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The Role of Biopsychosocial Factors in the Onset and Persistence of Hypertension: A Systematic Review

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A B S T R A C T

The aim of the present review was to identify and elucidate the biological, psychological, and social factors influencing hypertension. This study was conducted based on the principles of a systematic review, and 23 eligible articles selected through searches of reputable scientific databases were examined. Inclusion criteria comprised studies that directly investigated the role of biological, psychological, or social variables in patients with hypertension. The findings indicated that biological factors such as obesity, high body mass index, metabolic disorders, insufficient physical activity, and family history play a prominent role in the development of the disease. In the psychological domain, stress, anxiety, depression, anger, and difficulties in emotion regulation were associated with increased blood pressure and reduced patient adherence to treatment. Social factors, including low socioeconomic status, lack of social and familial support, and experiences of violence or discrimination, were also identified as major underlying risk factors. Critical appraisal of the studies revealed that evidence related to biological factors was more robust, whereas psychological and social findings, due to cross-sectional designs and extensive reliance on self-report instruments, require more rigorous investigation. The conclusion of this review indicates that hypertension is a multidimensional phenomenon and that its management cannot be achieved solely by addressing biological dimensions. The simultaneous integration of biological, psychological, and social components within the biopsychosocial model can provide a deeper understanding of the disease and serve as a foundation for designing more comprehensive interventions aimed at sustainable control and improvement of patients' quality of life.

Keywords: *hypertension, Biological Factors, Psychological Factors, Social Factors, Biopsychosocial Model*

1. Introduction

Hypertension is a leading, highly prevalent chronic noncommunicable disease and a major driver of preventable morbidity and mortality worldwide, largely because it increases the risk of stroke, ischemic heart disease, heart failure, chronic kidney disease, and premature death. Despite the availability of effective pharmacotherapies and evidence-based lifestyle recommendations, population-level rates of diagnosis,

treatment, and sustained blood pressure control remain suboptimal in many settings, making hypertension a persistent systems-level challenge for health services and public health policy (1). The burden of hypertension is not only clinical; it also extends to social and economic domains through productivity losses, disability, and inequities in access to high-quality care. Consequently, modern scholarship increasingly treats hypertension not merely as an isolated cardiovascular condition, but as a multifactorial syndrome shaped by interacting biological pathways and modifiable behavioral and contextual determinants (1).

At the biological level, the pathophysiology of hypertension reflects complex disturbances in vascular tone, renal sodium handling, neurohormonal signaling, endothelial function, and oxidative–inflammatory balance. Obesity has emerged as one of the most consistent and potent biological contributors, with mechanistic links spanning kidney dysfunction, increased sympathetic activation, altered natriuretic capacity, and chronic low-grade inflammation; these processes amplify intravascular volume and peripheral resistance and thereby facilitate the development and maintenance of high blood pressure (2). In parallel, genetic architecture and gene–environment interplay shape interindividual differences in blood pressure regulation, treatment response, and long-term cardiovascular risk, underscoring that hereditary susceptibility can meaningfully set the stage upon which later behavioral and psychosocial stressors operate (3). Oxidative stress is increasingly discussed as a cross-cutting biological mechanism—both as a consequence of vascular dysfunction and as a driver of endothelial impairment, arterial stiffness, and inflammatory cascades that reinforce hypertensive trajectories (4). These biological insights are critical, but their clinical translation is incomplete when psychosocial context, health behaviors, and treatment adherence are not simultaneously addressed.

The psychological and neuroendocrine stress literature provides a strong conceptual basis for understanding how emotional distress and chronic adversity may become “biologically embedded” and expressed through cardiovascular dysregulation. Dysregulation of the stress system, including hypothalamic–pituitary–adrenal (HPA) axis activation and downstream endocrine and immune effects, can contribute to metabolic perturbations, inflammatory signaling, and autonomic imbalance, all of which are plausibly relevant to hypertension onset and persistence (5). From a behavioral medicine perspective, stress processes are also consequential because they alter health behaviors—sleep, diet, physical activity, alcohol use, and medication-taking—thereby linking subjective experience to objective clinical outcomes (6). A substantial body of evidence has connected chronic psychosocial stress to sustained elevations in blood pressure through sympathetic activation, vascular reactivity, and cumulative allostatic load (7). Earlier prospective syntheses similarly concluded that psychological factors, as measured by stress-related and affective constructs, can predict subsequent hypertension development, reinforcing that the mind–body relationship is not merely correlational but may have temporal precedence in some populations (8).

Contemporary population data continue to support these associations. In a large U.S. national sample spanning multiple years, psychological distress was associated with hypertension, highlighting the epidemiologic importance of distress as a cardiovascular risk correlate and the possibility that broader mental health burdens contribute measurably to hypertension prevalence (9). At the same time, finer-grained research has complicated the narrative by distinguishing between blood pressure levels and the experience of being diagnosed with hypertension. Using large-scale cohort resources, associations have been reported between mental health indicators, blood pressure, and later development of hypertension, suggesting that the relationship may differ depending on whether one examines systolic blood pressure as a continuous physiological signal or hypertension as a clinical label with behavioral and psychosocial consequences (10). In parallel, the prevalence of anxiety and depression among patients living with hypertension has been repeatedly documented across diverse contexts, emphasizing that comorbid mental health conditions are not peripheral but clinically relevant to self-care and long-term control (11).

Mechanistic plausibility and clinical relevance are further strengthened by studies that examine emotion-related constructs and self-regulation capacities. In hypertensive samples, anger expression has been linked to quality of life through pathways fully mediated by anxiety and depression, indicating that emotional processes may influence patient-

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reported outcomes via intermediate affective states rather than through direct effects alone (12). Relatedly, emotion dysregulation and anxiety have been examined as part of a "biopsychosocial interplay" in primary care settings, with evidence that difficulties in emotional regulation are associated with mental health burden and may undermine efficient self-care behaviors in hypertension management (13). Medication adherence and treatment resistance—critical determinants of control—also appear to be shaped by psychological profiles: patients with apparently treatment-resistant hypertension have shown meaningful associations between maladaptive psychological features and lower adherence, suggesting that "resistant" disease may sometimes reflect a complex mixture of biological severity and psychosocial barriers to sustained therapeutic engagement (14). In addition, community-based work among hypertensive African Americans has illustrated how multilevel risks co-occur—obesity, distress, adherence challenges, and lifestyle factors—highlighting that psychosocial and behavioral determinants frequently cluster with biomedical risks in real-world settings (15).

The social environment adds another critical layer. Social determinants of health—including education, income, neighborhood deprivation, and access to high-quality preventive and chronic care—shape both exposure to hypertension risks and the feasibility of long-term disease control. A prospective cohort analysis in the United States found that social and behavioral risk factors were associated with earlier onset of adult hypertension, emphasizing that accumulating social disadvantage and stress-related exposures can accelerate cardiometabolic trajectories (16). At a more granular level, social determinants have also been linked to incident apparent treatment-resistant hypertension, including differential risks among White and Black adults, suggesting that structural and contextual factors—education, caregiving resources, neighborhood socioeconomic context, and public health infrastructure—may influence both hypertension severity and the effectiveness of standard care pathways (17). Social support is frequently theorized as a protective buffer that reduces stress reactivity and facilitates adherence; consistent with this, cohort evidence indicates that functional support is inversely associated with incident hypertension, although not all dimensions of support (structural support or satisfaction) show equivalent predictive value (18). Such findings reinforce that "support" is multidimensional and that specific functional resources may matter more than network size or perceived satisfaction when it comes to incident hypertension risk.

Exposure to violence and social adversity further illustrates how upstream stressors may translate into downstream cardiovascular risk. In a nationally relevant sample of Kenyan women, experience of emotional violence was associated with hypertension, underscoring that gendered social stressors and interpersonal trauma may be salient risk contexts, particularly where preventive services and psychosocial supports are unevenly available (19). Longitudinal evidence from Estonia has additionally documented that rapid socio-economic changes and psychosocial factors co-evolve with hypertension prevalence over time, suggesting that macro-level societal transitions can shape population cardiovascular health through both material pathways and psychosocial stress processes (20). Cross-sectional data among older adults in Bangladesh likewise demonstrate that hypertension correlates with a constellation of physio-psychosocial risks, highlighting the relevance of socioeconomic status, sleep problems, comorbidities, and lifestyle in shaping disease patterns within aging populations (21). Taken together, these studies support a view of hypertension as deeply embedded within social context and life-course exposures rather than confined to individual biology.

Methodological advances have enabled researchers to examine moment-to-moment processes that connect stress and emotion to blood pressure variability in everyday life. Ambulatory monitoring research has shown that psychological stress and physical activity can influence ambulatory blood pressure variability and that contextual factors may modify these associations, helping clarify pathways through which daily experiences contribute to cardiovascular load (22). Digital platforms now allow very large-scale ecological assessments; using a mobile-based approach, daily stress demands, coping resources, and affective states have been associated with blood pressure in real-world conditions, indicating that the demand-to-resource balance and negative affect can be particularly informative predictors beyond stress levels alone (23). These approaches add ecological validity and help move the field beyond clinic-based snapshots, aligning with

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biopsychosocial frameworks that emphasize dynamic interactions between individuals and environments.

Biobehavioral studies also emphasize the central role of sleep, metabolic regulation, and substance use as bridges between psychosocial states and cardiovascular physiology. Among individuals with resistant hypertension, better sleep quality has been associated with more favorable metabolic indices and physical fitness, suggesting that sleep may be an actionable pathway linking behavior, metabolism, and cardiovascular risk (24). Alcohol use has similarly been implicated as a modifier of antihypertensive treatment effect, with evidence that alcohol consumption can attenuate blood pressure reduction and necessitate more intensive pharmacotherapy to achieve control (25). These findings are consistent with a systems view in which behavioral exposures both reflect and reinforce psychosocial stress and social context, thereby shaping the overall effectiveness of clinical management strategies.

At the level of patient capabilities and health system interaction, health literacy, self-efficacy, and self-management behaviors emerge as practical levers for improving outcomes. In a structural equation modeling study among rural patients, hypertension-related health literacy had a strong direct association with health-related quality of life, and self-management behavior, social support, and self-efficacy also contributed meaningfully, suggesting that improving patient understanding and agency can translate into better lived outcomes even in low-resource contexts (26). In parallel, empirical work has shown associations among psychological distress, self-care, medication adherence, and hypertension control, highlighting that self-management is inseparable from psychological and behavioral determinants and that poor control may reflect modifiable barriers rather than therapeutic failure alone (27). This insight aligns with broader behavioral medicine perspectives that prioritize integrated care pathways addressing both medical treatment and the psychosocial conditions that enable sustained adherence (6).

Within this evolving landscape, nonpharmacological and integrative interventions are increasingly evaluated as adjuncts to standard care. A recent systematic review and meta-analysis has assessed yoga for arterial hypertension, reflecting a growing interest in mind–body approaches that may simultaneously target stress physiology, physical activity, and self-regulatory capacities (28). Exercise adherence is itself a major challenge in hypertension management, and motivational determinants have been highlighted as key factors influencing sustained engagement in physical activity among adults with hypertension, suggesting that behavioral change strategies must be psychologically informed rather than purely prescriptive (29). Moreover, emerging studies of self-care behavior grounded in patient knowledge emphasize that informational and cognitive factors remain foundational for consistent self-management in hypertension populations (30). Although some complementary approaches are reported in specific contexts (e.g., pregnancy-induced hypertension), such evidence is often based on narrow designs such as case studies and should be interpreted cautiously while still signaling areas where culturally tailored, lifestyle-centered strategies may be explored more rigorously (31).

Despite substantial progress, important gaps remain that justify a systematic synthesis focused explicitly on biopsychosocial determinants. First, the evidence base spans heterogeneous designs (cross-sectional surveys, cohorts, trials, ambulatory monitoring, and digital field studies), which can fragment conclusions and make it difficult for clinicians and policymakers to identify the most actionable, consistent determinants across contexts (9, 18, 23). Second, causal inference is frequently constrained by cross-sectional measurement of stress, affect, and social exposures, and by reliance on self-report instruments, which can inflate shared-method variance and obscure temporal ordering (7, 8). Third, social determinants and interpersonal adversities may operate differently across cultural settings, genders, and age groups, underscoring the need to integrate evidence from diverse regions and populations rather than extrapolating from a narrow subset of high-income contexts (19-21). Finally, treatment-resistant presentations raise particular questions about how psychological and social barriers interact with biological severity, and whether interventions targeting emotion regulation, motivation, and social support can meaningfully improve adherence and control in these high-risk groups (13, 14, 17).

Framed within the biopsychosocial model, hypertension can be conceptualized as the downstream expression of interacting biological substrates (genetic predisposition,

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obesity-related renal and vascular changes, oxidative–inflammatory processes), psychological drivers (stress system dysregulation, anxiety, depression, anger, emotion dysregulation), and social exposures (poverty, neighborhood disadvantage, low functional support, violence, discrimination), all of which shape behaviors critical to control (sleep, alcohol use, physical activity, adherence) (2, 3, 5, 12, 16). When evidence is organized through this lens, hypertension management becomes less about isolated risk-factor modification and more about integrated, context-sensitive care pathways that address mental health and social needs as legitimate components of cardiovascular prevention and chronic disease control (1, 26, 27). Accordingly, a systematic review that maps and synthesizes biopsychosocial determinants can provide a more coherent evidence base for designing multicomponent interventions, prioritizing high-yield targets, and informing both clinical practice and policy strategies aimed at sustainable blood pressure control.

This study aimed to systematically identify and synthesize the biological, psychological, and social factors associated with the onset, persistence, and control of hypertension.

2. Methods and Materials

This systematic review was designed and reported in accordance with the PRISMA 2020 guidelines. Electronic searches were conducted in the PubMed, Scopus, Web of Science, and Google Scholar databases. The search strategy was developed by first extracting key terms from the MeSH section in PubMed and then combining them with free-text keywords to achieve a balance between search sensitivity and specificity. The main MeSH terms and frequently used keywords selected after reviewing MeSH titles and definitions included: Hypertension, Blood Pressure, Psychosocial Factors, Stress, Psychological Factors, Depression, Anxiety, Anger, Emotion Regulation, Coping Behavior, Social Support, Socioeconomic Factors, Domestic Violence, Health Literacy, Obesity, Body Mass Index, Insulin Resistance, and Oxidative Stress. Search strings were constructed using the Boolean operators AND and OR and were limited to the title and abstract fields.

The time frame for eligible studies was defined as 2016 to 2025, and the search was restricted to publications in English and Persian. Inclusion criteria comprised studies conducted on adults with hypertension that examined biological, psychological, or social factors related to the onset, persistence, or control of the disease. Narrative review articles, case reports, letters to the editor, and conference abstracts were excluded.

The screening process was carried out independently by two researchers. Initially, titles and abstracts were screened, followed by full-text assessment of the selected studies. Discrepancies were resolved through discussion and consensus. In the initial stage, 657 records were identified; after removal of duplicates, 504 articles remained. During title and abstract screening, 174 articles were retained, and 52 full-text articles were assessed for eligibility. Ultimately, 23 studies met the inclusion criteria.

Study quality was assessed using the CASP, JBI, and AMSTAR-2 appraisal tools, selected according to the specific study design. Data were extracted using a standardized form and categorized into three domains: biological, psychological, and social. Due to heterogeneity in study designs and outcomes, evidence synthesis was conducted using a narrative approach.

The complete process of study identification, screening, and selection is presented in the PRISMA flow diagram (Figure 1).

Figure 1

PRISMA flow diagram of the included studies

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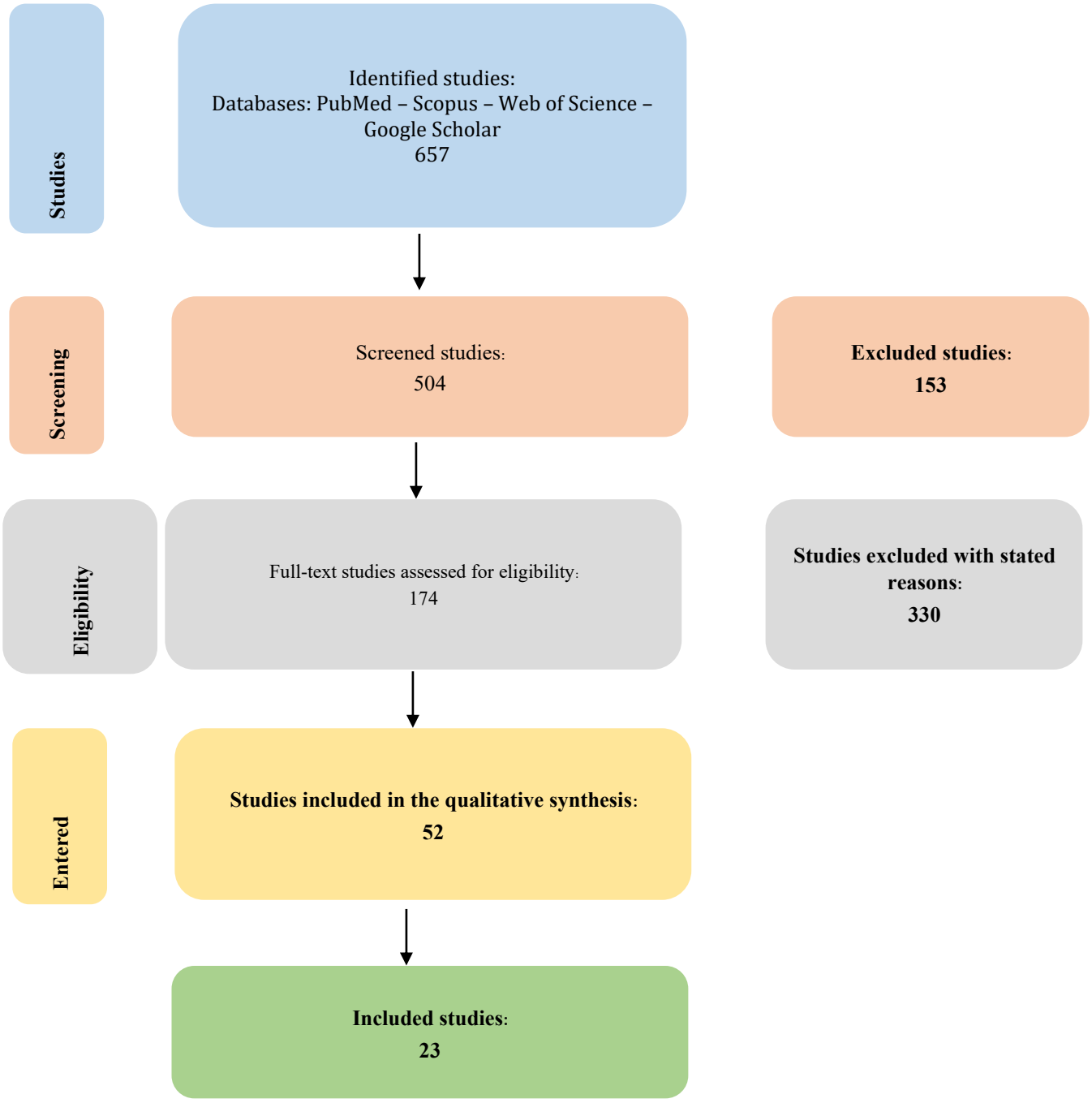

3. Findings and Results

The present systematic review included 23 published studies that examined multiple dimensions of hypertension from biological, psychological, and social perspectives. Overall, the results indicate that hypertension is not a single isolated disorder; rather, it reflects a complex interaction among the body, mind, and the social environment.

From a biological standpoint, factors such as obesity, elevated body mass index (BMI), metabolic abnormalities, insulin resistance, and genetic predisposition were repeatedly identified as key risk factors. These biological determinants form the physiological substrate of the disease and often constitute the primary basis for clinical interventions.

In the psychological domain, variables such as chronic stress, anxiety, depression, and difficulties in emotion regulation played a prominent role in both the onset and

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persistence of hypertension. Evidence suggests that psychological distress and maladaptive coping patterns not only increase susceptibility to hypertension, but also complicate treatment management and adherence.

Social dimensions complement this multidimensional picture. Low socioeconomic status, inequities in access to health services, weak social support, discrimination, and environmental violence were among the factors that intensify the population-level burden of disease. These variables often exert indirect but substantial effects on blood pressure through lifestyle pathways, treatment adherence, and chronic stress exposure.

Given this breadth of determinants, the findings underscore the importance of adopting a multidimensional approach to hypertension. Effective management is more likely when pharmacological and biological control is accompanied by adequate attention to patients' psychological and social conditions. To facilitate clearer comparison and systematic synthesis, summary tables of findings are presented below, followed by a more detailed analysis.

Table 1

Biopsychosocial Factors Associated With Hypertension

Source	Country	Study design	Sample size	Sex / Age	Assessment tools	Variable / Intervention	Key findings
Franco et al. (2022)	Italy	Open-label randomized trial	23 (final: 14)	40–60 years; 63% women	TAC; EndoPAT; SphygmoCor	Melatonin 1 mg/day for 1 year in patients with hypertension	One-year melatonin use significantly reduced arterial stiffness ($p = 0.022$) and increased plasma antioxidant capacity ($p = 0.041$). Endothelial function improved but was not significant ($p = 0.688$). Aix@75 also decreased significantly ($p = 0.020$).
Yeh et al. (2024)	China	Secondary analysis of a 12-week treatment trial	236 men (68 alcohol users; 168 non-users)	53–55 years; all men	Alcohol/smoking questionnaire; BP device; blood biochemistry; medical data; PSQI; cognitive test; exercise measures	Primary exposure: alcohol consumption; SBP/DBP, medication intensity, and BP control attainment were assessed	Both groups showed significant BP reductions (~14/26 mmHg) by week 4 ($p < 0.0001$). However, reductions were smaller among alcohol users, and BP control required higher medication doses; at week 12, higher-dose use was 54.7% vs. 36.6% in non-users.
Smith et al. (2023)	United States	Randomized clinical trial	140	Sedentary adults with treatment-resistant hypertension; mean age 62.5 years; 48% women	Actigraphy; PSQI; 45-min cognitive battery; HbA1c; fitness testing	Cardiac rehabilitation–based lifestyle modification (C-LIFE) vs. enhanced physician advice (SEPA)	Better sleep quality was associated with lower HbA1c ($p = 0.029$), lower HOMA-IR ($p = 0.008$), and higher peak VO_2 ($p = 0.006$), and was not associated with memory or processing speed.
Schonthaler et al. (2019)	United States	Descriptive study	2,052	Mean age 52.9 ± 9.9 years; 66.3% women	Standardized questionnaires: depression (PHQ-8), anxiety (GAD), perceived stress (PSS)	General health, family history, medication adherence, depression, anxiety, stress, and lifestyle	~45% had uncontrolled hypertension. >60% were obese and 46% had depressive symptoms; anxiety and stress were reported at lower levels. Only about half showed full medication adherence; unhealthy lifestyle (poor diet, low activity, smoking) was common, alongside ambivalent illness/treatment attitudes.
Petrov et al. (2016)	United States	Analytical cross-sectional with structural equation modeling (SEM)	589	Mean age 53.6 years; 47% men, 53% women	Childhood Trauma Questionnaire (CTQ); sleep quality/insomnia tools; BMI measurement	Childhood maltreatment and hypertension with mediating roles of sleep disturbance, BMI, and inflammatory markers	41.3% had hypertension. Childhood maltreatment correlated with sleep disturbance ($r = 0.36$, $p < 0.001$), higher BMI, and greater inflammation. Inflammation mediated the relationship between sleep disturbance and hypertension ($p < 0.001$).

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Aldirawi et al. (2024)	Jordan	Descriptive cross-sectional	276	Men with hypertension; ≥20 years; predominant ages 41–60 years	Arabic DASS-42; online self-report form + clinical/social data	Psychological stress and its associations with demographics, lifestyle, and social factors	55.1% reported psychological stress. Higher stress was associated with higher education ($p = 0.04$) and inadequate economic status ($p = 0.041$).
Petit et al. (2018)	Belgium	Analytical cross-sectional	35	Mean age 51 years; 54% women; mostly Caucasian; treatment-resistant hypertension	Medication adherence via LC-MS/MS; 24-hour BP; questionnaires: BSI, TAS-20, ERQ, CERQ, PDS	Medication adherence and treatment resistance in relation to demographic, clinical, and psychological factors	Overall medication adherence was 48%; it increased with higher education ($p < 0.05$) and decreased with hospitalization in the past year. Lower adherence was associated with somatization, difficulty describing feelings, and emotion suppression ($p < 0.05$). Treatment resistance was positively associated with anxiety, hostility, paranoid ideation, and maladaptive coping (e.g., self-blame, catastrophizing) ($p < 0.05$).
Samuel & Vihijma (2018)	Estonia	13-year follow-up cohort	219	Mean age ~55 years; 46.6% men; general population	Lifestyle, diet, physical activity, depressed mood, stressful life events, self-efficacy questionnaires	Lifestyle, psychosocial, and personality factors associated with incidence/prevalence over 13 years	Over 13 years, hypertension prevalence increased from 1.4% to 53%. Among those with hypertension: higher depressed mood and stress, and lower self-efficacy and quality of life ($p < 0.05$). Obesity increased risk fourfold ($p = 0.003$). Depressed mood correlated significantly with stress and low self-efficacy.
Guidotti et al. (2024)	Italy	Cross-sectional, exploratory	100	Hypertension patients, 20–85 years; equal sex ratio	STAXI-2 (anger); SCL-90-R (symptoms); SF-36 (mental/physical QoL)	Anger expression, anxiety, depression, mental health–related quality of life	Half scored above the GSI cut-off and showed higher anxiety, depression, and anger ($p < 0.05$). Mental health correlated negatively with anxiety and depression; anger indirectly worsened mental health via anxiety and depression ($p < 0.05$).
Ojik et al. (2016)	United States	Analytical cross-sectional	288,784 adults (≥18 years)	Women and men ≥18 years	K6 psychological distress; BMI; demographics and risk factors	Association between psychological distress (K6) and hypertension	Prevalence: distress 2.3%, hypertension 30.8%. Hypertension prevalence was higher among non-Hispanic Black individuals than White individuals. Psychological distress was associated with higher hypertension risk, and the association was stronger in men than women.
Schaare et al. (2023)	United States (UK Biobank)	Longitudinal cohort with cross-sectional analysis and follow-up	502,494 baseline; 47,933 follow-up	Median baseline age 58 years (37–73); 54.4% women	SBP; depression symptoms questionnaire; well-being scale; medication data; fMRI (emotion processing task)	SBP, number of antihypertensives, depressive symptoms, well-being, incident hypertension, emotion-related brain activity	Higher SBP was associated with fewer depressive symptoms and higher well-being, whereas having a hypertension diagnosis was associated with more depressive symptoms and lower well-being; this pattern replicated cross-sectionally and longitudinally. Individuals who later developed hypertension had lower mood at baseline.
Casagrande et al. (2019)	Italy	Analytical cross-sectional	951	404 men; 547 women	SBP; depression symptoms questionnaire; well-being scale; medication data; fMRI and record data	Differences in stress-coping styles across five groups (healthy vs. hypertension/cardiac groups)	Task-oriented coping was lower in patients with hypertension and heart disease than in other groups ($p < 0.001$). Avoidance-oriented coping was higher among patients with uncontrolled hypertension ($p < 0.001$). Emotion-oriented coping was lower in cardiac patients than untreated and uncontrolled groups ($p < 0.05$).

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Di Giacomo et al. (2024)	Italy	Cross-sectional	28 (primary hypertension)	21 men; 7 women	DASS-21 (depression/anxiety/stress); DERS-20 (emotion regulation difficulties); SC-CII (self-care skills)	Emotion regulation difficulties, depression, anxiety, stress, and self-care skills	Patients with hypertension and emotion regulation difficulties—especially in emotion acceptance, impulse control, and goal-directed behavior—showed higher depression and anxiety. Stress was associated with poorer emotional awareness and impulse control ($p < 0.01$). Lower emotional awareness was associated with lower self-efficacy in self-care behaviors.
Akinyilore et al. (2024)	United States	Longitudinal cohort (median follow-up 9.5 years)	5,031	Age ≥45 years; 55.1% White, 44.9% Black; both sexes	BP via standard aneroid sphygmomanometer; demographic/lifestyle/SES questionnaires; social support	Social determinants of health (SDOH) and apparent treatment-resistant hypertension (aTRH), including racial disparities	During follow-up, incident aTRH was 15.9% in White participants and 24% in Black participants. Lower education ($p = 0.005$), lack of a caregiver, residence in low-SES neighborhoods ($p < 0.001$), and living in states with weak public-health infrastructure ($p < 0.05$) were associated with higher aTRH risk.
Harding et al. (2022)	United States	Longitudinal cohort	1,516 (for social support analysis)	African American adults ≥21 years; normotensive at baseline; both sexes	BP via sphygmomanometer and semi-automated device; ISEL (functional support); Berkman Social Network Index	Functional/structural support and satisfaction with support in relation to incident hypertension	Mean functional support was 26 ± 5 (range 2–38). Over a median 6.9-year follow-up, 54% developed hypertension. Higher functional support was associated with lower hypertension incidence ($p < 0.05$), whereas structural support and satisfaction with support were not associated ($p > 0.05$).
Powell et al. (2021)	Bangladesh	Cross-sectional	529	Mean age 60 ± 10 years; 56.3% men	Seated BP via calibrated digital monitor per standard guidelines; height/weight for BMI; demographic data	Correlates of hypertension: age, sex, marital status, education, BMI, perceived health, smoking, heart disease, diabetes, sleep problems, employment, residence	Hypertension prevalence was 53.9% and was significantly associated with older age ($p < 0.001$), widowhood ($p < 0.05$), illiteracy/low education ($p < 0.001$), poor perceived health ($p < 0.001$), smoking ($p < 0.05$), heart disease ($p < 0.001$), obesity ($p < 0.001$), diabetes, sleep problems, unemployment, and urban residence ($p < 0.05$). In multivariable regression, older age and poor perceived health remained significant.
Pentel et al. (2019)	United States	Prospective cohort	41,745	Mean age ~48–56 years; ~56–61% women	Member Health Survey (MHS) for social/behavioral data; EHR data	Social and behavioral risk factors (education, financial strain, marital status, high stress, intimate partner violence, poverty)	A higher number of social/behavioral risks was associated with increased risk and faster onset of hypertension and diabetes; having ≥3 risks vs. none increased incident hypertension by 41% and diabetes by 53% ($p < 0.001$).
Zhang et al. (2021)	China	Cross-sectional with SEM	550	Mean age 58.14 ± 12.05 years; 46.3% men; 53.7% women	Hypertension health literacy questionnaire; chronic disease QoL tool; hypertension self-management scale; treatment adherence scale; Stanford self-efficacy scale	Health literacy, self-management, treatment adherence, self-efficacy, social support, and QoL in Kazakh patients with hypertension	SEM results: hypertension health literacy had the largest direct effect on QoL ($\beta = 0.350$, $p < 0.001$), followed by self-management ($\beta = 0.257$, $p < 0.001$), social support ($\beta = 0.190$, $p < 0.001$), and self-efficacy ($\beta = 0.183$, $p < 0.001$). Self-efficacy also had an indirect effect on QoL via self-management.
Eghbali et al. (2022)	Iran	Descriptive–analytical cross-sectional	252	Women: 60.6 ± 11.35; men: 60.5 ± 11.55; 61.3% women	8-item Morisky Medication Adherence Scale; GHQ-12; 16-item questionnaire based on WHO STEPS	Demographics, clinical indicators, and psycho-behavioral variables	Women with uncontrolled BP had greater psychological distress ($p = 0.044$). Controlled BP was associated with higher medication adherence ($p = 0.010$) and better self-care. Adherence increased with older age ($p = 0.001$) and physical activity. Self-care was

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							higher in men (p = 0.017) and more active individuals (p = 0.008), and was associated with lower psychological distress (p = 0.031).
Tomitani et al. (2023)	Japan	Cross-sectional observational using ambulatory BP monitoring (ABPM)	50 high-risk patients	Not reported	Multisensor 24-hour BP/HR monitoring device (30-min intervals); embedded Actigraph accelerometer; self-report	SBP/DBP, HR, momentary physical activity (pre-BP), and self-reported psychological/environmental factors	Physical activity before BP measurement increased SBP (+4.2 ± 2.0 mmHg, p = 0.036) and HR (+5.4 ± 1.1 bpm, p < 0.001). After adding stress and workplace to the model, the activity effect on BP became non-significant (p > 0.05), while negative affect (+7.4 ± 2.5 mmHg, p = 0.003) and workplace (+5.8 ± 2.1 mmHg, p = 0.005) were associated with higher BP. Negative affect had a stronger effect than short-term activity.
Okire et al. (2024)	Kenya	Cross-sectional	5,109 women	Women aged 15–49 years	DHS standardized questionnaire; self-reported hypertension; emotional violence exposure	Emotional violence exposure and hypertension (adjusting for demographic/behavioral factors)	Hypertension prevalence was higher among women exposed to emotional violence than those unexposed, and the association was significant (p < 0.001). Older age, higher education, and highest wealth quintile were also associated with higher hypertension likelihood (p < 0.01).
Gordon et al. (2021)	United States	App-based field study with cross-sectional–longitudinal design (3 weeks; EMA)	21,923 final participants (from 91,892 initial)	≥18 years; women and men	Smartphone optical sensor BP/HR via MyBPLab (Samsung) validated against FDA-cleared A&D UA-651BLE; in-app stress questionnaires; 3×/day for 21 days	SBP/DBP and HR; daily stress (demands/resources), demand-to-resource ratio, age, sex, BMI, self-rated health, positive/negative affect	Higher daily demands were associated with higher BP; greater coping resources were protective, and the demand-to-resource ratio was a stronger predictor than demands alone (ΔAIC/BIC > −500). Older adults showed more concordant physiological responses to self-reported stress. High-arousal negative affect increased BP/HR (p < 0.001), whereas low-arousal positive affect was associated with lower BP. Overall, daily stress and negative affect were associated with higher BP.
Abdisa et al. (2022)	Ethiopia	Multicenter cross-sectional	471	Median age 50 years; 51.2% men	Depression: PHQ-9; anxiety: GAD-7; social support: Oslo OSSS-3; clinical/demographic data	Outcomes: depressive symptoms and anxiety symptoms among individuals with hypertension; predictors: sex, education, marital status, etc.	Prevalence: depression 27.2%, anxiety 32.7%. Higher depression risk was associated with female sex (p < 0.05), no formal education (p < 0.05), comorbidity (p < 0.01), family history of depression (p < 0.01), and poor social support (p < 0.001). For anxiety, significant factors included female sex (p < 0.05), divorced/widowed status (p < 0.001), comorbidity (p < 0.05), and poor social support (p < 0.001).

Biological factors constitute the foundational basis for the development of hypertension. Somatic, metabolic, and genetic changes are factors that can predispose an individual to elevated blood pressure. These factors are primarily related to internal physiological processes and directly affect cardiovascular system function. Evidence has shown that obesity, as one of the most well-established risk factors, imposes additional load on blood vessels and multiplies the risk of developing hypertension (2). Excess body weight and elevated BMI are associated with increased inflammation and the occurrence of hypertension, and more than half of patients with hypertension experience obesity (2, 15, 16). Metabolic and biochemical changes also play a direct role in blood pressure regulation. Good sleep quality is associated with better glycemic control and reduced insulin resistance (24). Alcohol consumption reduces the effectiveness of

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pharmacological treatment (25), and one year of melatonin use has been shown to reduce arterial stiffness and improve antioxidant capacity (4). In addition, heredity and family history are among the most important biological underpinnings of hypertension and can complicate blood pressure control both directly and indirectly through pathways involving mental health (3, 32).

Psychological dimensions also represent a major component of the hypertension puzzle. Patients experience not only physiological changes but also psychological pressures that can make disease management more difficult. Psychological stress can elevate blood pressure both chronically and acutely. A national analysis in the United States found that stress significantly increases the risk of hypertension (9). In Jordan, more than half of patients with hypertension experience some degree of stress, and this condition has been associated with economic difficulties, a tense family environment, and physical inactivity (33). Likewise, Japanese studies have reported that negative emotions and occupational stressors are associated with increased systolic blood pressure (22). Other research has also shown that everyday stressors and negative emotions such as anger and fear can raise blood pressure (23). Anxiety is another major psychological problem in these patients. The prevalence of anxiety among individuals with hypertension has been reported as high (11), and women and individuals with weak social support are more likely than others to experience anxiety (18). Anxiety is also associated with treatment resistance and poorer blood pressure control (14). Depression is another common disorder in these patients, and the mood changes it produces can complicate disease control. Longitudinal analyses have shown that individuals who later developed hypertension reported lower mood at baseline, and people with hypertension also had lower quality of life and more depressive symptoms (10). Anger, as a negative emotion, is also observed in many patients with hypertension. Studies have shown that half of patients reported high levels of anger, anxiety, and depression, which was associated with reduced quality of life (12). Mediation analyses have further indicated that anger has an indirect effect on mental health through anxiety and depression. Difficulties in emotion regulation are also an important factor, contributing to increased depression and anxiety and reduced self-care (13). Maladaptive coping strategies such as suppression or catastrophizing have likewise been associated with lower medication adherence and poorer blood pressure control (14). In contrast, the use of adaptive coping styles—particularly task-oriented coping—has been linked to more favorable cardiovascular outcomes for patients (20).

Social factors also play an essential role in the onset and persistence of hypertension. Low socioeconomic status, including limited education, low income, and residence in deprived neighborhoods, has been associated with higher disease occurrence and treatment resistance (16). Poor economic conditions and illiteracy are linked to increased risk of developing hypertension (21). Poverty and financial strain may facilitate an earlier onset of the disease (16). In some studies, even women with higher education and income have shown higher hypertension prevalence, which has been attributed to environmental and behavioral differences (19). Social support is also considered a protective factor. Functional support can reduce the risk of developing hypertension (18) and improve patients' quality of life (26). Conversely, weak social support is associated with higher levels of depression and anxiety (11), and a tense family environment can intensify patients' stress (33). Violence and environmental stress are other important social determinants. Exposure to emotional violence among women is significantly associated with higher blood pressure (19). In addition, social discrimination and neighborhood poverty have been linked to difficulty in disease control (15). Daily environmental stressors may also directly increase blood pressure (23).

A synthesis of the evidence indicates that hypertension results from a complex interaction among biological, psychological, and social factors. From obesity and metabolic disorders to stress, anxiety, and socioeconomic conditions, multiple determinants collectively shape the disease trajectory. These findings emphasize that hypertension management should be multidimensional and that, alongside pharmacological treatment, patients' mental health and social conditions should receive serious attention. To facilitate understanding of the biopsychosocial determinants of hypertension, the results of this review are summarized in the tables below.

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Table 2

Biological Factors Associated With Hypertension

Factor	Pathway of effect	Representative evidence
Obesity and elevated BMI	Increased hemodynamic load, inflammation, activation of the renin–angiotensin system	Obesity increases the risk of developing hypertension by up to fourfold, and more than 60% of individuals with hypertension are obese.
Metabolic factors (sleep, insulin, inflammation, alcohol)	Insulin resistance, oxidative stress, circadian rhythm disruption	Better sleep quality is associated with lower HbA1c and C-reactive protein (CRP); melatonin reduced arterial stiffness; alcohol consumption reduced treatment effectiveness.
Heredity and family history	Genetic predisposition; indirect effects via depression	Family history is an independent risk factor for hypertension; family history of depression makes disease control more difficult.

Table 3

Psychological Factors Associated With Hypertension

Factor	Pathway of effect	Representative evidence
Affective–emotional factors (stress, anxiety, depression, anger)	Chronic and acute stress increase blood pressure; anxiety is linked to treatment resistance; depression reduces quality of life; anger correlates with anxiety and depression and worsens mental health	Stress increased hypertension risk by 49%; anxiety was common in patients with hypertension; depression was associated with lower well-being; anger had an indirect effect on mental health.
Emotion regulation and impulse control	Inability to accept emotions, inadequate impulse control, and emotion suppression lead to lower adherence and poorer self-care	Emotion regulation difficulties were associated with higher depression and anxiety and lower self-efficacy.
Coping styles and adherence	Greater reliance on emotion-focused and avoidance coping is associated with greater disease severity; task-oriented coping is protective; low adherence is linked to stress and emotion suppression	Cardiovascular patients used task-oriented coping less frequently; lower adherence was associated with somatization and maladaptive coping strategies.
Accelerating and predisposing factors	Chronic stress exposure, life events, trauma, sleep disturbance, and inflammation exacerbate psychological symptoms and hypertension	Childhood maltreatment increased hypertension risk through sleep disturbance and inflammation; insufficient sleep was associated with higher stress.

Table 4

Social Factors Associated With Hypertension

Factor	Pathway of effect	Representative evidence
Socioeconomic status	Deprivation, low education, low income, limited access to services	Lower education, poverty, and financial strain are associated with hypertension; in some populations, even highly educated women showed higher prevalence.
Social support and family relationships	Increased coping resources, reduced stress	Functional support reduces hypertension risk and improves quality of life; weak support is associated with higher depression and anxiety.
Violence and environmental stress	Emotional violence, social discrimination, daily stressors	Emotional violence among women is associated with higher hypertension; neighborhood poverty and discrimination make disease control more difficult; daily stress increases blood pressure.

4. Discussion

The findings of the present systematic review provide convergent evidence that hypertension is best understood as a biopsychosocial condition arising from the dynamic interaction of biological vulnerability, psychological processes, and social context. Across the included studies, biological factors such as obesity, metabolic dysregulation, oxidative stress, and genetic predisposition consistently emerged as foundational drivers of hypertension onset and persistence. Mechanistic research highlights that obesity-related renal dysfunction, inflammation, and sympathetic overactivity create a physiological milieu that favors sustained blood pressure elevation, thereby explaining why excess body weight is repeatedly associated with both higher prevalence and poorer control of hypertension (2, 4). Genetic susceptibility further modulates these processes, shaping individual variability in blood pressure regulation and responsiveness to treatment (3). Importantly, the reviewed studies demonstrate that biological risk does not operate in isolation; rather, it is often amplified or attenuated by behavioral and psychosocial factors such as sleep quality, alcohol consumption, and stress-related neuroendocrine activity. For example, evidence that alcohol use reduces

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antihypertensive treatment effectiveness and necessitates higher medication intensity underscores how lifestyle behaviors interact with pharmacological mechanisms (25). Similarly, the association between improved sleep quality and more favorable metabolic indices among individuals with resistant hypertension suggests that sleep represents a critical biological–behavioral bridge influencing cardiovascular risk (24). These results are consistent with stress physiology models showing that dysregulation of endocrine and inflammatory pathways contributes to both metabolic dysfunction and vascular damage (5).

Beyond biological substrates, the review highlights the central role of psychological factors in shaping hypertension risk, disease experience, and treatment outcomes. Chronic psychological stress was one of the most robust correlates of hypertension across populations, aligning with earlier evidence that sustained psychosocial stress contributes to long-term blood pressure elevation via sympathetic activation and cumulative allostatic load (7, 8). Large-scale epidemiological analyses confirm that psychological distress is associated with a higher prevalence of hypertension, reinforcing the population-level relevance of mental health for cardiovascular risk (9). More nuanced findings further indicate that the relationship between mental health and blood pressure is complex and bidirectional. For instance, cohort data suggest that while higher systolic blood pressure may coexist with fewer depressive symptoms in some contexts, the clinical diagnosis of hypertension is associated with poorer mental well-being and increased depressive symptoms over time (10). This distinction underscores the importance of differentiating between physiological blood pressure measures and the psychosocial meaning of living with a chronic diagnosis. Anxiety and depression were highly prevalent among hypertensive patients across diverse settings, including low- and middle-income countries, and were consistently associated with poorer self-care, reduced medication adherence, and diminished quality of life (11, 27). These findings align with behavioral medicine frameworks emphasizing that emotional distress undermines health behaviors critical to disease control (6).

Emotion-related constructs such as anger expression and emotion dysregulation further refined understanding of psychological pathways. Evidence that anxiety and depression fully mediate the relationship between anger expression and quality of life indicates that negative emotions exert their effects through interconnected affective processes rather than acting independently (12). Similarly, observational data from primary care settings show that emotional dysregulation is associated with higher anxiety and poorer self-care capacity, suggesting that deficits in emotional regulation may represent a modifiable target for improving hypertension management (13). These results resonate with findings from studies of treatment-resistant hypertension, where maladaptive psychological profiles were linked to lower medication adherence and apparent resistance to therapy, highlighting that resistance may partly reflect psychosocial barriers rather than purely biological refractoriness (14). Collectively, the psychological evidence supports a shift away from viewing mental health comorbidity as secondary or incidental, toward recognizing it as integral to hypertension prognosis and control.

The social dimension of hypertension emerged as equally salient in this review. Social determinants of health—including education, income, neighborhood conditions, and access to supportive resources—were consistently associated with both the development and progression of hypertension. Longitudinal data demonstrate that cumulative social and behavioral risks are linked to earlier onset of hypertension, emphasizing the life-course impact of socioeconomic adversity (16). Moreover, disparities in incident apparent treatment-resistant hypertension across racial groups highlight how structural and contextual factors, such as educational attainment, caregiving resources, and neighborhood deprivation, shape not only disease prevalence but also treatment responsiveness (17). The protective role of social support was evident in cohort studies showing that higher functional support reduced the risk of incident hypertension, even when structural support or satisfaction with support did not exert similar effects (18). This distinction suggests that tangible, functional assistance may be more influential than social network size or perceived adequacy alone. Conversely, exposure to social adversity—including emotional violence, discrimination, and chronic environmental stress—was associated with higher blood pressure and poorer control, particularly among women and marginalized populations (19, 20). These findings align with stress-embedding theories, which posit that repeated exposure to social threat and deprivation

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becomes biologically embedded through stress-responsive systems, thereby elevating cardiovascular risk (5).

Methodologically, the review also illustrates the value of emerging approaches that capture real-world, dynamic interactions between stress, behavior, and blood pressure. Ambulatory monitoring studies demonstrate that momentary psychological stress and contextual factors influence blood pressure variability beyond the clinic setting, providing ecological validity to biopsychosocial models (22). Digital and mobile-based research further shows that daily stress demands, coping resources, and affective states predict blood pressure fluctuations, with the balance between demands and resources offering a particularly strong explanatory framework (23). Such evidence supports moving beyond static risk-factor models toward dynamic, context-sensitive understandings of hypertension. Additionally, findings related to health literacy, self-efficacy, and self-management behaviors emphasize that patient capabilities and knowledge are critical mediators between psychosocial context and clinical outcomes. Structural equation modeling studies indicate that hypertension-specific health literacy has a strong direct association with quality of life, with self-management and social support exerting both direct and indirect effects (26). Similarly, associations between psychological distress, adherence, and blood pressure control reinforce the notion that poor control often reflects modifiable behavioral and psychosocial barriers rather than inevitable disease progression (27). Complementary and integrative approaches, such as yoga and other lifestyle-based interventions, are increasingly evaluated within this biopsychosocial framework, with emerging evidence suggesting potential benefits for blood pressure regulation through combined physical, psychological, and stress-modulating pathways (28). Motivation and adherence to physical activity remain critical challenges, and studies emphasizing motivational determinants underscore the need for psychologically informed behavior-change strategies rather than purely prescriptive recommendations (29, 30).

5. Conclusion

Overall, the synthesis of findings affirms that effective hypertension management requires integrated attention to biological mechanisms, psychological well-being, and social context, consistent with global calls for more holistic, person-centered approaches to chronic disease care (1).

6. Limitations and Suggestions

One limitation of this review is the heterogeneity of study designs and measurement approaches across the included literature. Many studies relied on cross-sectional designs and self-report instruments for psychological and social variables, limiting causal inference and raising the possibility of reporting bias. Additionally, variability in definitions of stress, social support, and adherence constrained direct quantitative comparison across studies. Although the review incorporated evidence from diverse geographic and socioeconomic contexts, certain regions and populations remain underrepresented, which may limit generalizability. Finally, the narrative synthesis approach, while appropriate given heterogeneity, precluded formal meta-analytic estimation of effect sizes for many psychosocial and social determinants.

Future research should prioritize longitudinal and interventional designs that can clarify temporal and causal relationships among biological, psychological, and social factors in hypertension. Greater use of mixed-methods and ecological momentary assessment could help capture dynamic processes linking daily stress, emotion regulation, behavior, and blood pressure. Studies should also examine how interventions targeting mental health, social support, and health literacy interact with pharmacological treatment, particularly in populations with apparent treatment-resistant hypertension. Cross-cultural research and equity-focused analyses are needed to better understand how social determinants and structural factors shape hypertension risk and control across different settings.

From a practice perspective, hypertension care should move toward integrated, multidisciplinary models that address mental health and social needs alongside medical management. Routine screening for psychological distress, stress, and social adversity in hypertensive patients could help identify modifiable barriers to control. Clinicians should emphasize sleep quality, alcohol moderation, and stress management as core components of treatment, not adjuncts. Strengthening functional social support and enhancing patient health literacy and self-efficacy may improve adherence and quality of life. Ultimately, adopting

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a biopsychosocial approach in routine practice can support more sustainable blood pressure control and better long-term outcomes for patients with hypertension.

Authors' Contributions

M.T.A. led the conceptualization of the study, development of the review protocol, and supervision of the systematic search process. M.F. was responsible for data extraction, quality appraisal of eligible studies, and synthesis of findings across biological, psychological, and social domains. M.A.F. contributed to database searches, verification of extracted data, and organization of the final thematic structure. All authors participated in drafting, critical revision, and final approval of the manuscript.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethics Considerations

This systematic review was conducted using publicly available data from previously published studies. No new data were collected, and no human or animal participants were directly involved in this research. Therefore, ethical approval and informed consent were not required for this study. The review was performed in accordance with ethical standards for research integrity, transparency, and responsible reporting.

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