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IMPACT OF HEALTH LITERACY ON CLINICAL OUTCOMES: THE MEDIATING ROLE OF MEDICATION ADHERENCE AMONG PATIENTS WITH HYPERTENSION IN MALAYSIA

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Abstract

Hypertension remains the leading modifiable cardiovascular risk factor in Malaysia, yet optimal blood pressure control continues to be a significant public health challenge. This paper develops a conceptual model examining the relationship between patient health literacy and clinical outcomes among Malaysian patients with hypertension, with medication adherence proposed as a mediating mechanism. Guided by health literacy theory and the Chronic Care Model, health literacy is conceptualized as the predictor, medication adherence as the mediator, and systolic and diastolic blood pressure control as clinical outcomes. However, limited evidence has examined whether medication adherence explains the relationship between health literacy and blood pressure control among Malaysian patients with hypertension. A structured synthesis of peer-reviewed literature from Malaysia and comparable settings indicates that higher health literacy is associated with greater medication adherence, while adherence is an established predictor of improved blood pressure control and cardiovascular outcomes. Evidence from a Malaysian randomised controlled trial at University Malaya Medical Centre further supports the proposed pathway. National Health and Morbidity Survey data show that hypertension control improved from 27.5% in 2006 to 37.4% in 2015, but remained below 40%, highlighting the continuing need for effective hypertension management. Based on the evidence, a conceptual framework and four hypotheses are proposed, with a quantitative cross-sectional design using validated measures of health literacy, medication adherence (via the MyMaat-12), and objectively measured blood pressure. PLS-SEM or SEM is proposed to test the hypothesised relationships and mediation pathway. The model provides a theoretically grounded framework for understanding how health literacy may influence hypertension outcomes through medication adherence and may inform health literacy-sensitive interventions in Malaysian primary care.

Keywords: health literacy, medication adherence, clinical outcomes, hypertension, blood pressure control, Malaysia, Chronic Care Model

1.Introduction

1.1 Background of the Study

Hypertension is the leading modifiable risk factor for cardiovascular disease, stroke, and chronic kidney disease worldwide (Zhou et al., 2021). In Malaysia, successive National Health and Morbidity Surveys (NHMS) have tracked a persistently high burden: national hypertension

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prevalence was estimated at 34.6% in 2006, 33.6% in 2011, and 35.3% in 2015 (Ab Majid et al., 2018), while NHMS 2023 reported 29.2%, compared with 30.0% in 2019, 30.3% in 2015, and 32.7% in 2011 (Institute for Public Health, 2023), with an earlier national study reporting 27.8% among adults aged 15 and above (Rampal et al., 2007) and a later community-based salt study reporting prevalence as high as 49.4% depending on sampling and case definition (Zaki et al., 2021). Recent national evidence indicates that hypertension remains an important public-health challenge. NHMS 2023 found that 17.3% of adults knew they had hypertension and 11.9% had raised blood pressure without knowing they had hypertension. Among people with known hypertension, 91% were taking antihypertensive medication and 48% had blood pressure below 140/90 mmHg (Institute for Public Health, 2023). A substantial body of evidence links poor medication adherence to worse clinical outcomes in hypertension, including less blood pressure reduction, higher cardiovascular event risk, and higher mortality (Kengne et al., 2023; Kim et al., 2025). Health literacy — the ability to access, understand, appraise, and apply health information (as operationalised in scales such as the HLS-EU-Q16 and HLS19-Q12) — is increasingly recognised as an upstream determinant of this adherence behaviour (Karakurt et al., 2025; Gultekin et al., 2025; Guo et al., 2023). In Malaysia specifically, Elnaem et al. (2021) reported good levels of both health literacy and adherence among a sample of Malaysian hypertensive adults during the COVID-19 pandemic, and adherence scores differed significantly between those with controlled versus uncontrolled blood pressure ($p = 0.001$). More directly, a randomised controlled trial conducted at University Malaya Medical Centre (Rana et al., 2026) found that medication adherence statistically mediated the effect of a mobile adherence-support intervention on blood pressure outcomes (indirect $\beta = -0.16$, $p = 0.006$), providing local Malaysian evidence for adherence as a mediating mechanism — albeit for an intervention pathway rather than a health-literacy pathway specifically.

1.2 Problem Statement

Three gaps motivate this paper. First, while the health-literacy–adherence relationship is well documented internationally (Karakurt et al., 2025; Lenggogeni et al., 2024; Alzoubi et al., 2026), Malaysia-specific empirical evidence that explicitly models medication adherence as a mediator between health literacy and clinical outcomes (rather than testing health literacy and adherence as separate, parallel predictors) remains limited. Second, existing Malaysian hypertension research has concentrated on prevalence and control-rate surveillance (Ab Majid et al., 2018; Abdul-Razak et al., 2016) or on self-care/quality-of-care audits (Salim et al., 2019; Teh et al., 2020) rather than on the psychosocial mechanism linking patient understanding of

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health information to measurable clinical outcomes. Third, where mediation has been formally tested locally, it has been in the context of a technology intervention (Rana et al., 2026) rather than baseline health literacy as it exists in the general hypertensive population attending routine primary care.

1.3 Research Objectives

RO1: To examine the direct effect of health literacy on clinical outcomes among Malaysian patients with hypertension.

RO2: To examine the effect of health literacy on medication adherence.

RO3: To examine the effect of medication adherence on clinical outcomes.

RO4: To examine whether medication adherence mediates the relationship between health literacy and clinical outcomes.

1.4 Research Questions

RQ1: Does health literacy significantly influence clinical outcomes among hypertensive patients in Malaysia?

RQ2: Does health literacy significantly influence medication adherence?

RQ3: Does medication adherence significantly influence clinical outcomes?

RQ4: Does medication adherence mediate the relationship between health literacy and clinical outcomes?

1.5 Significance of the Study

Theoretically, the paper extends health literacy theory and the Chronic Care Model to an explicit mediation pathway (health literacy → adherence → clinical outcomes) in the Malaysian primary care setting, complementing the intervention-focused mediation evidence from Rana et al. (2026) with a baseline, non-interventional model. Practically, given that hypertension control in Malaysia has not exceeded 40% in any NHMS wave to date (Ab Majid et al., 2018), identifying modifiable, upstream levers such as health literacy has direct relevance for primary care policy, nursing and pharmacist-led patient education, and chronic disease management programmes (Teh et al., 2026).

2. Literature Review

2.1 Health Literacy

Health literacy refers to the cognitive and social skills that determine an individual's ability to access, understand, and use information to promote and maintain good health, commonly assessed using instruments such as the HLS-EU-Q16 (Lenggogeni et al., 2024), the HLS19-Q12 (Gultekin et al., 2025), or condition-specific tools such as the High Blood Pressure Health

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Literacy Scale (HBP-HLS; Alzoubi et al., 2026). Across settings, health literacy levels among hypertensive populations vary considerably: Karakurt et al. (2025) reported above-average health literacy in a Turkish sample, whereas Lor et al. (2019) found 84.9% of a Hispanic-American sample had inadequate health literacy, illustrating substantial population and measurement-tool variation that should inform instrument selection in a Malaysian study.

2.2 Medication Adherence

Medication adherence — most commonly measured via self-report tools such as the 12-item Malaysian Medication Adherence Assessment Tool (MyMAAT-12) is a well-established determinant of hypertension control. Non-adherence rates in the reviewed literature ranged from roughly 40% (Karakurt et al., 2025) to over 60% (Lenggogeni et al., 2024), and a systematic review of 45 studies found poor adherence consistently associated with smaller blood pressure reductions, higher cardiovascular event risk (HR 1.1-1.9), and higher mortality (HR 1.4-1.8) (Kengne et al., 2023). A large South Korean cohort of 238,950 patients confirmed that poor adherence independently elevated the risk of composite cardiovascular outcomes across all systolic blood pressure categories (Kim et al., 2025).

2.3 Clinical Outcomes in Hypertension

Clinical outcomes in this literature are most often operationalised as measured systolic and diastolic blood pressure, blood-pressure control status (e.g., <140/90 mmHg), or, in longer cohort studies, composite cardiovascular events (myocardial infarction, stroke, heart failure hospitalisation, all-cause mortality) (Kim et al., 2025). In Malaysia, control rates remain a persistent concern: NHMS 2023 reported that 48% of individuals with known hypertension had blood pressure below 140/90 mmHg, while 17.3% of adults knew they had hypertension and 11.9% had raised blood pressure without prior awareness (Institute for Public Health, 2023).

2.4 Health Literacy, Adherence, and Outcomes in the Malaysian Context

Malaysian evidence directly addressing this model is emerging but limited. Elnaem et al. (2021) found generally good health literacy and adherence among 144 Malaysian hypertensive adults, with adherence scores differing significantly by blood-pressure-control status. Salim et al. (2019), studying hypertension self-care (a related but broader construct) in Selangor primary care clinics, found self-care was only moderate overall and was significantly lower among men, those with lower education, and those without a family history of hypertension. Most directly relevant to this paper's proposed mediation model, Rana et al. (2026), in a randomised trial at University Malaya Medical Centre (N = 275), used Structural Equation Modelling to show that

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six-month medication adherence mediated the effect of a mobile adherence-support intervention on blood pressure outcomes (indirect β = -0.16, p = 0.006), with a sequential mediation chain linking early and later adherence gains to blood pressure improvement.

2.5 Medication Adherence as a Mediating Mechanism

Outside Malaysia, several studies have formally tested adherence or literacy-related constructs as mediators. Guo et al. (2023), using SEM in a Shanghai community sample of 1,697 patients, found health literacy directly influenced adherence (β = 0.291) and also mediated the effect of education on adherence, alongside a sequential mediation pathway through social support. Delavar et al. (2020) and Karami et al. (2023), in randomised/quasi-experimental designs, found that health-literacy-tailored education interventions significantly improved medication adherence, with mixed but generally favourable effects on blood pressure. A large meta-analysis of 42 RCTs (n = 9,332) confirmed that health literacy interventions significantly reduced systolic (-6.90 mmHg) and diastolic (-3.03 mmHg) blood pressure and improved both adherence (SMD = 0.69) and self-efficacy (SMD = 0.35) (Yu et al., 2026), while a complementary meta-analysis of health education interventions found a 33% improvement in adherence (RR = 1.33) (Mustara et al., 2025). Collectively, this literature supports adherence as a plausible, empirically supported mediating mechanism between health literacy and clinical outcomes, consistent with the pathway proposed for the Malaysian hypertensive population in this paper.

3. Theoretical Framework

This paper draws on health literacy theory, which frames health literacy as a modifiable patient-level determinant operating through proximal behavioural pathways (notably self-management and medication-taking behaviour) to influence distal clinical outcomes (Karakurt et al., 2025; Guo et al., 2023). This is complemented by the Chronic Care Model, which situates patient self-management support — including health literacy and adherence — within a broader primary-care system context relevant to Malaysia's public primary care clinics (Teh et al., 2026; Salim et al., 2019). Empirically, the mediating role of adherence proposed here is consistent with the necessity-concern framework applied to antihypertensive adherence (Wilhelm et al., 2017) and directly supported by local Malaysian SEM-based mediation evidence (Rana et al., 2026).

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4. Conceptual Framework and Hypothesis Development

Based on the literature and theoretical framework reviewed above, Figure 1 presents the proposed conceptual model, in which health literacy is hypothesised to influence clinical outcomes both directly and indirectly through medication adherence.

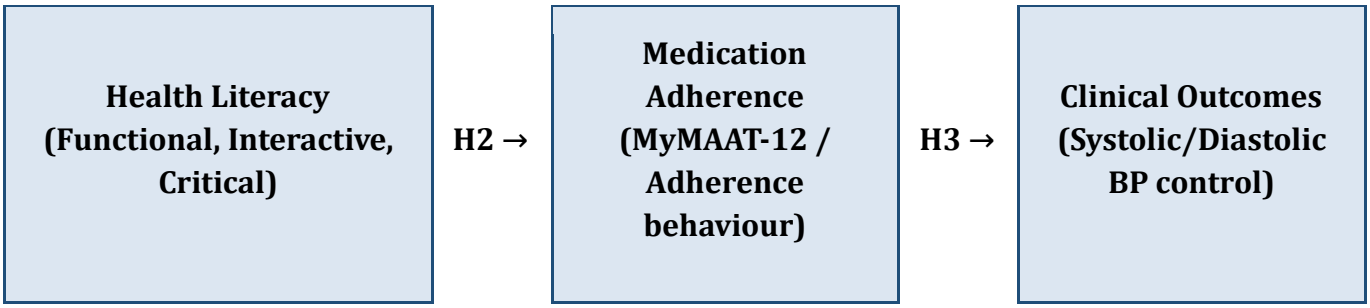


Figure 1Proposed Conceptual Framework

Hypotheses

H1: Health literacy has a significant positive effect on clinical outcomes among hypertensive patients in Malaysia.

H2: Health literacy has a significant positive effect on medication adherence.

H3: Medication adherence has a significant positive effect on clinical outcomes.

H4: Medication adherence mediates the relationship between health literacy and clinical outcomes.

Table 1Malaysian National Hypertension Prevalence, Awareness, Treatment and Control: Historical NHMS Data and Latest NHMS 2023 Findings

Survey Year	Hypertension Prevalence	Known / Aware Hypertension	Raised BP among those not known	Treatment*	Control*
2006	34.6%	35.6%	—	78.9%	27.5%
2011	33.6%	40.7%	—	—	—
2015	35.3%	37.5%	—	83.2%	37.4%
2019	30.0%	15.9%	14.1%	—	—
2023	29.2%	17.3%	11.9%	91%*	48%*

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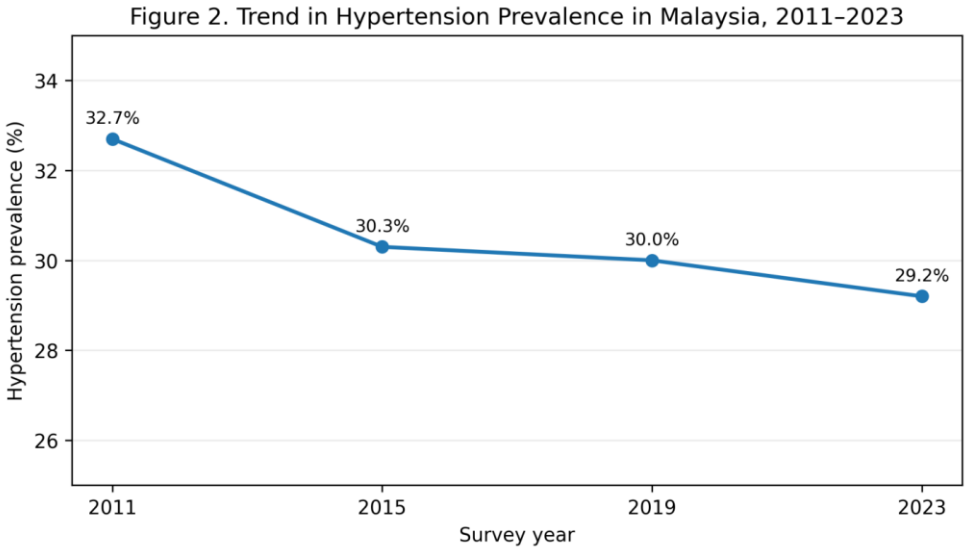


Figure 2Trend in Hypertension Prevalence in Malaysia, 2011–2023

5.4 Instruments and Measures

Health literacy is proposed to be measured using a validated, condition-relevant instrument such as the HLS-EU-Q16 (Lenggogeni et al., 2024) or the High Blood Pressure Health Literacy Scale (HBP-HLS; Alzoubi et al., 2026), both used and validated in hypertensive populations. Medication adherence is proposed to be measured using the self-reported 12-item Malaysian Medication Adherence Assessment Tool (MyMAAT-12) the most widely used tool in the reviewed literature (Lenggogeni et al., 2024; Delavar et al., 2020), or the Medication Adherence Report Scale (MARS-5; Alzoubi et al., 2026). Clinical outcomes are proposed to be measured objectively using two standardised in-clinic blood pressure readings, consistent with Malaysian national survey methodology (Ab Majid et al., 2018; Zaki et al., 2021), classified as controlled (<140/90 mmHg) versus uncontrolled.

5.5 Data Analysis

Structural Equation Modelling (SEM) or Partial Least Squares SEM (PLS-SEM), consistent with the analytical approach in Guo et al. (2023) and Rana et al. (2026), is recommended. The analysis would proceed in two stages: (1) assessment of the measurement model (reliability, convergent and discriminant validity of the health literacy and adherence scales), and (2) assessment of the structural model (path coefficients, R^2, and bootstrapped mediation testing for H4), with logistic regression as a complementary approach for the binary controlled/uncontrolled blood pressure outcome, consistent with Teh et al. (2020).

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6. Expected Contributions and Implications

6.1 Theoretical Implications

The proposed model extends health literacy theory and the Chronic Care Model to an explicit, formally tested mediation pathway in the Malaysian hypertensive population, complementing Rana et al.'s (2026) intervention-focused mediation evidence with a baseline (non-interventional) health-literacy model, and addressing calls for more locally grounded, non-Western evidence in this domain (Guo et al., 2023; Qin et al., 2023).

6.2 Practical and Policy Implications

Given that hypertension control in Malaysia has not exceeded 40% in any national survey wave since 2006 (Ab Majid et al., 2018) and only 42.8% of patients in a recent primary care audit were adequately controlled (Teh et al., 2020), findings supporting this model would suggest that structured health-literacy-focused patient education — delivered by nurses, pharmacists, or through primary care programmes such as those catalogued in Teh et al.'s (2026) scoping review — could be a cost-effective lever for improving adherence and, ultimately, blood pressure control, consistent with the significant blood-pressure reductions reported in health-literacy intervention meta-analyses (Yu et al., 2026; Mustara et al., 2025).

7. Limitations and Future Research

- This paper is conceptual/literature-based; the proposed model and hypotheses have not yet been empirically tested with primary Malaysian patient data.
- A cross-sectional design, once implemented, would capture health literacy, adherence, and blood pressure at a single point in time and cannot fully establish causal ordering; a longitudinal or interventional extension (as in Rana et al., 2026) is recommended as a next step.
- Self-report adherence measures (e.g., MyMAAT-12) are subject to social desirability bias; objective adherence measures (e.g., pharmacy refill data, pill counts) should be considered where feasible.
- Future research should test additional covariates shown to matter in this literature — education, income, comorbidities, and ethnicity (Abdul-Razak et al., 2016; Salim et al., 2019) — as moderators or controls, and should ensure appropriate ethics committee approval (e.g., MREC or institutional IRB) prior to primary data collection involving patients.

8. Conclusion

This paper synthesizes current, verifiable peer-reviewed and national survey evidence to build a conceptual case that health literacy influences clinical outcomes among Malaysian hypertensive patients both directly and through the mediating mechanism of medication adherence. Malaysian NHMS data confirm that this remains a practically important problem,

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with NHMS 2023 reporting blood-pressure control below 140/90 mmHg in 48% of individuals with known hypertension (Institute for Public Health, 2023), and the closest local empirical precedent, Rana et al.'s (2026) University Malaya Medical Centre trial, provides direct Malaysian evidence that adherence mediates a related intervention-to-outcome pathway. The broader international literature on health literacy, adherence, and hypertension outcomes provides strong converging theoretical and empirical support. The proposed SEM/PLS-SEM methodology, benchmarked against comparable studies (target n = 300-400), offers a concrete next step toward empirically testing the model in Malaysian primary care.

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