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REVIEWS

Medication adherence in patients with hypertension: a Systematic Review

Adherencia al tratamiento en pacientes con hipertensión: una Revisión Sistemática

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ABSTRACT:

Introduction: Medication adherence plays a critical role in the effective management of hypertension. Despite the availability of effective antihypertensive therapies, suboptimal adherence remains a major barrier to blood pressure control worldwide.

Objective: Understanding the factors associated with medication adherence is essential to inform clinical practice and nursing interventions in chronic disease management.

Material and method: This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines. A comprehensive literature search was performed in PubMed, ScienceDirect, Wiley Online Library, and ProQuest for studies published in English between January 2000 and December 2024. Observational studies examining factors associated with antihypertensive medication adherence among adult patients with hypertension were included. A narrative thematic synthesis was used to integrate the findings.

Results: The initial search yielded 1,658 records, of which 29 studies met the inclusion criteria. Factors influencing medication adherence were grouped into four analytical categories: individual internal factors, healthcare facility–related factors, medication-related factors, and clinical factors. Individual internal factors were most frequently reported; however, adherence behavior reflected complex interactions across all categories.

Conclusions: Medication adherence among patients with hypertension is influenced by multiple interacting determinants rather than a single dominant factor. Strengthening nursing-led education, counseling, and follow-up strategies may help address modifiable barriers to adherence and support long-term hypertension management across diverse healthcare settings.

Keywords: Hypertension; Medication adherence; Blood pressure; Antihypertensive; Systematic review.

RESUMEN:

Introducción: La adherencia al tratamiento farmacológico desempeña un papel fundamental en el manejo eficaz de la hipertensión. Diversos factores contribuyen a la discrepancia entre los objetivos de control de la hipertensión a nivel poblacional y las tasas reales de control.

Objetivo: identificar y evaluar los factores asociados con la adherencia al tratamiento farmacológico en pacientes con hipertensión.

Material y método: Directrices de los *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA) 2020. Se realizaron búsquedas exhaustivas de literatura en bases de datos de acceso abierto como PubMed, ScienceDirect, Wiley Online Library y ProQuest.

Resultados: La búsqueda inicial en las bases de datos arrojó 1.658 artículos, de los cuales 29 estudios cumplieron con los criterios de inclusión después de la selección. Los factores identificados que influyen en la adherencia al tratamiento farmacológico se clasificaron en cuatro categorías: factores internos individuales, relacionados con los centros de salud, con los medicamentos y clínicos. Entre ellos, los factores internos individuales resultaron ser la categoría más predominante. Sin embargo, existen interconexiones significativas entre los factores de las diferentes categorías, que en conjunto pueden afectar la adherencia de los pacientes hipertensos a sus regímenes terapéuticos prescritos.

Conclusiones: se identificó que los factores que influyen en la adherencia al tratamiento farmacológico en pacientes con hipertensión pueden clasificarse en factores internos individuales, relacionados con los centros de salud, con los medicamentos y factores clínicos. No obstante, no fue posible determinar de manera concluyente cuáles de estos factores contribuyen de forma más significativa a la falta de adherencia.

Palabras clave: Hipertensión; Adherencia al tratamiento; Presión arterial; Antihipertensivos; Revisión sistemática.

INTRODUCTION

Hypertension is well understood to be a chronic, noncommunicable disease that is commonly found throughout the world. It is also a major risk factor for coronary heart disease, stroke, chronic kidney disease, and mortality [1,2]. For a long time, antihypertensive therapy has been widely available even in the most remote healthcare facilities; however, in reality, the desired blood pressure control has not yet been achieved in some locations. Based on previous studies, it is known that medication adherence is the main cause of the failure to achieve the expected results, even reducing the effectiveness of treatment and increasing the risk of complications [3].

Medication adherence is commonly defined as the extent to which a patient's medication-taking behavior corresponds with agreed recommendations from a healthcare professional regarding dose, timing, and duration[4]. Poor adherence is associated with uncontrolled blood pressure, higher rates of cardiovascular events, avoidable hospitalizations, and increased healthcare cost[5], whereas adequate adherence improves clinical outcomes and supports long-term hypertension control[6].

Adherence behavior is multifactorial and influenced by interacting determinants at multiple levels, including patient-related factors (e.g., knowledge, beliefs, self-efficacy, psychological status, and social support), healthcare factors (e.g., access, continuity of care, and patient–provider communication), medication-related factors (e.g., regimen complexity, dosing frequency, and adverse effects), and clinical factors (e.g., comorbidities and disease duration)[7]. Because these determinants can vary across health systems and sociocultural contexts, synthesizing evidence across diverse settings is important to inform comprehensive strategies to improve adherence[8].

Medication adherence is a key focus in the management of chronic diseases [9]. The roles of nurses that are emphasized include education, counseling, monitoring, follow-up, and building patients' self-confidence [10]. Understanding the factors related to medication adherence in patients with hypertension will serve as a crucial foundation for designing appropriate interventions, both in primary care settings and community environments, as part of efforts to improve outcomes in hypertension treatment.

Although numerous primary studies have examined factors associated with antihypertensive medication adherence, findings remain heterogeneous and are often reported in isolation, focusing on specific determinants such as sociodemographic characteristics, medication-related issues, or psychological factors[11]. Existing systematic reviews have frequently addressed adherence in chronic disease more broadly or have emphasized selected domains, limiting integrated interpretation across patient-, treatment-, and healthcare-related dimensions[12]. A synthesis that organizes these determinants within a coherent analytical framework and highlights implications for nursing practice may support clearer interpretation and more effective intervention development.

Therefore, this systematic review aims to identify and synthesize factors associated with antihypertensive medication adherence among patients with hypertension based on observational studies conducted worldwide. The findings are intended to support evidence-informed clinical practice, especially nursing strategies that address modifiable barriers to adherence.

MATERIAL AND METHOD

Protocol

This systematic review was guided by the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) 2020 guidelines[13].

Search strategy

A systematic literature search was performed in PubMed, ScienceDirect, Wiley Online Library, and ProQuest. In addition, Google Scholar and manual reference screening of included articles were used to identify further eligible studies.
The search strategy combined controlled terms and free-text keywords related to hypertension and medication adherence. The core search string was adapted to each database but followed the same logic. An example search strategy used in PubMed was:

("hypertension" OR "high blood pressure") AND ("medication adherence" OR "treatment adherence" OR "drug adherence" OR "medication compliance") AND ("antihypertensive" OR "antihypertensive agents").

Limits applied: English language; publication dates from 1 January 2000 to 31 December 2024; human studies. All retrieved records were exported to a reference manager, duplicates were removed, and titles/abstracts were screened before full-text assessment.

Eligibility Criteria

Studies were included if they met all of the following criteria: (1) original empirical research with an observational quantitative design (cross-sectional, cohort, prospective, or retrospective); (2) conducted among adults (≥18 years) diagnosed with hypertension; (3) assessed adherence to antihypertensive medication using a validated instrument (e.g., MMAS-4/MMAS-8, Hill-Bone CHBPTS, MARS, MPR) or clearly described adherence measurement; (4) reported factors associated with medication adherence/non-adherence; (5) published in peer-reviewed journals; (6) conducted in any country/region (global scope); and (7) published in English between 1 January 2000 and 31 December 2024.

Studies were excluded if they were review articles, editorials, letters, case reports, conference abstracts, or if the population was not patients with hypertension or the study did not evaluate antihypertensive medication adherence.

Justification of limits: The English-language restriction was applied to ensure accurate appraisal and interpretation of methods and findings. The limitation of this timeframe is solely intended to examine the management of interventions and how compliance is measured in the context of technological advancements over the past decade.

Data Extraction

Two authors independently extracted data from each of the included studies into an Excel spreadsheet. The extracted data primarily included general study information (authors, year, and country), study design, sample, mean age, instruments used, factors analyzed, and main findings.

Data Synthesis

The synthesis was conducted using a thematic narrative approach to summarize data from eligible studies. The factors were limited to those associated with adherence or nonadherence, which were then coded to facilitate classification into broader themes based on context or concept.

The thematic grouping was iterative and discussed among the review team until consensus was reached. This process generated four analytical categories used to organize the results: (1) individual internal factors, (2) healthcare facility–related factors, (3) medication-related factors, and (4) clinical factors. These categories were derived from the synthesis process (i.e., emergent from the extracted evidence) and were used to structure interpretation across heterogeneous studies.

Quality Appraisal

The quality of the studies was evaluated using a modified version of the National Heart, Lung, and Blood Institute Assessment Tool for cohort and cross-sectional studies. This tool includes 14 questions, such as: 'Is the research question or objective clearly stated?'; 'Is the study population clearly defined and specified?'; 'Is the outcome measure (dependent variable) well-defined, valid, reliable, and consistently applied across participants?'; and 'Are potential confounding variables measured and

statistically adjusted for their effect on the relationship between exposure and outcome?'. Each question was rated with a 'yes' or 'no,' and the quality of each study was categorized as follows: Good, if all criteria were met; Fair, with 11 or more 'yes' responses; and Poor, with fewer than 11 'yes' responses. The results from each reviewer were compared, and any discrepancies were resolved through discussion and consensus. Studies categorized as poor quality were excluded from the review.

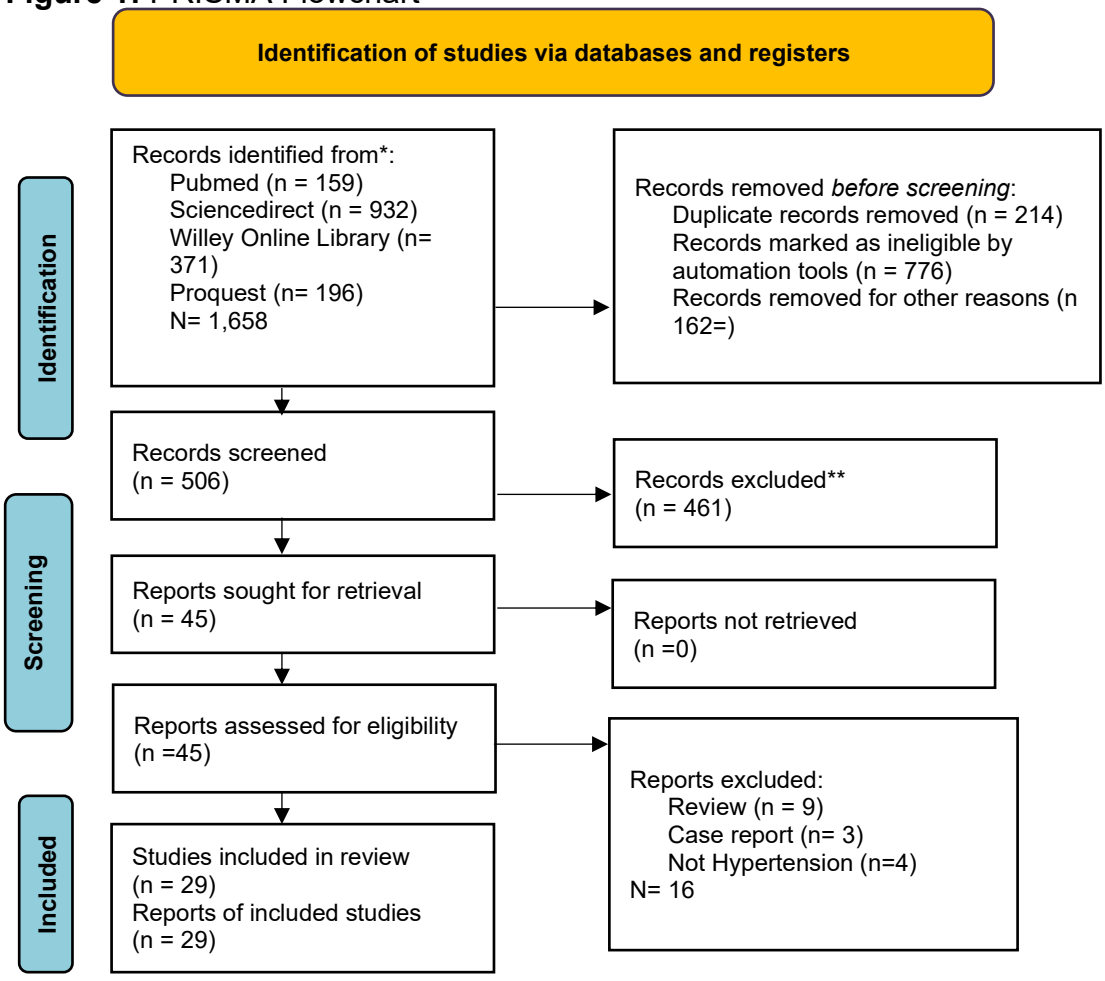
Risk of Bias Assessment

Risk of Bias was assessed using The Risk of Bias in Non-randomized Studies - of Exposure (ROBINS-E). This tool provides a structured approach to assessing the risk of bias in observational epidemiologic studies. The assessment categories are Very High, High, Some concerns, and Low risk of bias.

RESULTS

The database search yielded 1,658 articles, including manually searched articles. After removing duplicates and screening titles and abstracts, 506 articles were selected for screening. Of the 45 articles, 16 articles were excluded for the following reasons: review studies, case reports, and not hypertension. The remaining 29 studies at the time of finalization were included in the systematic review.

Figure 1: PRISMA Flowchart



Characteristics of eligible studies

A total of 29 studies were qualitatively analyzed in this review (Table 1). These studies were conducted across various countries and continents, including the United States (N=7) (14–20), China (N=5)[21–25], and two studies each from India[26,27], Indonesia[28,29], Iran[30,31], Poland[3,32], and Turkey[33,34]. Additionally, one study each was carried out in Ireland[35], Malaysia[36], Namibia[37], Oman[38], South Korea[39], the United Kingdom[40], and Vietnam[41]. The participant numbers in these studies varied from 80 to 4,544, with a mean age ranging from 40 to 77.5 years.

Secara keseluruhan jenis studi yang dianalisis adalah studi observational dengan desain cross-sectional, retrospective, dan prospective, Dimana desain tersebut digunakan untuk menilai factor-faktor yang berhubungan dengan kepatuhan terhadap pengobatan hipertensi. Sebagian besar studi menilai Tingkat kepatuhan menggunakan instrument Morisky Medication Adherence Scale (MMAS) 4 item maupun 8 item. Sementara itu, satu studi menggunakan the Medication Possession

Ratio (MPR)[15], satu studi lainnya menggunakan Medication Adherence Self-Efficacy Scale (MASES)[34], satu di Indonesia menggunakan Medication Adherence Report Scale (MARS)[29], studi di US, India, Polandia, Namibia menggunakan Hill-Bone compliance to high blood pressure therapy scale (HILL-BONE CHBPTS)[3,14,37,41], Studi lainnya di India menggunakan Brief Medication Questionnaire (BMQ)[43], untuk menilai kepatuhan minum obat.

Overall, the types of studies analyzed were observational studies with cross-sectional, retrospective, and prospective designs, aimed at assessing the factors associated with adherence to hypertension medication. Most studies measured adherence levels using the Morisky Medication Adherence Scale (MMAS), either the 4-item or 8-item version. Additionally, one study utilized the Medication Possession Ratio (MPR)[15], another employed the Medication Adherence Self-Efficacy Scale (MASES)[34], and one study conducted in Indonesia used the Medication Adherence Report Scale (MARS)[29]. Studies in the United States, India, Poland, and Namibia applied the Hill-Bone Compliance to High Blood Pressure Therapy Scale (HILL-BONE CHBPTS)[3,14,37,41], while another study in India used the Brief Medication Questionnaire (BMQ)[43] to assess medication adherence.

Table 1. Data Extraction of eligible studies

Author, Year, Country	Study Design	Sample Size	Mean Age	Region/ Ethnicity (as reported)	Adherence Instrument	Factor Analyzed	Key Findings
Abel & Efird, 2013, US	Cross-sectional	80	47.8	African American	-TPS -CHBPTS	Trust in primary health care provider	increasing levels of trust in the health care provider was associated with greater medication adherence (P=0.015)

Author, Year, Country	Study Design	Sample Size	Mean Age	Region/ Ethnicity (as reported)	Adherence Instrument	Factor Analyzed	Key Findings
Al-Noumani et al., 2018, Oman	Cross-sectional	215	53.6	Arabic	-MMAS -BMQ -BIPQ -MASES-R -CCI	Patient's beliefs	-Participants with higher self-efficacy were 2.5 times more likely to have high adherence (OR 2.59; P = .001), -Those with stronger beliefs about medication necessity were twice as likely to have high adherence (OR 1.98; P =.006) -Those more concerned about their medication were approximately one-third as likely to have high adherence (OR 0.34; P =.001)
Baggarly et al., 2014, US	Retrospective	4,544	40.5	Black, white, Other	-MPR -CCI	-Drug Classes, -Race, -Gender, -Age -Comorbidity	-Persistence: greater in White if taking ARBs (OR 0.09); Black < White if taking ACEIs, BBs, Diuretics (OR 0.39; 0.54; 0.41, respectively); female < male if taking BBs (OR 0.54)
Boratas & Kilic, 2018, Turkey	Cross-sectional	147	70.29		-MASES	-Duration of HT -Frequency of follow-up visit for HT -Knowing the name of the medication used	-HT duration (P <0.05) -Knowing the name of the medication (P 0.802) -the mean scores of MASES of patients who took medication regularly were

Author, Year, Country	Study Design	Sample Size	Mean Age	Region/ Ethnicity (as reported)	Adherence Instrument	Factor Analyzed	Key Findings
						-Frequency of medication intake -Status of taking medication regularly -Status of alternative method use	higher than the scores of those who did not take regularly (p= 0.000) -MASES scores of hypertensive patients aged 61 years and older were found to be higher than those of the other age groups (p = .000) -the MASES scores of the patients who did not use alternative method were higher (p=0.050)
Chunhua, 2016, China	Cross-sectional	1,159	59.89	Asian	-MMAS -SSRS	-Social support -HT duration -Household income -Taking antihypertensive tablets -Frequency of medication -Social support	-> 45 years old (OR=1.29) -Higher household income [OR=1.04), -Shorter hypertension duration (OR=0.68), -Took a smaller number of antihypertensive tablets (OR=0.82), -Received a lower frequency of medication per day (OR=0.54) -Had more social support (OR=1.37)
Durand et al., 2018, Ireland	Cross-sectional	204	69.86	Caucasian	-MMAS -MARS -GMS -SR-BAI -BMQ	-Medication-taking habit -Beliefs and coherence	-Habit strength associated with patients' unintentional non-adherence >

Author, Year, Country	Study Design	Sample Size	Mean Age	Region/ Ethnicity (as reported)	Adherence Instrument	Factor Analyzed	Key Findings
						-Pill burden	intentional adherence (P <.0001) -No association between pill burden and adherence (P = -0.8)
Alfian et al., 2022, Indonesia	Cross-sectional	440	64.5	Austronesia	-BIPQ -MARS	-Illness perception	-Lower treatment control (OR: 0.80), lower patient's comprehension of hypertension (OR: 0.89), and higher patient's emotions (OR: 0.93) were associated significantly with the medication nonadherence
Bhusal et al., 2016, India	Cross-sectional	129	49.89	Dravida	-HILL-BONE CHBPTS	-Medication adherence - Unintentional adherence	-Miss the medications, Miss the prescription refilled, ran out of hypertensive pills contributed to lower medication adherence.
Jankowska-Polanska et al., 2016, Poland	Cross-sectional	233	63.5	Caucasian	-MMAS-8 -HK-LS	-Knowledge- Hypertension grade -Disease duration, -Type of treatment - Hypotensive drugs administered -Presence of	-Knowledge level (P=0.001) -High level of knowledge on hypertension (*P*=0.001), non-pharmaceutical hypertension treatment (*P*=0.006); regular BP measurements (*P*=0.004) significantly associated to high adherence

Author, Year, Country	Study Design	Sample Size	Mean Age	Region/ Ethnicity (as reported)	Adherence Instrument	Factor Analyzed	Key Findings
						comorbidities	
Kamran et al., 2015, Iran	Cross-sectional	671	45	Caucasoid	-HBM -MMA	-Lifestyle	-Unrestricted meal habits (P <0.001) -Smoking (P <0.01) -Salt intake >5 g (P <0.001)
Karakurt & Kasicki, 2012, Turkey	Cross-sectional	750	64.5	Caucasoid	-questionnaire developed independently	-Sociodemographic -Unintentional -HT duration	-HT duration (P >0.05) -Aware of the complications (P <0.001) -Monthly income (P >0.05)
Khan et al., 2013, UK	Cross-sectional	200	40	Caucasian	-MMA	-Intentional -Unintentional	-Younger age of HT patients is lower adherence than the elder -Intentional non-adherence > Unintentional Non-adherence
Kressin et al., 2007, US	Cohort	793	65.5	African American, White	-Adapted Questionnaire -PEI -VR-12 -MCS -PCS	-Experiences with providers -Sociodemographic -Health belief	-Total patient exit interview score: AAs > Whites (p<.01) -BP medications perception: AAs > White (P ≤.01) -Non-adherence: AAs > white (P <.05) -Trust in the Physician: AAs < White (P <.05) -Confidence in taking medications as prescribed was associated with better adherence (p<.0001) -Perception that one's BP

Author, Year, Country	Study Design	Sample Size	Mean Age	Region/ Ethnicity (as reported)	Adherence Instrument	Factor Analyzed	Key Findings
							continues to be high was associated with worse adherence (p=.006)
Li et al., 2015, China	Cross-sectional	2,445	65.5	Mongoloid	-MMAS-8 -C-BIPQ	-Sociodemographic -Number of chronic medications taken on a daily basis -Duration of drug use -Frequency of self-administered blood pressure measurement -Knowledge -Illness perception	-Older age (p <0.001), -being employed (p-value < 0.001), -having family members with hypertension (p-value = 0.010) -Self-perceived health status as being good (p-value <0.001) -High illness perception score (p < 0.001)
Lo et al., 2016, China	Cross-sectional	195	76.4	Mongoloid	-C-MISS-R -IPQ-R -MMAS	-Illness perception -Demographic	-Older age were more adhere to prescribed antihypertensive medication (OR 1.70) -Living with family were less adhere to antihypertensive medication (OR 1.52) -Stronger beliefs associated with an increased odd of medication adherence (OR 1.14)
Lor et al., 2019, US	Cross-sectional	1,355	62	Hispanic	-WICER-CHS -NVS	-Health literacy	-Adequate health literacy was associated with a

Author, Year, Country	Study Design	Sample Size	Mean Age	Region/ Ethnicity (as reported)	Adherence Instrument	Factor Analyzed	Key Findings
					-PROMIS-SF v1.0 -MMAS	-Depression -Sleep disturbance	higher adherence score (P= 0.002) -Depression (p value < 0.001) -Sleep disturbance -(p value < 0.001) -as age increases, adherence scores decrease (p = 0.013) -as anxiety (p = 0.001), depression (p =0.024), and sleep disturbance (p < 0.001) increase, adherence scores increase.
Mahmoudian et al., 2017, Iran	Cross-section al	300	61.27	Caucasoid	-Patient's satisfaction questionnaire -MMAS	Patients' satisfaction	A lower level of satisfaction derived from building the relationship (confidence interval [CI] =0.95, 0.06–0.71 and OR = 0.20) and empathy subscales (CI = 0.95, 13–0.80 and OR = 0.33) was associated with nonadherence to treatment after controlling the physicians' gender and patients' age, gender, education, and duration of disease.

Author, Year, Country	Study Design	Sample Size	Mean Age	Region/ Ethnicity (as reported)	Adherence Instrument	Factor Analyzed	Key Findings
Nakwafila et al., 2022, Namibia	Cross-sectional	400	48.9	Negroid	-HBCHTS	-Availability of medication -Social supports -Attendance of follow-up	Receiving enough medication at the last check-up until the next one (OR = 5.44), encouragement of family and friends (OR = 0.11), attendance of follow-ups on schedule (OR = 8.49) were associated to good adherence
Park et al., 2012, South Korea	Cross-sectional	241	77.5	Mongoloid	-MIA -MMAS	-HT duration -Knowledge	-Time since diagnosis (P < 0.001) -Time since beginning antihypertensive medication (P < 0.001) -having better memory was associated with adherence to antihypertensive medication (OR 1.05)
Rahmawati & Bajorek, 2017, Indonesia	Cross-sectional	384	65.7	Mongoloid	-MMAS-8	-Knowledge -Education	-Good knowledge predicted good adherence (OR 7.1) -Higher formal education (OR 2.7)
Rajpura & Nayak, 2014, US	Cross-sectional	117	60	White	-BIPQ-r -BMQ -BMQ-d -PRISM-RII -SIS -IPM	-Illness perceptions, -Medication beliefs, -Illness burden	-Higher scores on the BIPQ-r scale related to higher levels of medication adherence (P <0.001)

Author, Year, Country	Study Design	Sample Size	Mean Age	Region/ Ethnicity (as reported)	Adherence Instrument	Factor Analyzed	Key Findings
							-Negative and significant association (*P* = 0.014) to medication adherence -Positive and significant association (P < 0.001) between self-illness separation scores and medication adherence -Negative and significant association (P < 0.001) between illness perception measures and medication adherence.
Ramli et al., 2012, Malaysia	Cross-sectional	653	57.84	Mongoloid	-MMAS -HBABPTS	-Sociodemographic -Knowledge on BP goal -Medication Knowledge -HT Duration -Experience of side effects -Traditional medicine used	-Female > male (OR 1.46; P <0.05) -Chinese > Indian (*P*< 0.05) to adhere -Knowledge on BP Goal (P 0.119) -Medication knowledge (P <0.001) -Side effects (P 0.416) -Traditional medicine (P 0.114)
Patel & Taylor, 2002, US	Cross-sectional	102	58.61	African American, White	-MMAS -Adapted questionnaire	-Illness attribution -Perceived control	-No significant relationships between adherence and illness attributions

Author, Year, Country	Study Design	Sample Size	Mean Age	Region/ Ethnicity (as reported)	Adherence Instrument	Factor Analyzed	Key Findings
							-Perceived control (P<0.01) -Patients who less control in reducing their BP were more adherent to medications.
Roumie et al., 2011, US	Prospective Cohort	499	67	White	-PCAS -PAM	-Patient-centered primary care -HT duration	-Duration of hypertension was 6–10 years (OR 1.92) related to adherence -the lowest patient centered primary care scores had the lowest adherence
Shi et al., 2019, China	Cross-sectional	420	60.6	Mongoloid	-C-MMAS-8 -C-MLSHP	-Medication literacy -Sociodemographic	-Knowledge (P < 0.01), attitude (P < 0.01), and behavior (P < 0.01) were significantly associated with medication adherence -Annual income (OR 1.199)
Thomas et al., 2011, India	Cross-sectional	608	58.40	Dravida	BMQ	-Duration of HT -Number of antihypertensive medications prescribed -Number of tablets consumed daily	-Duration of HT significant to non-adherence (P=0.031) -No association between the adherence pattern and the number of antihypertensive medications being prescribed -Total number of tablets consumed daily (P <0.001)

Author, Year, Country	Study Design	Sample Size	Mean Age	Region/ Ethnicity (as reported)	Adherence Instrument	Factor Analyzed	Key Findings
Thuy et al., 2020, Vietnam	Cross-sectional	300	68.11	Mongolia	-HBCS -MRCI -LIADLS -MSPSS -SF-HLQ -CIPCS -HBHPS -MASESR-r	-Medication regimen complexity -Duration of HTN -Health belief -Self-efficacy -Physical function -Social support -Health literacy -Patient-provider communication	-Medication regimen complexity, health literacy, patient-provider communication, health belief, and self-efficacy were significantly associated with medication adherence -Physical function and social support were not significantly related to medication adherence.
Uchmanowicz et al., 2018, Poland	Cross-sectional	150	72.1	Caucasian	-Hill-Bone CHBPTS	-Demographic -Socioeconomic -Clinical factors	-Lower adherence in appointment keeping is correlated with age and duration of disease -Lower adherence is correlated with age and duration of disease
Wang et al., 2014, China	Cross-sectional	382	65	Mongoloid	-MMAS-4 -ESCA -FIS-HP	-Sociodemographic -Morbidity -Long-term antihypertensive medication use -Self-care agency -Fear of intimacy with helping	-Single and had only one type of other common chronic disease reported the lowest MMAS-4 scores (p = .005) -Age, gender, marital status, education level, number of common chronic diseases, long-term antihypertensive

Author, Year, Country	Study Design	Sample Size	Mean Age	Region/ Ethnicity (as reported)	Adherence Instrument	Factor Analyzed	Key Findings
						professionals	medication use showed significant association with the MMAS4.

***MMAS = Morisky Medication Adherence Scale; MMAS-4 = 4-item Morisky Medication Adherence Scale; MMAS-8 = 8-item Morisky Medication Adherence Scale; MPR = Medication Possession Ratio; MARS = Medication Adherence Report Scale; MASES = Medication Adherence Self-Efficacy Scale; MASES-R = Medication Adherence Self-Efficacy Scale–Revised; HILL-BONE CHBPTS = Hill-Bone Compliance to High Blood Pressure Therapy Scale; BMQ = Brief Medication Questionnaire; BIPQ = Brief Illness Perception Questionnaire; C-BIPQ = Chinese version of the Brief Illness Perception Questionnaire; HBM = Health Belief Model–based questionnaire; HBCHTS = Hill-Bone Compliance to High Blood Pressure Therapy Scale; IPQ-R = Illness Perception Questionnaire–Revised; MMA = Morisky Medication Adherence questionnaire; MIA = Medication Intake Adherence questionnaire; NVS = Newest Vital Sign; PROMIS-SF = Patient-Reported Outcomes Measurement Information System–Short Form; CCI = Charlson Comorbidity Index; SSRS = Social Support Rating Scale; GMS = General Medication Scale; MRCI = Medication Regimen Complexity Index; MSPSS = Multidimensional Scale of Perceived Social Support; SF-HLQ = Short-Form Health Literacy Questionnaire; LIADLS = Lawton Instrumental Activities of Daily Living Scale*.

Summary of Study Quality Assessment

Based on the results of the study quality assessment (Table 2), it was found that 11 studies fell into the Fair category[3,14,18,20,24,28,36,37,40,41], while 18 others were classified as Good[15–17,19,22,23,25,29–34,38,39,41,42,43].

Table 2. Assessment of Study Quality Based on NIH Criteria

Author	14 Criteria													
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14
Abel & Efird, 2013	Y	N	Y	Y	Y	Y	Y	Y	N	N	Y	Y	Y	Y
Al-Noumani et al., 2018	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Baggarly et al., 2014	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Boratas & Kilic, 2018	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Chunhua, 2016	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Durand et al., 2018	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Alfian et al., 2022	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Bhusal et al., 2016	Y	N	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
Jankowska-Polanska et al., 2016	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Kamran et al., 2015	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Karakurt & Kasicki, 2012	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Khan et al., 2013	Y	N	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
Kressin et al., 2007	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Author	14 Criteria													
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14
Li et al., 2015	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Lo et al., 2016	Y	Y	N	N	Y	N	Y	Y	Y	Y	Y	Y	Y	Y
Lor et al., 2019	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Mahmoudian et al., 2017	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Nakwafila et al., 2022	Y	N	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
Park et al., 2012	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Rahmawati & Bajorek, 2017	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Rajpura & Nayak, 2014	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Ramli et al., 2012	N	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Patel & Taylor, 2002	Y	Y	N	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y
Roumie et al., 2011	Y	N	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y
Shi et al., 2019	N	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Thomas et al., 2011	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Thuy et al., 2020	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Uchmanowicz et al., 2018	N	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
Wang et al., 2014	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Y= Yes; N=No

Summary of Risk of Bias Assessment

Based on the risk of bias assessment using the RoBINS-E tool (Figure 2), two studies were found to be categorized as High Risk of Bias [37,42], thirteen studies fell into the Some Concerns category[14,29,38][16,40][18,21,23][28,36][3,41][25], and the remaining studies were classified as Low Risk.

Figure 2: Traffic Light plot for ROBINS-E Assessment tool

Factors Associated with Medication Adherence in Hypertensive Patients

There is a wide variety of factors that have been reported as either related or unrelated to adherence to antihypertensive medication. The factors mentioned in the studies analyzed include: the level of trust in healthcare providers, patients' beliefs, sociodemographic variables, duration of hypertension, knowledge, comorbidities, medication class, frequency of follow-up visits, alternative treatments, household income, social support, and others. The multitude of variables analyzed in these studies underscores the importance of classifying the factors into several categories to facilitate a better understanding of the highly varied elements involved.

Individual Internal Factors

The primary classification we identified pertains to the internal aspects of the patients themselves concerning external factors. Several factors within this classification include sociodemographic elements (such as age, sex, income, education, race, etc.), beliefs,

knowledge (regarding hypertension, medications, blood pressure, etc.), social support, perception, forgetfulness, lifestyle, trust and experiences with healthcare providers, anxiety and depression, sleep disturbances, satisfaction, attendance at follow-up appointments, and physical functioning.

Health care facilities Factors

Several factors analyzed from the eligible studies include patient-centered primary care, lack of appointment adherence, follow-up visits, blood pressure monitoring, health literacy, and communication between patients and providers.

Factors related to medications

Factors associated with medication use include the complexity of the prescribed medication, the use of alternative or traditional medicine, long-term medication usage, drug classes, frequency of daily medication intake, the patient's habitual adherence to the medication regimen, and the presence of side effects from the medication.

Clinical Factors

Two factors classified under clinical factors were identified: the total number of comorbidities present in the patient and the duration of hypertension in the patient.

The relationship between the analyzed factors and medication adherence

From a sociodemographic perspective, several factors consistently demonstrate a significant relationship with medication adherence among the studies analyzed. Almost all studies agree that older age correlates with higher adherence compared to younger individuals. A study conducted in China found that individuals over the age of 45 had an odds ratio (OR) of 1.29, indicating that patients in this age group were 1.29 times more likely to adhere to their medication compared to younger patients[23]. Moreover, Lo et al.[21] reported an OR of 1.70 for age as a factor. A strong significance related to age and medication adherence was also observed in another study in China, which concluded that older individuals were more compliant with their medication than younger ones, with a p-value of <0.001[22]. Studies in the United States and Turkey noted that adherence increased with age, showing significance values of $P = 0.013$ and $P < 0.000$[17,34]. Three additional studies in Poland and China also found strong significance for the age factor[3,25,40].

In addition to age, gender also contributes to medication adherence among hypertensive patients, although only a few studies have analyzed this relationship and found strong significance. For instance, Ramli et al.[36] in Malaysia found that females were 1.46 times more compliant than males ($P < 0.05$). Another study in China also noted a significant correlation related to gender[25]. Racial factors were consistently analyzed across several eligible studies, including one in the United States that demonstrated differences in adherence between African Americans and whites, despite a relatively low OR of 0.54[15]. Furthermore, differences in race in another study in the U.S. were associated with medication perception, where African Americans exhibited a more positive perception compared to whites. However, regarding non-adherence and trust in

physicians, African Americans scored higher than whites[16]. A study in Malaysia also examined racial differences between Chinese and Indian patients concerning hypertension medication adherence, finding strong significance among Chinese participants with a p-value of <0.05.

Considering that individuals with hypertension generally belong to the elderly demographic, it is crucial for those who may have physical limitations to receive social support from family or close acquaintances. Social support is one of the factors that has been shown to have a strong correlation with medication adherence among hypertensive patients. A study in Namibia indicated that patients receiving health support from family and friends were 0.11 times more likely to adhere to their treatment compared to those who did not receive such support[37]. Furthermore, this is related to the patients' attendance at follow-up programs scheduled by healthcare providers, where attendance in these programs increases the likelihood of medication adherence by eight times[37].

However, a study conducted in Vietnam found contradictory results, indicating that social support did not significantly correlate with medication adherence [41]. Additionally, a different finding emerged from a study in Poland, which noted that patients' non-adherence to appointments for blood pressure monitoring was associated with age and the duration of their disease[3].

Other significant factors relate to the healthcare facility situation, such as the level of trust patients have in their healthcare providers, which appears to be an important focus. A study in the U.S. highlighted the importance of this trust, as it positively impacts patients' adherence to their prescribed treatments[14]. This trust also extends to confidence in the physician, as found by Kressin et al.[16], who noted that patients' trust in the physician responsible for their care significantly contributes to their adherence to antihypertensive medications (P<0.05).

There may be a connection to the communication model between healthcare providers and patients, as a study in Vietnam found a very strong correlation between communication variables and patient adherence to antihypertensive medications [41]. This might also explain other factors, such as patient satisfaction. A study in Iran indicated that a lack of satisfaction is strongly associated with patients' non-adherence to their antihypertensive medication. This satisfaction is further described as stemming from the quality of the relationship and a lack of empathy[31].

Thus, it can also be observed that a lack of appointments may relate to the satisfaction factor, which is another element influencing patients' medication adherence. A study in Poland indicated that low adherence to appointments is strongly correlated with age and disease duration[3]. This finding is further supported by a study in Turkey[34].

Hypertensive patients are sometimes prescribed a variety of medications that can be quite complex to understand. Factors such as the complexity of the treatment regimen contribute significantly to the non-adherence of hypertensive patients. A study in Vietnam concluded that there is a very strong statistical significance between regimen complexity and medication adherence[41]. In addition to complexity, other factors such as long-term use[22,25], frequency of medication[22,23,34], and side effects[36] appear to be strong predictors of patients' adherence to their medication.

Clinical factors also seem to play a substantial role in the level of medication adherence among patients. Factors such as morbidity and the duration of hypertension have been shown to correlate with adherence levels in eligible studies. Boratas et al.[34] found a strong significance between the duration of hypertension and adherence, with a P-value of <0.05. Similar results were observed by researchers in China, with an odds ratio (OR) of 0.68[23], Turkey, with a P-value >0.05[33], South Korea with a P-value <0.001[39], Malaysia[36], the United States[20], India with a P-value of 0.031[42], and Vietnam[41]. Meanwhile, studies in the United States[15], Poland[32], and China[25] found a significant relationship between comorbidity and medication adherence.

DISCUSSION

This systematic review synthesized evidence from 29 observational studies conducted across diverse geographical and healthcare contexts to identify factors associated with antihypertensive medication adherence. The findings demonstrate that medication adherence among patients with hypertension is not driven by a single determinant, but rather emerges from a complex interaction of individual internal factors, healthcare facility–related factors, medication-related factors, and clinical factors. This multidimensional pattern reinforces the view of adherence as a dynamic behavioral process shaped by personal beliefs, treatment characteristics, and health system performance.

The consistency of the individual internal factor age as a determinant of adherence has been reported across all studies analyzed in this review. Hypertensive patients who are older demonstrate significantly higher adherence compared to younger patients. Some studies report higher vulnerability, stability in daily activities, and increased access to healthcare services, particularly among the elderly [44]. However, this finding alone cannot fully explain adherence behavior in hypertensive patients. This is because other variables, such as those within the psychological and cognitive domains which include beliefs, perceptions, self-efficacy, emotional responses, and forgetfulness are also closely related to adherence.

The Necessity–Concerns Framework proposed by Horne and colleagues supports the role of patients' beliefs regarding hypertension and antihypertensive medications. Patients are more likely to adhere to antihypertensive therapy if they believe that such therapy is essential for preventing complications. Conversely, non-adherence is often driven by concerns regarding medication side effects, long-term dependence, and the burden of treatment. These findings underscore that non-adherence is not merely due to chance or forgetfulness but can also result from patients' subjective decision-making regarding their condition and its treatment.

Other internal factors that also significantly contribute to non-adherence among patients with hypertension are health knowledge and literacy. Adherence is generally observed in patients with a high level of knowledge, particularly regarding their hypertension and treatment regimens. This aligns with previous correlational studies reporting a significant relationship between health literacy and adherence to antihypertensive medication [45]. Another community study in Shanghai found that health literacy is directly and closely associated with medication adherence; furthermore, it mediates the effects of educational level and social support on medication adherence [46]. Providing information alone is not sufficient; it must be combined with various interventions and counseling

strategies to enhance self-efficacy, support active engagement in treatment, and address emotional and motivational barriers. A good understanding of treatment regimens and self-efficacy in self-management can minimize the gap between knowledge and adherence.

Although social support is known to influence adherence, its significance varies across studies. These findings may also be influenced by the context and the measurement methods used. A study in China found the importance of social support in improving medication adherence and health literacy, both directly and indirectly [47]. Other studies report that the significance of the relationship between cultural, family, or structural factors can alter the impact of social support on adherence. For example, a clinical study in Indonesia found that support from family and caregivers facilitates the practical aspects of treatment (medication supervision), although in reality this effect varies depending on the extent of the family's role and the patient's condition. This underscores that social support is not a sole determinant but rather acts as a contextual modifier that interacts with factors such as education, socioeconomic status, and access to healthcare services.

Factors related to health facilities, especially the relationship between patients and service providers, have been shown to be crucial determinants of treatment adherence. Trust in the health care provider, satisfaction with the care, and good communication have been consistently related to higher levels of compliance . This finding is consistent with the chronic care model and the patient-centered care model that emphasizes continuity of relationships and collaborative decision-making as the foundation for effective self-management [47]. Studies have shown that patients who believe in their healthcare providers and feel listened to during their consultations have more faith in their treatment plan and are more likely to stick with long-term therapy. Poor communication, lack of empathy and inconsistent follow up on the other hand are related to non-adherence and absence at appointments. The results show that adherence is not only determined by the characteristics of patients, but also by the quality of interpersonal interaction in the health service system [48].

Regular follow-up attendance and continuity of care have also been shown to play pivotal roles in sustaining adherence. Evidence from population-based cohort studies indicates that patients with better continuity of care and consistent follow-up visits exhibit higher adherence to medications and reduced risk of hypertension-related complications. Specifically, higher continuity of care correlated with greater adherence and lower long-term complication rates, suggesting that sustained engagement with healthcare providers reinforces treatment regimens over time [49]. Furthermore, follow-up attendance provides opportunities for tailored feedback, troubleshooting of medication-related issues (such as side effects), and reinforcement of therapeutic goals, all of which support adherence behavior. Taken together, these findings underscore the multidimensional nature of medication adherence in hypertension, which is influenced by cognitive understanding, psychosocial support, and healthcare system factors.

Medication-related factors were frequently associated with non-adherence, particularly regimen complexity, dosing frequency, and adverse effects. Complex regimens increase cognitive load and practical burden, especially among older patients and those with comorbidities. Even when pill burden alone was not statistically significant in some studies, complexity in administration schedules and perceived inconvenience contributed to unintentional non-adherence [50]. Side effects of treatment are often

encountered with long-term medication use, which can lead to reduced patient adherence. Treatment fatigue can foster a negative perception of the benefits of treatment for certain conditions, such as hypertension, which is typically asymptomatic. Treatment side effects significantly contribute to increased anxiety, which may ultimately lead to the decision to discontinue treatment. Therefore, simplifying treatment regimens is a top priority in addressing this issue. This simplification must be accompanied by treatment counseling and side effect management, with the ultimate goal being sustained adherence [51].

Previous studies have reported that the duration of hypertension and comorbidities are closely associated with adherence patterns among patients with hypertension. There is a non-linear relationship between the duration of hypertension and the level of adherence (high or low) to the treatment regimen. The study found that the formation of medication-taking habits is strongly supported by longer duration of medication use, contradicting other studies that suggest it actually increases fatigue and apathy. Comorbidities are among the primary factors that add to the complexity of a patient's condition by increasing the burden of treatment and creating competing health priorities. This ultimately underscores the need for a coordinated and individually tailored care approach [52].

The findings of this review are important in contributing to healthcare in general, and nursing practice in particular. It is known that nurses play a crucial role in identifying barriers to patient adherence, providing education and counseling, and supporting self-management. Interventions provided to patients should not be limited to patients' knowledge alone, but should go deeper to address their beliefs, concerns, emotional responses, and practical challenges. A counseling-based approach appears highly promising in addressing non-adherence, whether conscious or unconscious on the part of the patient. Additionally, effective communication between patients and healthcare providers has strong potential to enhance the continuity of care. Integrating adherence assessment into healthcare practice can increase patients' awareness of their involvement in long-term treatment. Systemically, treatment regimens may need to be reviewed to simplify them. Furthermore, it is also important to ensure access to consistent follow-up care to reduce barriers to achieving adherence.

Some of the limitations identified in this review include highly variable study designs, compliance instruments, and statistical analysis approaches, which preclude the possibility of a quantitative synthesis. The cross-sectional study designs found in the analyzed studies limit the ability to draw causal conclusions. However, the current thematic synthesis provides a coherent framework for understanding the determinants of adherence across various contexts. Moving forward, the use of standardized adherence instruments, longitudinal designs, and evaluations of theory-based interventions and nurse-led care are necessary. Such efforts are crucial for improving blood pressure control and reducing the long-term burden of hypertension.

CONCLUSIONS

Patient adherence to hypertension treatment is influenced by several factors, including individual internal factors, healthcare facilities, medications, and clinical factors.

This review did not identify any consistent determinants associated with nonadherence across all contexts; therefore, a multifaceted approach is needed to address the needs of patients and the healthcare system. It is believed that structured education, adherence assessment, counseling, and follow-up can overcome the barriers faced and support long-term hypertension care.

Future research should focus on the use of standardized adherence instruments and evaluate theory-based and nurse-led care interventions to improve adherence and blood pressure-focused outcomes.

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