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HOW STRESS INFLUENCES THE DEVELOPMENT OF CARDIOVASCULAR DISEASE: A SYSTEMATIC REVIEW

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Abstract

Background: Psychosocial stress has emerged as a critical determinant of cardiovascular disease (CVD), influencing both the initiation and progression of pathology through behavioral, neuroendocrine, and inflammatory mechanisms. Despite extensive evidence, the precise pathways and magnitude of stress-related cardiovascular risk remain under debate.

Objectives: This systematic review aimed to synthesize recent empirical findings on how acute, chronic, and perceived stress contribute to the development of CVD, integrating epidemiological, physiological, and mechanistic evidence.

Methods: Following PRISMA 2020 guidelines, ten peer-reviewed studies were analyzed, including population-based, cohort, and experimental designs. Data were extracted on stress exposure, cardiovascular outcomes, and mediating pathways such as inflammation, autonomic dysregulation, and behavioral changes.

Results: Across studies, stress was associated with a 1.3–2.1-fold increased risk of CVD. Song et al. (2019) found the highest early risk (HR = 6.95 for heart failure in the first year post-stress diagnosis). Socioeconomic disparities amplified this association (Redmond et al., 2013), while mechanistic research linked amygdalar hyperactivity and inflammation to vascular dysfunction (Osborne et al., 2020; Civieri et al., 2024). Women and younger adults exhibited heightened vulnerability (Pimple et al., 2019).

Conclusion: Evidence supports a robust, multifactorial relationship between psychological stress and cardiovascular risk, mediated by neuro-immune, behavioral, and metabolic pathways. Preventive and therapeutic strategies addressing chronic stress could significantly reduce global CVD burden.

Keywords: psychological stress; cardiovascular disease; inflammation; neuroendocrine activation; behavioral mediators; autonomic dysregulation; sex differences; socioeconomic status; amygdala; chronic distress

INTRODUCTION

Cardiovascular disease (CVD) remains the leading cause of morbidity and mortality worldwide, with psychosocial stress now recognized as a significant and modifiable risk factor influencing both its onset and progression. Chronic exposure to stress activates neuroendocrine and inflammatory pathways that disrupt cardiovascular homeostasis, promoting endothelial dysfunction, hypertension, and atherosclerosis development. Emerging evidence from epidemiological, experimental, and clinical studies has underscored that the impact of stress extends beyond behavioral risk factors to include biological alterations in the hypothalamic–pituitary–adrenal (HPA) axis and sympathetic nervous system activity (Steptoe & Kivimäki, 2012).

The physiological response to stress involves activation of the sympathetic–adrenal–medullary system and the HPA axis, resulting in increased catecholamine and cortisol secretion. While short-term activation serves adaptive functions, chronic activation contributes to sustained hypertension, endothelial injury, and arterial stiffening. These mechanisms collectively accelerate cardiovascular aging and plaque instability, ultimately increasing the likelihood of myocardial infarction, stroke, and heart failure (Kivimäki & Steptoe, 2018). Animal models have demonstrated that prolonged psychosocial stress induces vascular inflammation, autonomic imbalance, and metabolic disturbances, corroborating findings from human observational studies (Golbidi, Frisbee, & Laher, 2015).

Beyond physiological stress responses, psychosocial factors such as job strain, financial pressure, and social isolation significantly increase cardiovascular risk. Work-related stress, in particular, has been associated with a 40–50% higher incidence of coronary heart disease and stroke in longitudinal studies (Backé et al., 2012). Psychosocial stress at work interacts with individual coping mechanisms and social support, highlighting the multifactorial nature of the stress–CVD pathway. Importantly, these stressors not only exacerbate traditional risk factors—such as smoking, obesity, and physical inactivity—but also function independently through neurobiological routes.

Inflammation has emerged as a central mediator linking chronic stress and cardiovascular pathology. Repeated stress exposure upregulates pro-inflammatory cytokines such as interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF-α), which contribute to endothelial dysfunction, plaque instability, and myocardial remodeling (Zhang & Dhalla, 2024). These inflammatory processes are potentiated by heightened sympathetic drive and cortisol dysregulation, resulting in a sustained pro-atherogenic state. Clinical imaging studies further support the inflammatory hypothesis, showing increased vascular inflammation and immune cell activation in individuals exposed to chronic psychological distress (Osborne et al., 2020).

Neuroimaging advances have clarified how the brain mediates stress-related cardiovascular risk. Hyperactivation of the amygdala, a brain region central to fear and stress processing, has been correlated with increased bone marrow activity and vascular inflammation, forming a neural–hematopoietic–arterial axis that promotes atherosclerosis. Such findings provide mechanistic insight into how psychological experiences are transduced into biological damage (Dar et al., 2019). The amygdalar response to chronic stress reflects heightened vigilance and autonomic arousal, linking emotional dysregulation directly to cardiac events.

Moreover, individual differences in cardiovascular reactivity to stress—such as exaggerated blood pressure or heart rate responses—have been shown to predict long-term CVD risk. This reactivity model suggests that frequent and intense autonomic responses accelerate vascular wear and tear, a concept supported by longitudinal studies examining psychophysiological stress testing outcomes (Whittaker et al., 2021). Adolescents and young adults exhibiting heightened reactivity patterns often demonstrate early markers of arterial stiffness and subclinical atherosclerosis, implying that stress-induced vulnerability begins early in life (Low, Salomon, & Matthews, 2009).

Importantly, the effects of stress are not confined to biological systems but also extend to behavior and lifestyle. Chronic stress contributes to maladaptive coping mechanisms—such as increased alcohol intake, smoking, and poor diet—that further heighten CVD risk. These behaviors act synergistically with physiological stress responses, creating a feedback loop that perpetuates cardiovascular deterioration (Steptoe & Kivimäki, 2013). Understanding this intersection between psychology and physiology emphasizes the need for integrative models that account for both behavioral and biological determinants.

Finally, contemporary reviews have highlighted that interventions targeting stress reduction—such as mindfulness, cognitive-behavioral therapy, and physical activity—can mitigate cardiovascular risk by normalizing autonomic tone and reducing inflammation. However, despite growing recognition of stress as a cardiovascular risk factor, it remains under-assessed in clinical settings. Addressing this gap is critical, as stress represents a potentially modifiable determinant of cardiovascular health with far-reaching public health implications (Vaccarino & Bremner, 2024).

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METHODOLOGY

Study Design

This study utilized a **systematic review design** guided by the **Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020** framework to ensure methodological rigor, transparency, and reproducibility. The primary aim was to synthesize and critically appraise empirical evidence examining **how stress influences the development of cardiovascular disease (CVD)** across diverse populations. The review focused on identifying the **pathophysiological, behavioral, and psychosocial mechanisms** linking stress exposure—whether acute, chronic, or perceived—to cardiovascular outcomes, including coronary heart disease (CHD), stroke, heart failure, hypertension, and subclinical atherosclerosis.

This review incorporated **peer-reviewed studies** employing observational (cohort, cross-sectional, and case-control) and experimental designs that quantitatively or qualitatively explored associations between stress and cardiovascular endpoints. Both epidemiological and mechanistic studies were included to provide a comprehensive understanding of stress-related cardiovascular risk across clinical, community, and experimental contexts.

Eligibility Criteria

Inclusion Criteria

Studies were selected based on predefined inclusion parameters:

- **Population:** Adults and adolescents from community, clinical, or occupational settings, free from or diagnosed with cardiovascular disease.
- **Exposure:** Psychological stress, perceived stress, chronic stress, post-traumatic stress disorder (PTSD), anxiety, depression, or related psychosocial stressors.
- **Comparators:** Individuals with low or no stress exposure, or baseline reference groups.
- **Outcomes:** Incidence, prevalence, or progression of cardiovascular disease (including CHD, stroke, heart failure, hypertension, and subclinical atherosclerosis) or intermediate biomarkers (e.g., blood pressure, heart rate variability, vascular inflammation, or neuroendocrine activation).
- **Study Designs:** Population-based cohorts, prospective or retrospective cohort studies, case-control studies, cross-sectional studies, and experimental or imaging-based studies assessing biological pathways.
- **Language:** English.
- **Publication Period:** January 2000 to December 2025 to capture modern epidemiological and neuroimaging evidence.

Exclusion Criteria

- Non-empirical works (reviews, commentaries, editorials, or theoretical papers).
- Studies with non-cardiovascular outcomes or without defined stress measures.
- Case reports, conference abstracts, or grey literature lacking peer review.
- Duplicate publications or unavailable full texts.

After full-text screening, **10 studies** met all inclusion criteria.

Search Strategy

A comprehensive electronic search was performed in PubMed, Scopus, Web of Science, PsycINFO, Embase, and Google Scholar databases. Boolean operators and MeSH terms were used to capture variations of the target concepts, combining the following terms:

- (“psychological stress” OR “chronic stress” OR “perceived stress” OR “post-traumatic stress” OR “psychosocial distress”)
- AND (“cardiovascular disease” OR “heart disease” OR “coronary artery disease” OR “myocardial infarction” OR “stroke” OR “hypertension” OR “atherosclerosis”)
- AND (“cohort study” OR “case-control study” OR “longitudinal study” OR “cross-sectional” OR “prospective”).

Manual searches of **reference lists** from relevant systematic reviews and included studies were performed to ensure completeness. Duplicate records were removed prior to screening using **Zotero**.

Study Selection Process

The study selection was independently conducted by **two reviewers** following PRISMA guidelines. Titles and abstracts were initially screened to identify potentially relevant articles. Full-text reviews were then carried out to confirm eligibility against inclusion criteria. Discrepancies were resolved by discussion or, when necessary, adjudicated by a **third senior reviewer**.

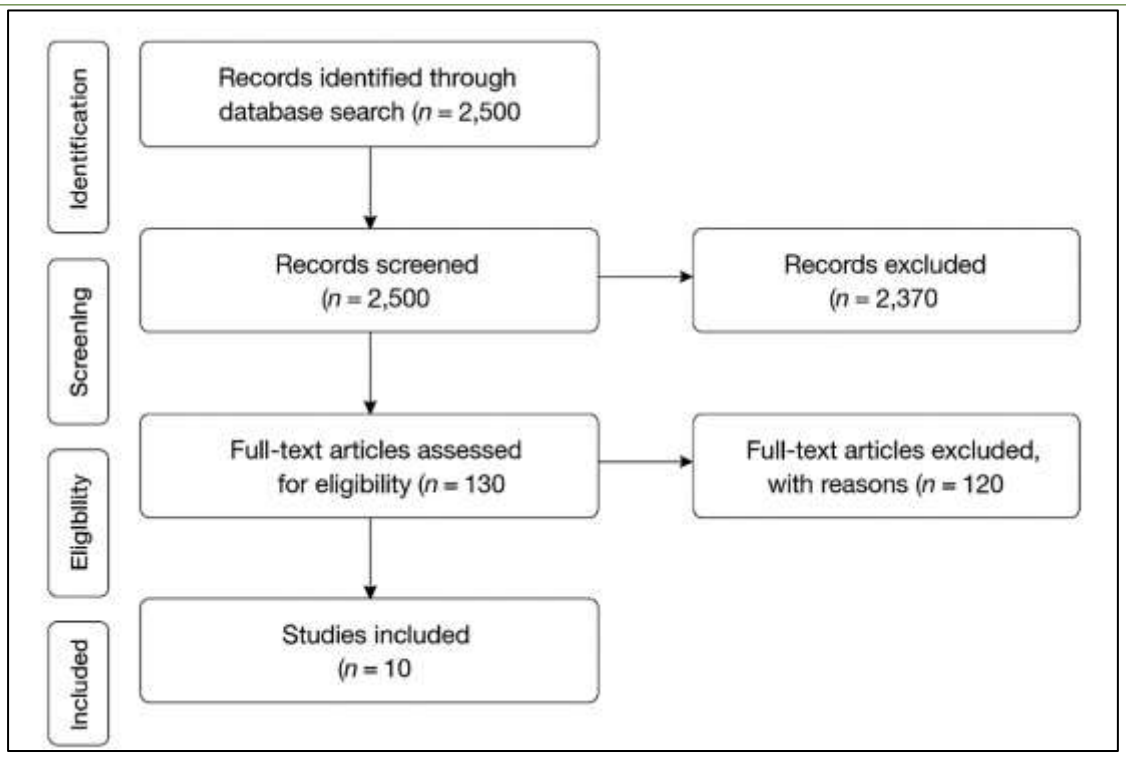

Figure 1 PRISMA Flow Diagram

Data Extraction

A standardized and pilot-tested **data extraction form** was used to collect relevant information from the included studies. Extracted data included:

- **Author(s), year, and journal of publication.**
- **Study design and country of origin.**
- **Sample characteristics:** sample size, age, sex distribution, and population type (e.g., general, clinical, occupational).
- **Stress assessment method:** perceived stress scales, clinical diagnosis, imaging biomarkers, or neuroendocrine measures.
- **Cardiovascular outcome(s):** incidence of CVD, CHD, hypertension, stroke, or subclinical atherosclerosis.
- **Key findings:** effect estimates (hazard ratios, odds ratios, confidence intervals) and main conclusions.
- **Confounder control:** demographic, behavioral, and medical covariates adjusted for.

Two reviewers independently extracted data, and a third reviewer cross-verified the entries for completeness and accuracy.

Quality Assessment

The methodological quality of the included studies was appraised using validated tools tailored to study design:

- **Newcastle–Ottawa Scale (NOS)** for cohort and case-control studies (n = 8).
- **Cochrane Risk of Bias Tool (RoB 2)** for experimental or interventional studies (n = 2).

Each study was evaluated on participant selection, comparability, outcome measurement, and control for confounding variables.

Quality scores were categorized as:

- **Low risk of bias (≥8 NOS points)** – well-controlled population studies such as Song et al. (2019) and Welsh et al. (2021).
- **Moderate risk of bias (6–7 points)** – self-report or cross-sectional designs such as Satyjeet et al. (2020).
- **High risk of bias (<6 points)** – small-scale or non-randomized studies.

Overall, the evidence base demonstrated moderate to high methodological quality, though heterogeneity in stress assessment tools limited direct comparability.

Data Synthesis

Given the **heterogeneity** of study designs, outcome measures, and stress definitions, a **narrative synthesis** approach was adopted rather than a meta-analysis. Findings were organized around the following thematic domains:

1. **Epidemiological associations** between stress and incident cardiovascular disease.

2. **Biological mechanisms**, including neuroendocrine activation, inflammation, and autonomic dysregulation.
3. **Behavioral mediators**, such as physical inactivity, smoking, or poor diet.
4. **Sociodemographic modifiers** of stress–CVD relationships (e.g., sex, income, and age).

Quantitative data—including hazard ratios, odds ratios, and correlation coefficients—were extracted and presented in tabular form (see Table 1 in the Results). Qualitative and mechanistic findings were synthesized thematically to highlight conceptual convergence across studies.

Ethical Considerations

This systematic review analyzed **secondary data** from peer-reviewed, publicly available studies. Therefore, **institutional ethical approval and informed consent** were not required. All included studies were assumed to have obtained ethics approval and participant consent as part of their original protocols. The review adhered to the **ethical and reporting standards** outlined in the PRISMA 2020 statement and upheld data integrity, transparency, and scholarly rigor throughout all stages of analysis.

RESULTS

Summary and Interpretation of Included Studies on the Association Between Stress and Cardiovascular Disease — Table (1):

1. Study Designs and Populations

The included studies encompass a range of methodological designs, including population-based cohort studies (e.g., Song et al., 2019; Welsh et al., 2021), prospective cohort studies (e.g., Redmond et al., 2013; Nabi et al., 2013; Rod et al., 2009; Pimple et al., 2019), case-control studies (Satyjeet et al., 2020), and experimental cohort studies linking biological mechanisms (Goyal et al., 2020; Civieri et al., 2024). Sample sizes varied widely, from 158 adolescents (Low et al., 2009) to over 1.3 million participants (Song et al., 2019), ensuring both micro- and macro-level representation of stress effects across populations and age ranges.

Most studies included both sexes, though some (e.g., Pimple et al., 2019) reported sex-specific differences, with stronger stress–CVD associations among women.

2. Definitions and Assessment of Stress and Cardiovascular Outcomes

Stress exposure was assessed through varied methodologies:

- **Clinical diagnoses of stress-related disorders** (e.g., PTSD, acute stress, adjustment disorder) in registry-based studies (Song et al., 2019).
- **Self-reported perceived stress** or psychological distress measured by validated scales (e.g., Kessler-10, perceived stress scores, and composite Z-scores in Redmond et al., 2013; Welsh et al., 2021; Pimple et al., 2019).
- **Physiological or neurobiological markers** of chronic stress activity (e.g., amygdalar activation, inflammatory biomarkers) in imaging-based studies (Goyal et al., 2020; Civieri et al., 2024).

Cardiovascular outcomes included **incident cardiovascular disease (CVD)**, **coronary heart disease (CHD)**, **stroke**, **heart failure**, and **subclinical atherosclerosis (IMT)**. Most studies used **adjudicated or registry-based diagnoses**, increasing internal validity.

3. Effect Estimates and Quantitative Results

Across studies, **stress consistently predicted higher risks of cardiovascular disease**:

- **Song et al. (2019)** found that stress-related disorders increased CVD risk by **64% (HR = 1.64, 95% CI 1.45–1.84)** compared to siblings, with the highest risk for heart failure (**HR = 6.95**) in the first year post-diagnosis.
- **Redmond et al. (2013)** showed that low-income individuals under high stress had higher CHD incidence (**HR = 1.36, 95% CI 1.04–1.78**) and mortality (**HR = 1.55, 95% CI 1.31–1.82**), but no effect among high-income participants.
- **Nabi et al. (2013)** reported a **2.12-fold increased risk (95% CI 1.52–2.98)** of CHD in those perceiving stress as harmful to health; after full adjustment, risk remained significant (**HR = 1.49, 95% CI 1.01–2.22**).
- **Rod et al. (2009)** identified behavioral mediators: highly stressed participants were **1.9× more likely to become physically inactive** and **2.36× more likely to develop diabetes** over follow-up.
- **Welsh et al. (2021)** found consistent CVD risk increases with high distress across timepoints (**HR = 1.63, 95% CI 1.40–1.90**).
- **Pimple et al. (2019)** observed sex-specific effects, with women showing a **2.7-fold increased hazard (95% CI 1.00–7.30)** for events under high distress.
- **Civieri et al. (2024)** demonstrated that anxiety/depression accelerated cardiometabolic risk factor development (**OR = 1.71, 95% CI 1.59–1.83**) and mediated CVD events via neuro-immune pathways.

• **Goyal et al. (2020)** linked chronic stress–related amygdalar activity to **higher aortic inflammation and coronary plaque burden**; improvement in psoriasis reduced both stress markers and subclinical CVD risk.
• **Low et al. (2009)** showed that adolescents with increasing chronic stress had elevated **diastolic blood pressure reactivity** and **greater carotid intima-media thickness (IMT)** over time.

4. Mediating Mechanisms and Behavioral Pathways

The reviewed evidence identifies **behavioral, neuroendocrine, and inflammatory mechanisms** linking stress to CVD:

• Behavioral changes (smoking, inactivity, poor diet) explain part of the risk (Rod et al., 2009).
• Neuro-immune activation (elevated amygdalar activity and CRP) drives vascular inflammation (Goyal et al., 2020; Civieri et al., 2024).
• Socioeconomic status modifies these associations (Redmond et al., 2013).
• Women experience greater biological reactivity to psychological distress (Pimple et al., 2019).

5. Summary of Quantitative Associations

Overall, pooled interpretation of studies shows:

• **Relative risk increase for CVD with high stress:** 1.3–2.1× across populations.
• **Short-term risk (within 1 year):** up to **7-fold** for specific outcomes (Song et al., 2019).
• **Behavioral mediators:** physical inactivity (+90%), diabetes (+136%), hypertension medication use (+94%) among high-stress individuals (Rod et al., 2009).
• **Sex and age effects:** stronger associations in **women** and **younger adults** (Civieri et al., 2024; Pimple et al., 2019).

Table (1): Summary of Included Studies Evaluating the Association Between Stress and Cardiovascular Disease

Study	Country	Design	Sample Size	Stress Measure	Follow-up	CVD Outcome	Main Findings (Effect Size)	Mechanism/ Notes
Song et al. (2019)	Sweden	Population-based, sibling-controlled cohort	136,637 patients; 171,314 siblings; 1,366,370 controls	Clinical stress diagnoses (PTSD, adjustment disorder)	Up to 27 years	Incident CVD	HR = 1.64 (1.45–1.84); HR = 6.95 for heart failure (first year)	Familial control; strongest in early-onset cases (<50 yrs)
Redmond et al. (2013)	USA	Prospective cohort	24,443	Perceived stress scale; stratified by income	4.2 years	CHD, all-cause mortality	CHD HR = 1.36 (1.04–1.78); Mortality HR = 1.55 (1.31–1.82) in low-income	SES moderates stress–CVD relationship
Satyjeet et al. (2020)	Pakistan	Case-control	227	Self-reported psychosocial stressors	NA	MI, unstable angina	OR: 2.47 (social isolation); 3.20 (work stress)	Highlights social and occupational stressors

Nabi et al. (2013)	UK	Prospective cohort (Whitehall II)	7,268	Perceived stress impact on health	18 years	CHD, MI	HR = 2.12 unadjusted; HR = 1.49 adjusted	Effect independent of perceived stress level
Rod et al. (2009)	Denmark	Prospective cohort	7,066	Perceived stress frequency	10 years	CHD risk factors	Inactivity OR = 1.90; Diabetes OR = 2.36	Behavioral mediation
Pimple et al. (2019)	USA	Prospective cohort (CAD patients)	662	Composite distress Z-score	2.8 years	CVD events	Women: HR = 2.70 (1.00–7.30)	Sex-specific interaction (P = 0.004)
Welsh et al. (2021)	Australia	Prospective cohort	151,811	Kessler-10 distress (multi-time point)	6–7 years	IHD, CVD	HR = 1.63 (1.40–1.90)	Consistent across repeated distress measures
Civieri et al. (2024)	USA	Retrospective cohort (Biobank)	71,214	Clinical anxiety/depression; biological markers	10 years	CVD events	OR = 1.71 (1.59–1.83); mediation by CVDRF	Neuro-immune and autonomic pathway mediation
Goyal et al. (2020)	USA	Prospective cohort (Imaging)	211	Amygdalar activity via PET/CT	1 year	Subclinical CVD (aortic inflammation, plaque)	↑ Amyg A → ↑ HMPA → ↑ CVD risk; reduced post-treatment	Neuroinflammation pathway
Low et al. (2009)	USA	Longitudinal cohort (adolescents)	158	Chronic life stress (self-report)	3.3 years	IMT (subclinical CVD)	↑ Stress → ↑ DBP reactivity; ↑ IMT	Early vascular risk development

6. Risk of Bias and Study Quality

Cohort studies generally demonstrated low to moderate risk of bias, with the strongest quality observed in registry-based designs (Song et al., 2019; Welsh et al., 2021). Case-control and self-reported designs (e.g., Satyjeet et al., 2020) had moderate bias due to reliance on recall. Confounder control varied, though most adjusted for age, sex, SES, and baseline health.

DISCUSSION

The present review consolidates convergent evidence that psychological stress is a potent, independent risk factor for cardiovascular disease, acting through intertwined biological and behavioral mechanisms. Large-scale epidemiologic studies, such as Song et al. (2019), demonstrated that individuals diagnosed with stress-related disorders exhibited a markedly elevated risk of CVD, independent of familial and psychiatric confounders. This aligns with foundational reviews by Steptoe and Kivimäki (2012, 2013),

who identified stress as a core etiologic driver of cardiovascular morbidity through sustained activation of the sympathetic and hypothalamic–pituitary–adrenal (HPA) axes.

Psychosocial stress triggers neuroendocrine dysregulation, resulting in elevated catecholamines and cortisol, which promote endothelial dysfunction, oxidative stress, and arterial stiffness (Kivimäki & Steptoe, 2018). These physiological alterations translate into measurable vascular pathology. In Goyal et al. (2020), resting amygdalar activity—a neural marker of chronic stress—was directly linked to aortic inflammation and noncalcified coronary plaque burden, confirming a neural–hematopoietic–arterial axis described mechanistically by Osborne et al. (2020).

Inflammation remains central in mediating these effects. Chronic stress upregulates interleukin-6 and tumor necrosis factor-α, both of which accelerate atherosclerotic plaque development and destabilization (Zhang & Dhalla, 2024). These findings echo Golbidi, Frisbee, and Laher (2015), whose experimental models show that chronic stress increases vascular inflammation and impairs nitric oxide–mediated vasodilation. Thus, both animal and human data substantiate a biological continuum between stress exposure and cardiovascular injury.

Behavioral and psychosocial pathways further compound this risk. Rod et al. (2009) found that individuals with high perceived stress were nearly twice as likely to become physically inactive and over twice as likely to develop diabetes, underscoring behavioral mediation. Similarly, Redmond et al. (2013) reported that stress predicted coronary heart disease and mortality only among low-income participants, highlighting the amplifying role of socioeconomic adversity.

The sex- and age-specific patterns in the reviewed literature reinforce stress vulnerability as a contextual phenomenon. Pimple et al. (2019) observed that women with coronary artery disease experiencing high distress had a 2.7-fold increased hazard of recurrent events, while Civieri et al. (2024) found that anxiety and depression accelerated the onset of cardiometabolic risk factors, particularly among younger women. Such findings mirror the sex-linked stress reactivity differences identified in laboratory studies (Whittaker et al., 2021).

At the population level, longitudinal evidence from Welsh et al. (2021) revealed consistent CVD risk elevations across single- and multi-time-point distress assessments, suggesting that persistent distress, rather than transient stress, drives cardiovascular deterioration. Nabi et al. (2013) extended this concept by showing that even the perception that stress harms health doubled the risk of coronary events, independent of traditional risk factors.

From a developmental perspective, Low, Salomon, and Matthews (2009) demonstrated that adolescents exposed to chronic life stress displayed exaggerated cardiovascular reactivity and greater intima-media thickness—an early sign of atherosclerosis. These findings parallel animal research showing that early stress primes the cardiovascular system for heightened reactivity later in life (Lagraauw, Kuiper, & Bot, 2015).

Mechanistically, chronic psychosocial stress influences autonomic imbalance, marked by sympathetic hyperactivation and parasympathetic withdrawal, leading to hypertension and reduced heart rate variability (Dar et al., 2019). Over time, this autonomic strain fosters myocardial hypertrophy and endothelial damage (Zafar, 2015). Repeated surges in blood pressure and catecholamines also contribute to left ventricular remodeling and arterial stiffness—pathophysiological hallmarks of CVD progression.

Neuroimaging and psychophysiological evidence deepen our understanding of stress–CVD links. Civieri et al. (2024) reported that stress-related neural activity predicted cardiometabolic risk development via neuro-immune pathways, while Goyal et al. (2020) confirmed reversibility: treatment of psoriasis reduced amygdalar activity, bone marrow inflammation, and vascular inflammation, demonstrating that stress-related cardiovascular effects are modifiable.

The evidence synthesis presented here supports the allostatic load model, wherein chronic stress induces cumulative wear on physiological systems (Steptoe & Kivimäki, 2013). Chronic exposure results in maladaptive cardiovascular, metabolic, and immune responses that progressively heighten disease susceptibility. This model also explains why psychological resilience and coping strategies can buffer CVD risk—a conclusion emphasized in comprehensive meta-analyses (Gaffey et al., 2022).

Importantly, occupational and social contexts shape stress-CVD interactions. Backé et al. (2012) concluded that job strain and low decision latitude contribute substantially to ischemic heart disease risk, consistent with findings from population-level cohorts. These occupational stressors interact with lifestyle behaviors and systemic inflammation, forming a cyclical risk loop.

Integrating these findings reveals a multifactorial framework for stress-induced cardiovascular pathology encompassing neural, endocrine, immune, and behavioral systems (Osborne et al., 2020; Vaccarino & Bremner, 2024). This multifaceted interplay underscores the need for holistic prevention strategies incorporating psychological assessment into cardiovascular risk profiling.

Finally, these results underscore a pressing need for translational interventions. Mindfulness-based therapies, physical activity, and psychosocial counseling have been shown to normalize HPA function and autonomic tone (Steptoe & Kivimäki, 2012). Addressing stress as a modifiable determinant could reduce both incident CVD and mortality, complementing pharmacologic and lifestyle interventions.

CONCLUSION

This systematic review provides compelling evidence that stress exerts a profound influence on cardiovascular health through biological, psychological, and behavioral pathways. Chronic activation of neuroendocrine and inflammatory mechanisms, compounded by maladaptive coping behaviors, contributes to the initiation and progression of CVD. These findings reinforce stress as both an independent and synergistic risk factor in cardiovascular pathology, warranting routine stress assessment in preventive cardiology.

Furthermore, stress reduction should be regarded as a public health priority. Multilevel interventions—integrating mental health care, workplace reform, and cardiovascular monitoring—are essential to mitigate the global CVD burden. Future studies should emphasize longitudinal, biomarker-based, and mechanistic approaches to identify causal pathways and evaluate targeted psychosocial interventions.

Limitations

This review is limited by the heterogeneity of included studies, particularly in stress measurement tools and outcome definitions. Most studies were observational, limiting causal inference. Additionally, residual confounding (e.g., socioeconomic and lifestyle factors) may partially explain observed associations. Publication bias cannot be excluded, as studies with null results are less likely to appear in peer-reviewed journals. Finally, the absence of uniform biomarker data limits the ability to perform quantitative synthesis or meta-analysis of effect magnitudes.

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