructions and the public health system.	"*When I take my medicine, my blood pressure goes down.*" (P12, Male, 53 y/o) "*This medicine really helps me control my blood pressure*." (P12, Male, 53 y/o)	The quantitative clinical correlation is tied directly to the psychological concept of positive reinforcement. When patients connect their behavioural action (adherence) directly to a positive clinical result (controlled blood pressure), it validates their self-efficacy and strengthens medication adherence behaviour.

Universality of Core Themes

Despite differences in gender and ethnicity, participants expressed similar experiences and beliefs, suggesting that medication adherence behaviour is driven more by cognitive and behavioural factors than by demographic characteristics.

DISCUSSION

This study examined medication adherence among hypertensive patients in primary care clinics in Sarawak and explored the factors influencing medication adherence. The findings indicate that 68.9% of participants were adherent to their antihypertensive medications, and medication adherence was significantly associated with blood pressure control. Younger age, lower education level, and polypharmacy were identified as independent predictors of non-adherence. The qualitative findings further revealed that medication adherence behaviour was influenced by health literacy, beliefs about hypertension, perceived necessity of medication, side effects, and system-related factors such as medication changes and pill burden.

The medication adherence rate of 68.9% observed in this study is comparable to previous Malaysian studies but remains suboptimal. Ramli *et al.*

(2012) reported a medication adherence rate of 53.4% among hypertensive patients in Malaysian primary care, while Thew *et al.* (2022) reported medication adherence levels of approximately 60.7% among patients with uncontrolled hypertension in Sarawak (Ramli *et al.*, 2012; Thew *et al.*, 2022). A more recent Malaysian study reported higher self-reported medication adherence of 74.1%, although blood pressure control remained relatively low (Suleiman *et al.*, 2024). The variation in medication adherence rates across studies may be attributed to differences in measurement tools, study populations, and healthcare settings. Nonetheless, the non-adherence rate in the present study falls within the global non-adherence range of 27% to 40% reported in a large meta-analysis, suggesting that medication non-adherence remains a persistent issue in both local and global contexts (Lee *et al.*, 2022). The timing of this study in the post-pandemic era may have heavily influenced the observed medication adherence rate of 68.9%. In the wake of the COVID-19 pandemic, primary care settings have experienced significant macro-level shifts in clinic access patterns, patient health-seeking behaviours, and overall public attitudes toward long-term pharmaceutical management. This transitional period may explain why the medication adherence rate in this cohort is noticeably higher than pre-pandemic local figures, such as the 53.4% reported by Ramli *et al.* (2012) and the 60.7% reported by Thew *et al.* (2022). A heightened public awareness regarding the severe risks of poorly controlled chronic comorbidities, paired with the subsequent normalisation and restructuring of subsidised government primary care workflows, likely fostered a more proactive attitude toward daily medication adherence among certain cohorts. Conversely, shifting post-pandemic socioeconomic factors and altered clinic routines in Sarawak may also explain why approximately one-third of the patient population remained non-adherent, underscoring how evolving temporal health landscapes directly shape chronic self-management behaviour.

A key finding of this study is the significant association between medication adherence and blood pressure control, with adherent patients being nearly twice as likely to achieve controlled blood pressure. This finding is consistent with previous studies that have demonstrated a strong relationship between medication adherence and hypertension control (Burnier & Egan, 2019; Suleiman *et al.*, 2024). This reinforces the importance of medication adherence as a central component of hypertension management and highlights that improving medication adherence may be one of the most effective strategies to improve blood pressure control in primary care settings.

This study also identified younger age as a predictor of non-adherence, which is consistent with findings from previous studies showing that younger patients are more likely to have poor medication adherence due to lower perceived susceptibility to complications and competing life priorities (Burnier *et al.*, 2020; Nakajima *et al.*, 2021). The qualitative findings in this study support this explanation, as younger participants often perceived themselves as "not sick" and therefore did not prioritise medication adherence. In contrast, older participants were more adherent due to increased health awareness, experience with chronic illness, and fear of complications such as stroke.

Lower education level was another independent predictor of non-adherence, likely reflecting limited health literacy and poor understanding of hypertension and its treatment. A community study in Shanghai has shown that low health literacy is associated with lower educational level (Wu *et al.*, 2017). This is consistent with previous literature demonstrating that patients with lower educational attainment often have poorer medication adherence due to limited understanding of disease processes, medication benefits, and long-term consequences of uncontrolled hypertension (Burnier *et al.*, 2020). In addition, lower education levels are also associated with greater susceptibility to misinformation (Carletto *et al.*, 2025). This supported the qualitative findings in this study that misinformation, fear of side effects, and reliance on non-medical information sources contributed to non-adherence among patients with lower education levels.

Polypharmacy was also significantly associated with non-adherence, particularly among patients taking multiple non-antihypertensive medications. This finding is consistent with existing literature showing that complex medication regimens increase treatment burden, confusion, and medication fatigue, which subsequently reduce medication adherence (Burnier & Egan, 2019). Interestingly, the number of antihypertensive medications alone was not significantly associated with non-adherence after adjustment, suggesting that overall pill burden rather than antihypertensive regimen complexity specifically may be more important in influencing medication adherence behaviour.

The qualitative findings provided important contextual explanations for the quantitative results and highlighted that medication non-adherence is not purely a patient behaviour issue but is influenced by cognitive, psychological, and system-level factors. Patients reported forgetfulness, lack of symptoms, fear of side effects, and confusion due to medication changes as key barriers. These findings are consistent with the WHO framework, which describes medication adherence as a multidimensional phenomenon influenced by patient-related, therapy-related, condition-related, health system, and socio-economic factors (Sabaté, 2003). The finding that patients often stop medication due to absence of symptoms reflects the well-documented challenge of managing asymptomatic chronic conditions such as hypertension.

The unique local context of Sarawak heavily influences medication non-adherence, particularly

through the intersection of modern digital misinformation and traditional health beliefs. Qualitative interviews revealed that patients are highly susceptible to digital hearsay, with participants noting they saw claims on Facebook that "natural herbs" could completely cure hypertension. This reliance on non-medical sources often drives the use of complementary alternatives and fosters unfounded fears that long-term pharmaceutical therapies will damage vital organs like the kidneys. Interestingly, while structural and geographic inaccessibility are widely recognised challenges across Sarawak, geographic barriers did not emerge as a prominent theme in the qualitative findings. This unexpected discrepancy is likely because data collection occurred within government primary care clinics located in semi-urban hubs like Kuching and Kota Samarahan. Consequently, the interviewed cohort consisted entirely of individuals who had already successfully navigated transit and access barriers on their appointment days, thereby underrepresenting the lived experiences of more isolated, rural populations who face the brunt of Sarawak's geographical challenges.

The study also identified several facilitators of medication adherence, including belief in medication effectiveness, fear of complications, trust in healthcare providers, routine-building strategies, and family support. These findings highlight the importance of patient education, effective doctor–patient communication, and social support systems in improving medication adherence. The role of trust in healthcare providers is particularly important in the Malaysian public healthcare context, where medications are subsidised and long-term continuity of care is possible.

Despite the diverse and multi-ethnic composition of Sarawak's population, the qualitative findings suggest that key barriers to medication adherence were largely shared across ethnic groups. Participants consistently described low medication literacy, forgetfulness, concerns regarding long-term medication side effects, and difficulties sustaining treatment for an asymptomatic condition. Similar findings have been reported internationally. A systematic review of qualitative studies involving hypertensive patients from 16 countries demonstrated that beliefs surrounding hypertension, concerns about medication adverse effects, reliance on symptoms to judge disease control, and forgetfulness were remarkably consistent across ethnic and geographical settings (Marshall *et al.*, 2012). These observations suggest that the cognitive and behavioural mechanisms underlying medication adherence may transcend cultural boundaries and reflect common human responses to chronic disease management. Consequently, while medication adherence interventions in Sarawak should remain culturally sensitive and linguistically accessible, they should primarily address shared behavioural and health-system barriers that affect patients irrespective of ethnic background.

Strengths and Limitations

This study has several strengths. The mixed-methods design allowed for both quantification of medication adherence and in-depth exploration of patient experiences, providing a more comprehensive understanding of medication adherence behaviour. The relatively large sample size also improves the precision of the estimates of the quantitative findings. However, several limitations should be acknowledged. First, medication adherence was self-reported, which may be subject to recall and social desirability bias. Second, the cross-sectional design limits causal inference. Third, the study was conducted in government primary care clinics in Kuching and Kota Samarahan, which may limit generalisability to rural or private healthcare settings in Sarawak.

Other limitations are inherent to its mixed-methods design. First, the qualitative participants were not drawn from the quantitative study cohort, which may have limited the inclusion of perspectives from individuals who declined participation or were less engaged with healthcare services. Second, although interviews were conducted in participants' preferred languages (English or Malay language) and translated where necessary, subtle linguistic and cultural nuances may have been lost during transcription and translation, potentially affecting interpretation of meaning. Third, as interviews were conducted by healthcare-affiliated researchers, participants may have modified their responses due to social desirability bias, while interviewer assumptions could have influenced data collection and interpretation despite efforts to maintain reflexivity. Finally, the explanatory sequential design provided contextual understanding of quantitative findings but was not intended to achieve statistical generalisability of the qualitative insights.

CONCLUSION

This study found that approximately one-third of hypertensive patients in primary care clinics in Sarawak were non-adherent to their medications, and non-adherence was significantly associated with poor blood pressure control. Younger age, lower education level, and polypharmacy were key predictors of non-adherence, while qualitative findings highlighted the role of health literacy, beliefs, medication burden, and system-related factors. These findings suggest that interventions to improve medication adherence should focus on patient education, regimen simplification, and improving provider guidance and patient risk communication during times of medication changes and multi-drug adjustments. Addressing medication adherence is essential to improving blood pressure

control and reducing the long-term burden of cardiovascular disease in Sarawak and similar primary care settings.

Recommendation

From a clinical and public health perspective, the findings of this study have several important implications. First, medication adherence interventions should target younger patients, patients with lower education levels, and those with polypharmacy, as these groups are at higher risk of non-adherence. Second, improving health literacy and risk communication is essential, particularly in helping patients understand that hypertension is a lifelong condition that requires continuous treatment even in the absence of symptoms. Third, simplifying medication regimens and using pillboxes, reminder systems, and fixed-dose combination therapy may help reduce pill burden and improve medication adherence. Finally, improving provider guidance and counselling during medication changes may reduce confusion and improve medication adherence. Future studies should move beyond cross-sectional approaches and adopt prospective longitudinal designs to examine how medication adherence changes over time, particularly as patients age or face increasing medication burdens. Research should also extend to rural and remote interior regions of Sarawak to better understand the unique geographical, transportation, and healthcare access challenges encountered by indigenous communities. Incorporating objective medication adherence indicators, such as pharmacy refill records and Medication Possession Ratio (MPR), alongside self-reported measures may provide a more accurate assessment of medication adherence by reducing recall and social desirability biases. Furthermore, randomised controlled trials are warranted to evaluate the effectiveness of culturally appropriate digital health (mHealth) interventions, including simplified risk-communication tools, in addressing misinformation and improving health literacy among patients with hypertension in primary care settings.

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