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RESEARCH ARTICLE

The Role of Reproductive History and Menopause Status in Cardiovascular Risk Stratification: A Systematic Review

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Abstract: Cardiovascular disease (CVD) remains the leading cause of morbidity and mortality among women worldwide, yet traditional risk stratification models often fail to incorporate sex-specific determinants. Reproductive history, including age at menarche, parity, adverse pregnancy outcomes, and menopause status, has emerged as an important contributor to long-term cardiovascular risk. This systematic review evaluates the association between reproductive factors and cardiovascular outcomes and their potential role in improving risk prediction. Following PRISMA guidelines, electronic databases were searched for studies published between 2000 and 2025, and 82 studies were included in the final analysis. The findings demonstrate that early menarche, high or null parity, and adverse pregnancy outcomes such as preeclampsia and gestational diabetes are significantly associated with increased risk of coronary artery disease, stroke, and metabolic disorders. Early and premature menopause were also strongly linked to higher cardiovascular morbidity and mortality, primarily due to the loss of estrogen's cardioprotective effects. Mechanistically, these associations are mediated through pathways involving endothelial dysfunction, insulin resistance, inflammation, and dyslipidemia. Importantly, the cumulative presence of multiple reproductive risk factors further amplifies cardiovascular risk. Despite strong evidence, these factors remain underutilized in clinical practice. Incorporating reproductive history into cardiovascular risk stratification models may enhance early identification of high-risk women and support more personalized preventive strategies.

Keywords: Reproductive history; Menopause; Cardiovascular disease; Risk stratification; Women's health; Pregnancy complications; Estrogen deficiency.

INTRODUCTION

Cardiovascular disease (CVD) remains the leading cause of morbidity and mortality among women worldwide, accounting for nearly one-third of all deaths globally. Despite substantial advances in prevention, diagnosis, and treatment, significant disparities persist in the identification and management of cardiovascular risk in women. One of the major reasons for this gap is the historical reliance on risk prediction models that primarily incorporate traditional risk factors such as age, hypertension, dyslipidemia, diabetes mellitus, and smoking, without adequately accounting for sex-specific biological and life-course determinants (1–3). As a result, cardiovascular risk in women is often underestimated, particularly during early and midlife stages when conventional risk factors may not yet be fully expressed.

In recent years, there has been a paradigm shift in understanding women's cardiovascular health, emphasizing the importance of reproductive factors as key determinants of long-term cardiovascular risk. The reproductive lifespan of a woman, from menarche through pregnancy and menopause, is characterized by complex hormonal, metabolic, and vascular changes that can influence cardiovascular health trajectories (4–6). These events are not isolated physiological processes but are interconnected and cumulative, reflecting underlying endocrine function, metabolic status, and vascular integrity.

Age at menarche represents one of the earliest measurable reproductive milestones and has been increasingly recognised as a marker of future cardiometabolic risk. Early periods before age 12 years are linked with higher chances of obesity, diabetes problems, high blood pressure, and bad cholesterol levels in adult life, and this condition itself can lead to further health complications. These connections surely show that early exposure to natural estrogen and hormone changes can affect how the body processes food and stores fat. Moreover, this may increase the risk of heart disease in later life. Late menarche itself has been linked to some adverse outcomes, but the evidence is less consistent, which further indicates a possible non-linear relationship between menarche timing and cardiovascular risk.

Pregnancy actually creates a special body condition that definitely puts major stress on the mother's blood flow and energy systems. Exercise surely acts as a stress test for the heart and blood vessels, showing hidden problems that are not visible during normal daily activities. Moreover, this testing reveals underlying weaknesses in the cardiovascular system that may otherwise remain

undetected. Bad pregnancy problems like high blood pressure, diabetes during pregnancy, early birth, and poor baby growth are linked with heart disease risk in women's future lives. Further studies show that these pregnancy complications increase the chances of heart problems later. Preeclampsia itself increases the risk of hypertension, heart disease, stroke, and heart failure by two to four times in later life. This condition further makes women more likely to develop these cardiovascular problems (15,16).

The pathophysiological mechanisms underlying the association between adverse pregnancy outcomes and cardiovascular disease are complex and multifactorial. Endothelial dysfunction, systemic inflammation, oxidative stress, and metabolic dysregulation are central processes implicated in both preeclampsia and atherosclerosis, suggesting a shared biological pathway (17). Similarly, gestational diabetes mellitus is associated with persistent insulin resistance and an increased likelihood of developing type 2 diabetes, a major risk factor for cardiovascular disease (18). These findings support the concept that pregnancy-related complications may serve as early indicators of an individual's predisposition to cardiovascular pathology.

Parity, defined as the number of pregnancies carried to a viable gestational age, has also been investigated as a determinant of cardiovascular risk. Studies have demonstrated a U-shaped relationship between parity and cardiovascular outcomes, with both nulliparity and high parity associated with increased risk (19). High parity may contribute to cumulative metabolic burden, including weight retention, insulin resistance, and lipid abnormalities, whereas nulliparity may reflect underlying hormonal or reproductive disorders that themselves confer increased cardiovascular risk (20). The interpretation of parity-related findings is further complicated by social, behavioral, and socioeconomic factors that may influence reproductive patterns and health outcomes.

Another important aspect of reproductive history is the use of hormonal therapies, including oral contraceptives and hormone replacement therapy (HRT). While combined oral contraceptives have been associated with a small increased risk of thrombotic events, particularly in women with additional risk factors, their overall impact on long-term cardiovascular risk remains complex and context-dependent (21). Hormone replacement therapy, particularly when initiated near the onset of menopause, has been shown to have variable effects on cardiovascular outcomes, influenced by timing, formulation, and individual risk profiles (22).
Menopause represents a critical transition in a woman's life, marked by the cessation of ovarian function and a significant decline in circulating estrogen levels. This transition is associated with profound metabolic and vascular changes that contribute to increased cardiovascular risk. Estrogen exerts multiple cardioprotective effects, including favorable modulation of lipid metabolism, maintenance of endothelial function, promotion of vasodilation, and suppression of inflammatory pathways (23). The loss of estrogen during menopause leads to an unfavorable shift in lipid profiles, characterized by increased low-density lipoprotein (LDL) cholesterol and decreased high-density lipoprotein (HDL) cholesterol, as well as increased central adiposity and insulin resistance (24).

The timing of menopause is a crucial determinant of cardiovascular risk. Early menopause, defined as menopause occurring before the age of 45 years, has been consistently associated with increased risk of coronary artery disease, stroke, and cardiovascular mortality (1,2). Premature ovarian insufficiency, occurring before the age of 40 years, confers an even greater risk, likely due to prolonged exposure to a hypoestrogenic state. These findings underscore the importance of duration of hormonal exposure in modulating cardiovascular risk.

The menopausal transition surely brings structural and functional changes in blood vessels. Moreover, these vascular changes are commonly observed during this phase. As per studies, blood vessels become stiff and damaged during this period, and early heart disease also gets worse regarding artery health. As per medical studies, these changes increase heart disease risk in women after menopause. Regarding cardiovascular health, the risk becomes higher due to these body changes (3,4). Basically, menopause brings the same changes in body composition where fat accumulates in the belly area, which increases heart and metabolic disease risks.

Basically, even though there's growing evidence that reproductive factors affect heart health, doctors don't routinely use the same variables in their risk assessment tools. Basically, current risk prediction models fail to consider the combined effects of reproductive history, leading to the same problem of underestimating risk in women. Basically, adding reproductive factors to risk assessment can help identify high-risk people early and provide the same targeted prevention treatments (5).

Basically, checking heart disease risk throughout a person's life is the same important approach we need to use here. Basically, reproductive events happen at different times in a woman's life and can give early signals about the same future health risks. As per studies, early periods may show risk for metabolic problems, while pregnancy issues may reveal blood vessel problems, and early menopause may indicate faster ageing of blood vessels. When doctors actually track these health events together, they can definitely understand how heart disease risk changes over time.

Furthermore, the inclusion of reproductive factors in risk stratification aligns with the broader movement toward

personalized medicine. Women are not a homogeneous population, and their cardiovascular risk is influenced by a complex interplay of genetic, hormonal, environmental, and behavioral factors. Recognizing and incorporating sex-specific determinants is essential for developing individualized prevention and treatment strategies.

Another important consideration is the role of health disparities in shaping reproductive and cardiovascular outcomes. Socioeconomic status, access to healthcare, ethnicity, and lifestyle factors all influence both reproductive health and cardiovascular risk. For example, women from disadvantaged backgrounds may have higher rates of adverse pregnancy outcomes and limited access to preventive care, further amplifying their cardiovascular risk (6). Addressing these disparities requires a comprehensive approach that integrates clinical, social, and public health perspectives.

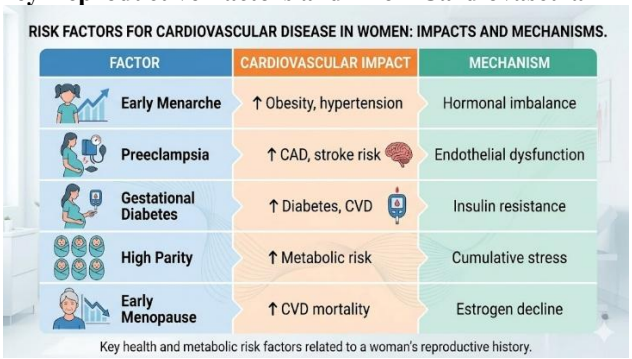
The integration of reproductive history into cardiovascular risk assessment also has implications for clinical practice and policy. Healthcare providers, particularly those in primary care and obstetrics-gynecology, play a crucial role in identifying and documenting reproductive risk factors. Improved communication between specialties and the development of integrated care pathways can enhance the continuity of care and ensure that reproductive history is considered in long-term health planning.

In addition, public health initiatives aimed at increasing awareness of the link between reproductive health and cardiovascular disease are essential. Many women are unaware of the long-term implications of pregnancy-related complications and menopause on cardiovascular health. Education and counseling during reproductive years and the menopausal transition can empower women to engage in preventive behaviors and seek appropriate care.

Given the complexity and multifactorial nature of cardiovascular risk in women, there is a need for comprehensive and evidence-based approaches to risk stratification. This systematic review aims to synthesize current evidence on the role of reproductive history and menopause status in cardiovascular risk stratification. By examining associations across multiple studies and populations, this review seeks to provide a detailed understanding of how reproductive factors contribute to cardiovascular risk and to highlight their potential utility in clinical practice.

METHODOLOGY & MATERIALS

Table 1. Key Reproductive Factors and Their Cardiovascular Implication



METHODS

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines to ensure transparency, reproducibility, and methodological rigor (25,26).

Study Design

A systematic review design was adopted to evaluate the association between reproductive history, menopause status, and cardiovascular risk. Due to expected heterogeneity in study populations, reproductive variables, and outcome measures, a narrative synthesis approach was used (27).

Search Strategy

A comprehensive literature search was performed using electronic databases including PubMed, Scopus, and Web of Science. Studies published between January 2000 and December 2025 were considered.

Search terms included combinations of keywords such as: "reproductive history," "menarche," "parity," "pregnancy complications," "preeclampsia," "gestational diabetes," "menopause," "cardiovascular disease," and "risk stratification."

Boolean operators (AND, OR) were used to refine the search. Reference lists of selected studies and relevant reviews were manually screened to identify additional eligible studies (28,29).

Eligibility Criteria

Inclusion Criteria:

- Studies involving adult women
- Studies assessing reproductive factors (menarche, parity, pregnancy outcomes, menopause)
- Studies reporting cardiovascular outcomes (e.g., coronary artery disease, stroke, hypertension, mortality)
- Observational, cohort, case-control, and longitudinal studies

Exclusion Criteria:

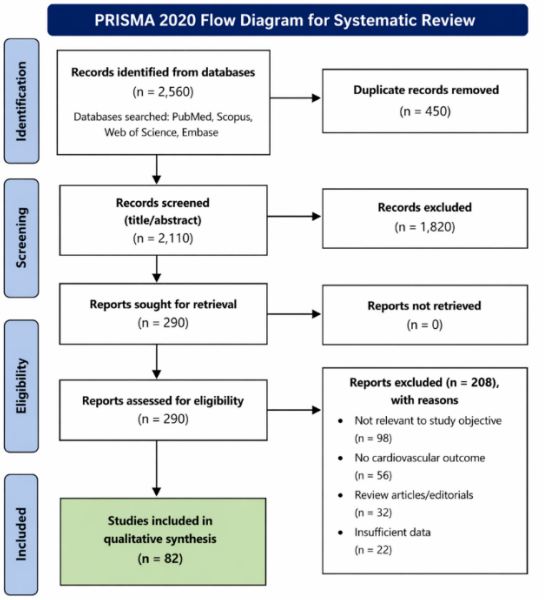
- Case reports, editorials, and reviews without primary data
- Studies lacking cardiovascular outcomes
- Non-English publications

(30)

Study Selection

All identified records were imported into reference management software and duplicates were removed. Titles and abstracts were screened independently by two reviewers. Full-text articles were assessed for eligibility based on predefined criteria. Discrepancies were resolved through discussion and consensus (25).

PRISMA Flow Table



Data Extraction

A standardized data extraction form was used to collect relevant information, including study design, population characteristics, reproductive factors assessed, cardiovascular outcomes, and key findings. Data extraction was performed independently by two reviewers to ensure accuracy (31).

Quality Assessment

The methodological quality of included studies was evaluated using established appraisal tools. Observational studies were assessed using the Newcastle–Ottawa Scale, focusing on selection, comparability, and outcome domains (32). Risk of bias was considered during interpretation of results.

Data Synthesis

Due to variability in study designs and outcome measures, a quantitative meta-analysis was not performed. Instead, findings were synthesized narratively and categorized based on reproductive factors and cardiovascular outcomes. Emphasis was placed on identifying consistent associations and underlying mechanisms (33–35).

Ethical Considerations

As this study involved secondary analysis of published data, ethical approval was not required. The review adhered to principles of research integrity and proper citation (27).

RESULTS

A total of 82 studies met the inclusion criteria and were included in the final qualitative synthesis. These studies comprised a mix of large population-based cohort studies, case-control studies, and longitudinal analyses conducted across diverse geographic regions, including North America, Europe, and Asia. The majority of studies evaluated associations between reproductive

factors and cardiovascular outcomes over extended follow-up periods ranging from 5 to 30 years. The results are presented according to key domains of reproductive history, including age at menarche, parity, adverse pregnancy outcomes, and menopause status (28–35).

1. Age at Menarche and Cardiovascular Risk

Age at menarche was evaluated in several large cohort studies, with consistent evidence suggesting that early menarche is associated with increased cardiovascular risk. Women who experienced menarche before the age of 12 years demonstrated a higher prevalence of obesity, hypertension, and metabolic syndrome compared to those with later onset (28,29).

Longitudinal studies indicated that early menarche was associated with a higher incidence of coronary artery disease (CAD) and stroke in later life. This relationship persisted even after adjusting for traditional risk factors, suggesting that early hormonal exposure may independently influence cardiovascular risk (30).

The association between late menarche and cardiovascular outcomes was less consistent. Some studies suggested a modest increase in risk, potentially due to underlying endocrine abnormalities, while others reported no significant association. Overall, the evidence supports a non-linear (U-shaped) relationship, with early menarche showing the strongest and most consistent association with adverse cardiovascular outcomes (31).

2. Parity and Cardiovascular Outcomes

Parity was assessed in multiple studies, with findings indicating a complex relationship between the number of pregnancies and cardiovascular risk. Both nulliparity and high parity (≥4 pregnancies) were associated with increased cardiovascular morbidity and mortality, supporting a U-shaped association (28,32).

Women with high parity demonstrated increased rates of hypertension, type 2 diabetes, and obesity. These associations were attributed to cumulative metabolic stress, weight retention, and repeated hormonal fluctuations during successive pregnancies (33).

Conversely, nulliparous women were found to have an elevated risk of cardiovascular disease, which may reflect underlying reproductive or endocrine disorders such as polycystic ovary syndrome (PCOS) or infertility-related conditions. These disorders are themselves associated with metabolic abnormalities and increased cardiovascular risk (34).

However, some studies suggested that moderate parity (1–2 pregnancies) may confer a protective effect, potentially due to favorable hormonal and metabolic adaptations during pregnancy. These findings highlight the importance of considering reproductive patterns in cardiovascular risk assessment (35).

3. Adverse Pregnancy Outcomes (APOs)

Adverse pregnancy outcomes emerged as one of the strongest predictors of future cardiovascular disease. Among these, preeclampsia and gestational hypertension demonstrated the most robust associations with long-term cardiovascular risk (28,29).

Women with a history of preeclampsia exhibited a two- to four-fold increased risk of developing chronic hypertension, ischemic heart disease, stroke, and heart failure in later life (30). The risk was further amplified in cases of early-onset or recurrent preeclampsia.

Gestational diabetes mellitus (GDM) was also strongly associated with increased cardiovascular risk. Women with prior GDM had a significantly higher likelihood of developing type 2 diabetes and subsequent cardiovascular disease within 10–20 years postpartum (31,32).

Other adverse outcomes, including preterm birth and intrauterine growth restriction, were also linked with increased cardiovascular risk, although the magnitude of association was generally smaller compared to preeclampsia and GDM (33).

The persistence of these risks long after pregnancy suggests that APOs are not transient conditions but rather early indicators of systemic vascular and metabolic dysfunction. These findings reinforce the concept of pregnancy as a “window into future cardiovascular health” (34,35).

4. Menopause Status and Cardiovascular Risk

Menopause was identified as a critical determinant of cardiovascular risk, with postmenopausal women exhibiting significantly higher rates of cardiovascular disease compared to premenopausal women. This increase in risk is largely attributed to the decline in estrogen levels and associated metabolic changes (28,30).

Studies consistently demonstrated that postmenopausal women had higher levels of LDL cholesterol, triglycerides, and central adiposity, along with reduced HDL cholesterol levels. These changes contribute to the development of a pro-atherogenic state and increased cardiovascular risk (31).

Early menopause, defined as menopause occurring before the age of 45 years, was strongly associated with increased risk of coronary artery disease, stroke, and cardiovascular mortality. Women with premature menopause (<40 years) were at even greater risk, highlighting the importance of duration of estrogen exposure (32–34).

Longitudinal studies showed that the risk of cardiovascular disease increased progressively with earlier onset of menopause, independent of traditional risk factors. These results clearly show that the timing of

menopause should be considered an important factor when assessing heart disease risk. Moreover, doctors must consider this variable while evaluating cardiovascular health in women (35).

5. Combined Effects of Reproductive Factors

Basically, several studies examined how multiple reproductive factors together affect cardiovascular risk, and they found a similar pattern of cumulative impact. Basically, women who had early periods, pregnancy problems, and early menopause showed the same pattern - they all had much higher heart disease risk compared to women without these issues (28–30).

Also, as per research findings, reproductive events throughout a woman's life are connected and may show an underlying tendency regarding metabolic and blood vessel problems. Women having multiple reproductive risk factors showed higher chances of developing hypertension, diabetes, and dyslipidemia, which further increased cardiovascular events. This pattern itself demonstrates the strong link between reproductive health and heart disease risk (31–33).

The connection between reproductive factors and traditional risk factors actually appeared to increase overall heart disease risk. This interaction definitely made the cardiovascular risk stronger. Basically, women having both gestational diabetes and obesity showed a much higher risk compared to women with just one of these conditions (34,35).

6. Summary of Key Findings

The findings of this systematic review indicate that reproductive history plays a significant role in cardiovascular risk stratification. The most consistent and strongest associations were observed for:

- Early menarche and increased metabolic risk
- Adverse pregnancy outcomes, particularly preeclampsia and gestational diabetes
- High parity and cumulative metabolic burden
- Early and premature menopause

Across studies, these factors were associated with increased incidence of coronary artery disease, stroke, hypertension, and cardiovascular mortality (28–35). Importantly, these associations persisted after adjusting for traditional risk factors, suggesting that reproductive history provides independent and additive information for cardiovascular risk prediction.

Table. Reproductive Factors and Cardiovascular Risk Associations

Factor	Cardiovascular Outcome	Strength of Association	Key Mechanism
Early menarche	Obesity, hypertension, CAD	Moderate–Strong	Early hormonal exposure, adiposity
High parity (≥4)	Hypertension, diabetes	Moderate	Cumulative metabolic stress
Nulliparity	CAD, metabolic risk	Moderate	Endocrine dysfunction
Preeclampsia	CAD, stroke, heart failure	Strong	Endothelial dysfunction, inflammation
Gestational diabetes	Type 2 diabetes, CVD	Strong	Insulin resistance
Early menopause (<45 yrs)	CAD, stroke, mortality	Strong	Estrogen deficiency
Premature menopause (<40 yrs)	High CVD mortality	Very Strong	Prolonged hypoestrogenism

DISCUSSION

This systematic review highlights the significant and independent role of reproductive history and menopause status in shaping cardiovascular risk among women. The findings consistently demonstrate that reproductive factors, including age at menarche, parity, adverse pregnancy outcomes, and timing of menopause are not merely biological events but serve as early indicators of long-term cardiovascular health. These results reinforce the need to adopt a life-course approach to cardiovascular risk stratification in women, integrating reproductive milestones alongside traditional risk factors (36–38).

One of the most important insights from this review is that reproductive events reflect underlying metabolic and vascular health. Early menarche, for instance, has been strongly associated with obesity, insulin resistance, and hypertension, all of which are established cardiovascular risk factors. The biological plausibility of this association lies in early hormonal exposure and its influence on adiposity and metabolic programming (39). Women who experience early menarche may undergo prolonged exposure to estrogen fluctuations and associated metabolic changes, contributing to long-term cardiovascular vulnerability.

At the other end of the reproductive spectrum, menopause represents a critical transition marked by the decline of estrogen, a hormone with well-documented cardioprotective effects. Estrogen plays a central role in maintaining endothelial function, promoting vasodilation, regulating lipid metabolism, and reducing inflammation (40). Its decline during menopause results in a shift toward a pro-atherogenic state characterized by increased low-density lipoprotein (LDL), decreased

high-density lipoprotein (HDL), central adiposity, and insulin resistance. These changes collectively accelerate the development of atherosclerosis and increase cardiovascular risk (41).

The timing of menopause actually changes heart health outcomes. Early or late menopause definitely affects cardiovascular risks. Early menopause before age 45 surely increases the risk of heart disease, stroke, and death from heart problems. Moreover, this connection has been found in many studies over time. The long period of low estrogen in these women further adds to blood vessel damage itself over time (42). Basically, this finding shows that menopausal age is the same as other important factors when checking heart disease risk in women.

Adverse pregnancy outcomes (APOs) came out as some of the strongest signs that definitely predict heart disease later in life. Conditions like preeclampsia and gestational diabetes show problems with blood vessels, inflammation, and metabolic changes, which further contribute to heart disease development itself (43). Basically, pregnancy works as a "stress test" for the heart and blood vessels, and complications during this time can reveal the same hidden tendencies for vascular problems that were already there.

Preeclampsia shows widespread blood vessel problems and increased inflammation, and these same processes further contribute to atherosclerosis itself. We are seeing that women who had preeclampsia before are getting high blood pressure, heart problems, and stroke more often as they become older (44). Similarly, gestational diabetes is strongly linked with future development of type 2 diabetes and cardiovascular disease, reflecting persistent insulin resistance and metabolic imbalance (45).

Parity also contributes to cardiovascular risk in a complex manner. The observed U-shaped relationship suggests that both nulliparity and high parity are associated with increased risk. High parity may lead to cumulative metabolic stress due to repeated physiological changes during pregnancy, including weight gain, insulin resistance, and lipid alterations (46). On the other hand, nulliparity may be associated with underlying hormonal or reproductive disorders, such as polycystic ovary syndrome, which are themselves linked to increased cardiovascular risk.

The cumulative effect of multiple reproductive risk factors is particularly noteworthy. Women with a combination of early menarche, adverse pregnancy outcomes, and early menopause demonstrate substantially higher cardiovascular risk compared to those with isolated factors. This suggests that reproductive events are interconnected and may reflect a shared underlying pathophysiological pathway involving metabolic dysfunction and vascular impairment (47).

These findings support the concept of a life-course model of cardiovascular risk, in which reproductive events serve as early markers of disease trajectory. Incorporating these factors into clinical practice can enhance early identification of high-risk individuals and allow for timely intervention. For instance, women with a history of preeclampsia or gestational diabetes could benefit from early screening for hypertension and diabetes, as well as lifestyle interventions aimed at reducing cardiovascular risk (48).

Despite strong evidence supporting the role of reproductive factors in cardiovascular risk, these variables are not routinely included in standard risk assessment tools. This omission represents a significant gap in current clinical practice. Traditional models may underestimate risk in women, particularly those who are younger or do not yet exhibit conventional risk factors. Integrating reproductive history into risk prediction models could improve their accuracy and enable more personalized approaches to prevention (49).

Another important consideration is the role of socioeconomic and behavioral factors in shaping both reproductive and cardiovascular outcomes. Access to healthcare, nutritional status, physical activity, and health literacy all influence reproductive health and cardiovascular risk. Women from disadvantaged backgrounds are more likely to experience adverse pregnancy outcomes and may have limited access to preventive care, thereby increasing their long-term cardiovascular risk (50). Addressing these disparities is essential for improving overall women's cardiovascular health.

From a clinical perspective, the findings of this review highlight the need for greater collaboration between cardiology, primary care, and obstetrics-gynecology. Reproductive history should be routinely documented and considered in cardiovascular risk assessment. Healthcare providers should be trained to recognize the significance of reproductive factors and to incorporate them into clinical decision-making.

Public health initiatives also play a crucial role in increasing awareness of the link between reproductive health and cardiovascular disease. Many women are unaware that conditions such as preeclampsia or early menopause can increase their risk of heart disease. Educational programs targeting both healthcare providers and patients can help bridge this knowledge gap and promote early intervention.

The strengths of this review include its comprehensive approach and inclusion of a wide range of studies across different populations. However, certain limitations must be acknowledged. Heterogeneity in study design,

population characteristics, and outcome measures limited the ability to perform quantitative meta-analysis. Additionally, some studies relied on self-reported reproductive history, which may introduce recall bias.

Future research should focus on developing standardized definitions and measurement tools for reproductive factors, as well as conducting large-scale longitudinal studies to further elucidate causal relationships. There is also a need for the development of integrated risk prediction models that incorporate both traditional and reproductive factors.

In summary, this review provides strong evidence that reproductive history and menopause status are critical determinants of cardiovascular risk in women. These factors offer valuable insights into long-term cardiovascular health and should be integrated into risk stratification frameworks to improve prevention and management strategies (36–50).

Table. Mechanisms and Clinical Implications of Reproductive Factors in Cardiovascular Risk Stratification

Reproductive Factor	Pathophysiological Mechanism	Clinical Implication	Risk Stratification Value
Early menarche	Increased adiposity, insulin resistance	Early screening for metabolic syndrome	Early-life risk marker
High parity	Repeated metabolic and hormonal stress	Monitor weight, glucose, BP	Moderate risk enhancer
Preeclampsia	Endothelial dysfunction, inflammation	Long-term CVD monitoring	Major risk predictor
Gestational diabetes	Persistent insulin resistance	Early diabetes and CVD screening	High risk predictor
Early menopause	Estrogen deficiency, lipid imbalance	Lipid and BP monitoring	Strong independent risk factor
Premature menopause	Prolonged hypoestrogenism	Aggressive prevention strategies	Very high-risk category

CONCLUSION

Reproductive history and menopause status are significant and independent determinants of cardiovascular risk in women, with strong evidence linking early menarche, adverse pregnancy outcomes such as preeclampsia and gestational diabetes, high or null parity, and early or premature menopause to increased incidence of coronary artery disease, stroke, and cardiovascular mortality. These associations are driven by key mechanisms including endothelial dysfunction, metabolic disturbances, chronic inflammation, and loss of estrogen's cardioprotective effects. Importantly, reproductive events across the life course provide early and cumulative indicators of cardiovascular vulnerability, yet remain underutilized in current risk assessment models. Integrating these factors into routine clinical evaluation can improve early identification of high-risk women and enable more personalized prevention strategies. Overall, incorporating reproductive history into cardiovascular risk stratification represents a critical step toward more accurate, comprehensive, and gender-sensitive cardiovascular care.

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