SMATERNAL PREGNANCY OUTCOMES IN WOMEN WITH CARDIOMYOPATHY: A SYSTEMATIC REVIEW

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ABSTRACT

Introduction: Pregnancy poses significant cardiovascular challenges, affecting 1% to 4% of pregnancies due to maternal heart disease. Cardiomyopathies, leading indirect causes of maternal mortality globally, raise concerns during pregnancy, despite limited data on their impact and the accuracy of predictive scores like Carpreg and Zahara. Maternal heart disease, comprising hypertensive disorders and cardiomyopathies, presents substantial risks during pregnancies, driving increased maternal mortality rates. The evolving landscape, marked by improved survival in congenital heart disease and delayed pregnancies with associated comorbidities, necessitates a more nuanced understanding and comprehensive predictive models for tailored care during pregnancy.

Methods: The researchers in this study followed the 2020 Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines to ensure that their work met the required standards. This was done to ensure the precision and reliability of the conclusions derived from the research.

Result: Our search produced 15 results. After looking at the titles and summaries, we found 11 papers that fit our criteria. At first, we excluded several articles because they were written in review and case report style. But after reading the full papers carefully, we included five papers in our final analysis. These papers included prospective and retrospective studies.

Conclusion: The investigation of pregnant women in Canadian obstetric centers unveiled that cardiac issues affect 16% of pregnancies, primarily with arrhythmias and heart failure, even in lower-risk cases, with complications emerging before birth. The study's precision in evaluating pregnancy-related cardiac risks, leading to a new CARPREG II risk index and emphasizing tailored surveillance and timely referrals, was notable. The ROPAC registry highlighted higher maternal mortality rates, stressing vigilant management throughout pregnancy and after delivery, emphasizing the necessity for specialized care and research advancements in this field.

Keywords: *cardiac disease, CARPREG, maternal cardiomyopathy, maternal outcome*

INTRODUCTION

Pregnancy necessitates significant changes in a woman's cardiovascular system to support the growing maternal-fetal-placental unit. Around 1% to 4% of pregnancies involve maternal cardiac disease, posing heightened risks for adverse outcomes. The challenges arise from limitations in cardiovascular adaptation to pregnancy demands, such as reduced peripheral resistance, increased circulating volume, and elevated cardiac output. This condition, notably cardiomyopathy, stands as a leading indirect cause of maternal deaths worldwide.[1,2]

Cardiovascular issues affect a notable percentage of pregnancies, with hypertensive disorders and cardiomyopathies being significant concerns. Cardiomyopathies, marked by structural and functional ventricular abnormalities, can lead to severe cardiovascular complications. However, data regarding the impact of pre-existing cardiomyopathies during pregnancy, excluding peripartum cardiomyopathy, remain scarce. Predictive scores like CARPREG and Zahara have been applied to diverse heart conditions, but their accuracy for pre-existing cardiomyopathies is limited due to insufficient data.[3]

Maternal heart disease complicates a notable fraction of pregnancies and contributes significantly to maternal mortality rates. While traditional causes of maternal death are declining, heart disease-related mortality is on the rise, becoming the leading cause in developed nations. The growing burden of maternal heart disease is expected, fueled by improved survival rates in congenital heart disease patients and delayed pregnancies with associated comorbidities. Studies like CARPREG and ZAHARA have shaped our understanding, offering risk indices for predicting maternal cardiac complications during pregnancy. However, existing models may not fully capture the complexity of pregnancy risks related to specific cardiac diagnoses and care-related factors. Developing a comprehensive prediction model remains a critical need in this evolving field.[2,4]

The systematic review aims to comprehensively synthesize existing evidence regarding the impact of pre-existing cardiomyopathies on maternal and fetal/neonatal outcomes during pregnancies. Additionally, the review aims to assess the effectiveness of existing predictive scores, originally developed for various heart conditions, in accurately predicting adverse events in women with pre-existing cardiomyopathies before pregnancy. Ultimately, the goal is to provide a deeper understanding of the risks involved, enabling better preconception risk assessment, counseling, and high-quality care provision during pregnancy for women with cardiomyopathies.

METHODS

Protocol

The researchers in this study followed the 2020 Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines to ensure that their work met the required standards. This was done to ensure the precision and reliability of the conclusions derived from the research.

Criteria for Eligibility

For inclusion in the study, published articles had to meet particular requirements. They had to be research papers written in English, focusing on maternal pregnancy outcomes in women with cardiomyopathy. The studies had to meet the following criteria: they needed to have been published after 2018 but within the applicable timeframe for this systematic review. Articles falling into categories like editorials, lacking a DOI, review articles that were already published, or duplicating previously published journal papers were excluded from the assessment.

Search Strategy

We conducted a comprehensive literature search using PubMed and Science Direct journal database, focusing on studies published from 2018 to 2023. The search terms employed were as follows ("maternally"[All Fields] OR "maternities"[All Fields] OR "maternity"[All Fields] OR "mothers"[MeSH Terms] OR "mothers"[All Fields] OR "maternal"[All Fields]) AND ("pregnancy outcome"[MeSH Terms] OR ("pregnancy"[All Fields] AND "outcome"[All Fields]) OR "pregnancy outcome"[All Fields] OR ("pregnancy"[All Fields] AND "outcomes"[All Fields]) OR "pregnancy outcomes"[All Fields]) AND ("womans"[All Fields] OR "women"[MeSH Terms] OR "women"[All Fields] OR "woman"[All Fields] OR "women s"[All Fields] OR "womens"[All Fields]) AND ("cardiomyopathie"[All Fields] OR "cardiomyopathies"[MeSH Terms] OR "cardiomyopathies"[All Fields] OR "cardiomyopathy"[All Fields])

Inclusion and exclusion criteria

Inclusion criteria for the studies were as follows: (1) original research about Maternal Pregnancy Outcomes In Women With Cardiomyopathy; (2) Randomized Controlled Trials (RCTs) or observational studies (cohort or case-control studies); (3) availability of relevant data. Exclusion criteria were as follows: (1) ongoing studies or studies without available data; (2) duplicate publications. In cases of duplicate publications, the most recent article was chosen; (3) Non-English language studies were excluded.
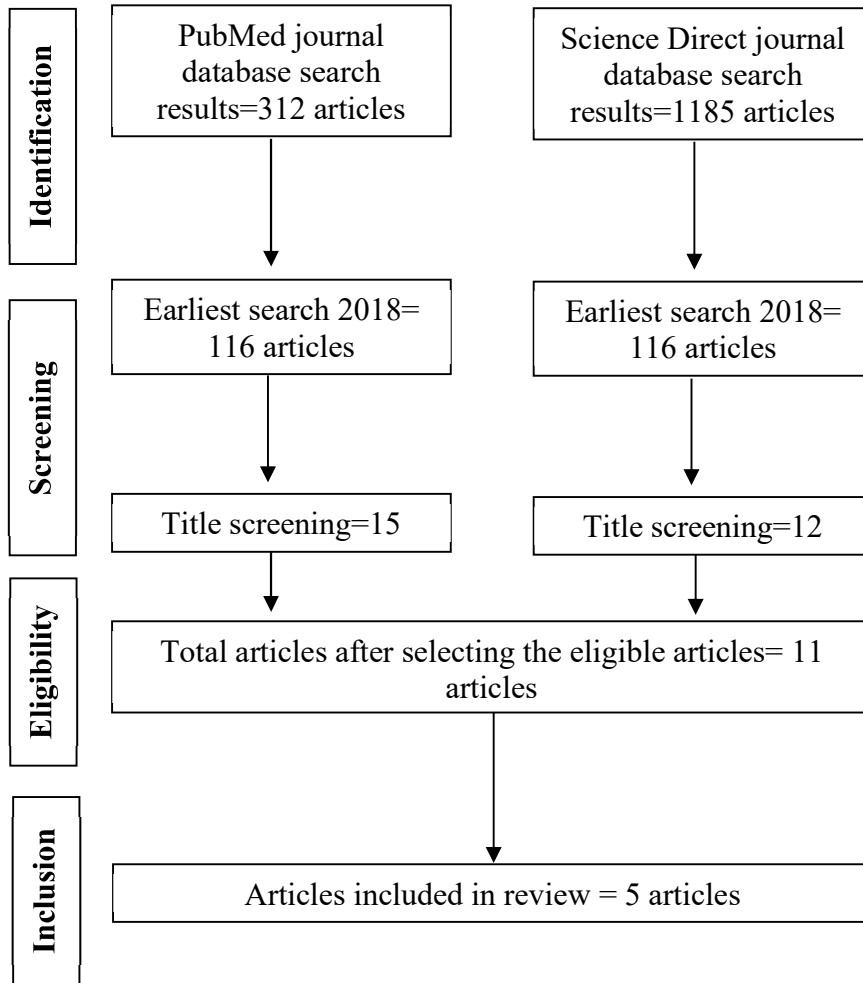
Figure 1. Article search flowchart

Data Retrieval

The authors conducted a thorough examination of relevant studies, specifically selecting those that met precise inclusion criteria. They focused on original, unpublished papers in English to ensure a refined and high-quality selection. The analysis covered essential information, such as study particulars, authors, publication dates, locations, and research methodologies, aligning with the study's objectives.

Author	Origin	Method	Sample Size	Result
Silversides et al., 2018.[5]	Canada	Prospective study.	In total, 1,938 pregnancies were included.	Cardiac complications occurred in 16% of pregnancies and were primarily related to arrhythmias and heart failure. Although the overall rates of cardiac complications during pregnancy did not change over the years, the frequency of pulmonary edema decreased (8% from 1994 to 2001 vs. 4% from 2001 to 2014; p value ¼ 0.012). Ten predictors of maternal cardiac complications were identified: 5 general predictors (prior cardiac events or arrhythmias, poor functional class or cyanosis, high-risk valve disease/left ventricular outflow tract obstruction, systemic ventricular dysfunction, no prior cardiac interventions); 4 lesion-specific predictors (mechanical valves, high-risk aortopathies, pulmonary hypertension, coronary artery disease); and 1 delivery of care predictor (late pregnancy assessment). These 10 predictors were incorporated into a new risk index (CARPREG II [Cardiac Disease in Pregnancy Study]).
Roos-Hesselink et al., 2019.[7]	Europe.	Prospective study.	5739 pregnancies.	Primary outcome was maternal mortality or heart failure, secondary outcomes were other cardiac, obstetric, and foetal complications. Researcher enrolled 5739 pregnancies; the mean age was 29.5. Prevalent diagnoses were congenital (57%) and valvular heart disease (29%). Mortality (overall 0.6%) was highest in the pulmonary arterial hypertension (PAH) group (9%). Heart failure occurred in 11%, arrhythmias in 2%. Delivery was by Caesarean section in 44%. Obstetric and foetal complications occurred in 17% and 21%, respectively. The number of high-risk pregnancies (mWHO Class IV) increased from 0.7% in 2007–2010 to 10.9% in 2015–2018. Determinants for maternal complications were pre-pregnancy heart failure or New York Heart Association >II, systemic ejection fraction <40%, mWHO Class 4, and anticoagulants use. After an increase from 2007 to 2009, complication rates fell from 13.2% in 2010 to 9.3% in 2017
Konishi, T. et al., (2020).[8]	Japan	Retrospectively analyze.	Thirty-five pregnancies and deliveries in 30 women, diagnosed with DCM before pregnancy.	All women had a left ventricular ejection fraction (LVEF) over 30% and belonged to the New York Heart Association (NYHA) class I or II before pregnancy. The mean gestational age at delivery was 36 weeks with 15 (43%) preterm deliveries. Eight pregnancies (23%) were complicated by peripartum cardiac events including 1 ventricular arrhythmia, 6 heart failures, and 1 significant deterioration in LVEF requiring termination of pregnancy. NYHA class II, pre-pregnancy use of angiotensin-converting enzyme inhibitor/angiotensin II receptor blocker/diuretics, elevated brain natriuretic peptide (BNP), and advanced diastolic dysfunction assessed by Doppler echocardiography were defined as risk factors for cardiac events. Although the more severe cases took beta-blockers during pregnancy, the rates of cardiac events and decreasing LVEF did not differ significantly between those taking beta-blockers and those who were not. Values of LVEF decreased by almost 10% after the average 4-year post-delivery follow-up period. The long-term event-free survival was considerably worse among women with peripartum cardiac events than in those without (p < 0.0001)
Billebeau, et al., 2018.[3]	France	Retrospective study in a referral centre for cardiomyopathies.	43 consecutive pregnancies in 36 women with dilated, hypertrophic, arrhythmogenic rightventricular or tachycardia-	The CARPREG score was predictive of maternal complication rate (67%, 36%and 31% in women with a CARPREG score of 2, 1 and 0, respectively). However, major cardiaccomplications occurred in four women with no risk factors. Left ventricular ejection fractionalone, gradient in hypertrophic cardiomyopathy, the Zahara score and the modified World HealthOrganization score appeared to be less discriminant than CARPREG for maternal outcome.

		induced cardiomyopathy, or left ventricular non-compaction.		Therewere two intrauterine fetal deaths, nine premature deliveries (23%), 17 low neonatal birthweights (40%) and 11 cases of hypoglycaemia (26%).
Soomro S, et al., 2019.[9]	Pakistan	Retrospective study	28 pregnant women with cardiac disease.	The most common cardiac disease among our patients was peripartum cardiomyopathy (n=12; 42.9%) followed by rheumatic heart disease in nine (32.1%) women. The rate of maternal mortality was 14.2% (n=4). There were eight (28.6%) cases of intrauterine devices (IUDs) and the remaining 20 (71.4%) babies were born alive and healthy.

RESULT

Our search produced 15 results. After looking at the titles and summaries, we found 11 papers that fit our criteria. At first, we excluded several articles because they were written in review and case report style. But after reading the full papers carefully, we included five papers in our final analysis. These papers included prospective and retrospective studies.

This research by Silversides et al in 2018 was focused on a cohort of consecutive pregnancies in women diagnosed with heart disease, who were under care at two major Canadian tertiary care hospitals. The study recruited women with congenital or acquired heart conditions, including arrhythmias, either receiving ongoing care or referred for consultation at the Toronto (since 1994) and Vancouver (since 2005) pregnancy programs. Over a span from 1994 to 2014, 2,032 pregnancies met the criteria for inclusion. However, 94 pregnancies (5%) were excluded due to patient refusal (12 pregnancies), termination (40 pregnancies), or spontaneous abortion (42 pregnancies), with 19 terminations arising from cardiac reasons.[5]

The analysis encompassed 1,938 pregnancies that progressed beyond 20 weeks gestation, with structural heart disease being prevalent (86.6%), predominantly represented by congenital heart disease (63.7% of pregnancies). The CARPREG risk score varied, with 59% having a score of 0, 36% a score of 1, and 5% a score greater than 1. Additionally, the mWHO classification varied among the pregnancies. Adverse maternal cardiac events were noted in 16% of the study group, with maternal cardiac death or arrest being infrequent (0.6%). Notably, excluded pregnancies before 20 weeks gestation witnessed three maternal cardiac deaths, associated with specific heart conditions. Most complications occurred during the antepartum period, with arrhythmias and congestive heart failure being the most common cardiac complications.[5]

The research also examined trends over time, revealing changes in certain complications but no significant difference in the frequency of maternal cardiac complications between two periods (1994-2000 and 2001-2014). Predictors of adverse cardiac events were identified, and a new risk index (CARPREG II) was established, showing promising predictive accuracy. Despite variations in cardiac events across risk groups and specific diagnoses, the CARPREG II risk index demonstrated robustness in predicting adverse events during pregnancies affected by heart disease. This predictive model maintained its accuracy across different timeframes and event types, providing valuable insights into risk assessment for pregnant women with heart conditions. [5]

The Registry Of Pregnancy And Cardiac Disease (ROPAC) is an international, observational registry that prospectively enrolled pregnant women diagnosed with congenital heart disease (CONHD), valvular heart disease (VHD), cardiomyopathy (CMP), or ischemic heart disease (IHD). Enrollment took place from January 2007 to January 2018, expanding in 2013 to include patients with pulmonary arterial hypertension (PAH) or aortic pathology (AOP). A total of 5739 pregnancies were recruited across 138 centers in 53 countries, detailed in the Supplementary material online, Appendix. Approximately 60% of women were from developed countries, with a mean maternal age of 29.5 years, and 45% being nulliparous. There were 96 twin pregnancies (1.7%). Differences between PREG1 and PREG2 cohorts were observed in various parameters such as nulliparity, geographical distribution, diagnosis, prior interventions, pre-pregnancy cardiac medication use, and distribution among mWHO classes, notably mWHO IV.[7]

Maternal cardiovascular outcomes revealed occurrences of maternal mortality, heart failure, and various causes of death, including refractory heart failure, complications related to mechanical valve thrombosis, endocarditis, primary cardiac arrest, among others. Heart failure and specific complications like valve thrombosis or aortic dissection were reported across different diagnostic groups. Regression analyses highlighted predictors of adverse outcomes, including pre-pregnancy New York Heart Association (NYHA) class, systemic ventricular ejection fraction (EF), signs of heart failure, mWHO IV, and anticoagulation use.[7]

Over time, there was an overall decrease in the incidence of death/heart failure, with variations observed until 2010 followed by a subsequent annual decrease. Despite this decline, the percentage of mWHO IV patients increased. Obstetric and fetal complications were noted in a portion of pregnancies, including emergency caesarean sections, preeclampsia, prematurity, among others, with varying prevalence among different diagnostic groups and mWHO categories. The

ROPAC study shed light on diverse maternal cardiovascular outcomes and their predictors, along with obstetric and fetal complications, illustrating variations across diagnostic groups and mWHO categories.[7]

This retrospective analysis by Yokouchi-Konishi in 2020 examined the medical records of women diagnosed with DCM before pregnancy, who gave birth between January 2000 and July 2019 at the National Cerebral and Cardiovascular Center in Japan. The study encompassed thirty women with thirty-five pregnancies. The average LVEF at DCM diagnosis was 39.0%. Prior to pregnancy, five women had experienced cardiovascular events, including heart failure and arrhythmias. Four women had received devices like PM or ICD. On average, there was a 9-year gap between DCM diagnosis and pregnancy. Twenty-four women were nulliparous, and all were classified as NYHA class I or II. LVEF before pregnancy varied between 30–44% in 12 pregnancies, 45–54% in 18 pregnancies, and 55% in 5 pregnancies of 5 women, who initially had DCM with LVEF <45% but recovered cardiac function before pregnancy. However, 3 of these 5 women experienced reduced LVEF during or after pregnancy.[8]

While most medications were continued post-conception, beta-blockers were administered during pregnancy to 26 patients (74.2%), primarily carvedilol. In terms of cardiac outcomes, eight pregnancies (22.8%) encountered peripartum cardiac events, predominantly heart failure. These events occurred during the third trimester or postpartum, prompting preterm deliveries in four cases. Notably, all complications were manageable. [8]

Comparison between women with and without peripartum cardiac events revealed several associations: NYHA class II, prior use of ACE-I or ARB, diuretic use before or during pregnancy, and increased BNP levels correlated with a higher likelihood of peripartum events. Additionally, women with peripartum cardiac events showed more advanced diastolic dysfunction earlier in pregnancy. [8]

The study monitored LVEF throughout different periods before, during, and after pregnancy, noting no significant changes at various time points. Women treated with beta-blockers displayed larger left ventricular dimensions before pregnancy and lower LVEF before pregnancy compared to those not receiving beta-blockers. In obstetric outcomes, the mean gestational age at delivery was 36.2 weeks, with about half resulting in Cesarean section, predominantly due to obstetric indications. Obstetric complications were prevalent, especially in women with larger left ventricular dimensions and lower LVEF before pregnancy. [8]

Long-term follow-up revealed that a majority of patients were on medication, primarily beta-blockers. However, there was a decrease in mean LVEF from pre-pregnancy to the final follow-up. Cardiovascular events occurred post-delivery in a subset of patients, impacting long-term event-free survival. Overall, the study highlighted the association between peripartum cardiac events and long-term cardiovascular outcomes in women diagnosed with DCM before pregnancy. [8]

In 2018, Billebeaua et al conducted a review of pregnancy records of women diagnosed with various forms of cardiomyopathy, excluding peripartum cardiomyopathy. This assessment covered the period between March 1997 and August 2013 at Pitié-Salpêtrière University Hospital. Among the 43 pregnancies included in the study involving 36 women, there were instances of DCM (n = 10), HCM (n = 28), ARVC (n = 3), TIC (n = 1, in a woman with a history of atrial flutter complicated by previous acute heart failure and failed radiofrequency ablation), and LVNC (n = 1). Maternal follow-up extended until delivery and at least one month post-delivery, with a longer duration if available.[3]

In 39 cases, the maternal heart condition was known before pregnancy. For four pregnancies (two DCMs, one HCM, and one ARVC), the underlying cardiomyopathy diagnosis wasn't established before pregnancy but arose due to cardiovascular complications during pregnancy. However, peri-partum cardiomyopathy was ruled out in two DCM-related cases.[3]

Before the current pregnancy, baseline maternal background data, captured at the last known cardiac evaluation, revealed an overall mean maternal age of 30.5 ± 5 years. Some women had a history of prepregnancy heart failure, and a few had received implanted cardiac devices. Medication profiles varied across the cohort based on the type of cardiomyopathy. For instance, beta-blockers were prescribed in 59% of women, while other drugs like antiarrhythmics, renin-angiotensin-aldosterone system inhibitors, diuretics, and mineralocorticoid receptor antagonists were used in smaller percentages. [3]

Maternal cardiovascular events were observed in 15 pregnancies (35%), notably with varying occurrences across different forms of cardiomyopathy. Among these events, there were unfortunate fatalities in cases where either the maternal cardiac condition was unknown or regular follow-up and treatment compliance were lacking. The study evaluated predictors of maternal cardiovascular complications using the CARPREG score, showing that certain risk factors were more strongly associated with adverse outcomes. However, the predictive value of some risk assessment tools like the Zahara score and modified WHO risk score was comparatively less significant. [3]

Regarding fetal and neonatal outcomes, there were mostly live births, with a few exceptional cases of termination due to fetal anomaly or intrauterine deaths linked to maternal sudden cardiac death or other complications. The study highlighted the correlation between maternal cardiovascular events and adverse fetal or neonatal outcomes, emphasizing the importance of regular monitoring and management of cardiac conditions during pregnancy. [3]

This retrospective analysis by Somroo et al encompassed the maternal records of 2,282 women registered at the Ghulam Muhammad Meher Medical Hospital's obstetrics and gynecology department throughout the entirety of 2018. Approval for the study was obtained from the institutional review board. During this period, 28 cases (1.2%) were identified with cardiovascular (CV) co-morbidities. Among these, 21 (75%) were diagnosed with CV co-morbidities during pregnancy, while the remaining 7 (25%) had pre-existing chronic CV conditions. The prevalent cardiac diseases observed in our patient cohort included peripartum cardiomyopathy (n=12; 42.9%) followed by rheumatic heart disease affecting nine (32.1%) women. Notably, 18 (64.4%) out of the 28 women were not previously scheduled for antenatal care.[9]

The recorded rate of maternal mortality was 14.2% (n=4), and all four cases were associated with peripartum cardiomyopathy. Among these, only one woman delivered a live baby, while the remaining three cases resulted in intrauterine deaths (IUD). There were a total of eight cases (28.6%) of intrauterine deaths, and the other 20 (71.4%) babies were born alive and in good health. These instances of intrauterine deaths were linked to peripartum cardiomyopathy in four cases, rheumatic heart disease in two cases, pre-eclampsia in one case, and ischemic heart disease (IHD) in one case.[9]

DISCUSSION

Prospective investigation involved a continuous cohort of pregnant women receiving advanced care at two prominent Canadian obstetric centers, offering valuable insights applicable to managing this growing demographic. The study reaffirms the prevalence of cardiac issues among pregnant women with heart disease, affecting 16% of pregnancies and primarily linked to maternal arrhythmias and heart failure (Central Illustration). Even in the lowest-risk group, complications still occurred in roughly 5% of cases. Most complications surfaced during the antenatal phase, although specific issues like heart failure or arrhythmias exhibited distinct periods of risk. While the overall incidence of cardiac complications during pregnancy hasn't notably changed over time, occurrences of pulmonary edema have declined.[5]

The assessment conducted in late pregnancy emerged as a pivotal factor influencing pregnancy outcomes. This aspect, combined with broader and lesion-specific maternal characteristics, might be integrated into a new, comprehensive CARPREG II risk index for predicting maternal cardiac issues during pregnancy. A notable aspect of the study was its ability to quantify the risk of less frequent yet serious cardiac complications, such as maternal death and cardiac arrest, in a sizable sample. Additionally, the study highlighted that severe cardiac events could occur at any point during pregnancy.[5]

The majority of cardiac complications were identified during the antepartum and postpartum periods, with fewer incidents during labor and delivery. Notably, the timing of arrhythmia-related complications differed from those linked to heart failure, suggesting distinct impacts of pregnancy-induced hemodynamic and hormonal changes based on the underlying cardiac condition. Hence, antenatal and postpartum surveillance should be tailored accordingly.[5]

An intriguing observation was the reduction in pulmonary edema frequency over time, coinciding with the integration of the CARPREG risk score into the management approach and the establishment of the maternal cardiac clinic. This suggests potential improvements attributed to better surveillance, early medication initiation, or a team-based care approach for women at risk of heart failure.[5] The study accentuated the significance of early pregnancy assessment, revealing higher incidences of adverse cardiac outcomes when assessments were delayed. This emphasizes the need for timely referral to specialized centers for pregnant women with heart disease, particularly given the 5% risk of cardiac complications in even the lowest-risk group.[5]

ROPAC, a prospective registry, encompasses 5739 pregnancies involving women with structural heart disease (IHD), pulmonary arterial hypertension (PAH), and aortic pathology (AOP), marking the largest registry of its kind to date. In our study, the overall maternal mortality rate was 0.6%, notably surpassing rates observed in the general pregnant population. The pivotal complication identified in our registry was heart failure, complicating 11% of pregnancies, with 7% arising within the initial postpartum week. These outcomes stress the critical need for vigilant management and monitoring of at-risk women for heart failure throughout pregnancy and post-delivery.[7]

Previously, the WHO aimed to reduce maternal deaths by 75% between 1990 and 2015, achieving a 44% reduction. The new Sustainable Development Goals aim for a further reduction in global maternal mortality to <70 deaths per 100,000 live births by 2030. Achieving this goal necessitates an accelerated decline in maternal mortality, a task impeded by the escalating contribution of heart disease to mortality rates. The insights from ROPAC can aid in identifying high-risk patients and areas where substantial improvements can be made, particularly focusing on diagnostic groups: low-risk and high-risk patients.[7]

Notably, the highest mortality and heart failure rates were observed in women with PAH, cardiomyopathies (CMP), and valvular heart disease (VHD), aligning with previous series. Over time, there was a decline in maternal mortality or heart failure, especially in VHD and CMP, while the rate in congenital heart disease (CONHD) remained consistently low. This study underlines that despite advances in managing PAH, this group remains at high risk, warranting advice against pregnancy.[7]

Within the CMP group, the mortality rate was 1.1%, and heart failure occurred in 28%. Current guidelines discourage pregnancy if the systemic ventricular ejection fraction is <30%, yet our data suggest that all patients with dilated CMP,

even with relatively preserved ejection fraction, represent a high-risk category. While a specific registry for patients with AOP is underway to analyze pregnancy risks and outcomes, this study identified a 1.8% dissection rate and a high prevalence of caesarean sections (52%) in this group. However, there's a dearth of data on the impact of labor on aortic dissection risk, necessitating further research to establish the optimal mode and timing of delivery. [7]

A significant proportion of patients with VHD had rheumatic heart disease (56%) and often presented late in pregnancy, contributing to high maternal mortality (1%) and heart failure rates (17%). Particularly severe mitral stenosis was associated with elevated complication rates. Among patients with mechanical valves, 7% suffered valve thrombosis, leading to an 18% mortality rate. Optimal anticoagulation strategies in these cases remain elusive, demanding urgent research.[7]

The study aligns with the 2018 ESC guidelines, emphasizing the importance of hospital care for all women with heart disease, stratified based on mWHO classes. Pre-conception counseling holds significance, associated with better outcomes. Pre-pregnancy predictors of heart failure and mortality included signs of heart failure or NYHA >II, systemic ventricular EF of <40%, mWHO IV, and anticoagulant use. This emphasizes the significance of pre-conception counseling and cardiovascular optimization. [7]

An intriguing observation was the increase in the number of pregnancies in women with mWHO IV disease over the study period, despite conventional advice against pregnancy in this high-risk group. This shift might stem from improved physician management comfort and awareness, alongside evolving patient preferences, necessitating careful management and centralized care for these patients. [7]

The study delved into pregnancy outcomes and the extended prognoses of women diagnosed with Dilated Cardiomyopathy (DCM) before pregnancy. Specifically, the analysis focused solely on individuals with preexisting DCM, excluding those diagnosed with DCM-like cardiomyopathy during pregnancy (such as PPCM), which denotes a distinct difference in pregnancy outcomes between the two conditions.[8]

All participants in the study had pre-pregnancy Left Ventricular Ejection Fraction (LVEF) ≥30%, a range deemed acceptable for pregnancy per the guidelines. Generally, women with mild to moderate LV dysfunction (LVEF ≥30–35%) demonstrated favorable pregnancy outcomes. The incidence of peripartum cardiac events in this study (23%) was notably lower compared to previous studies involving more severe cases (39% and 50%). This difference underscores the impact of varying levels of LV dysfunction and NYHA class III, recognized as higher risk factors during pregnancy. Notably, women classified as NYHA class II before pregnancy and those receiving ACE-I/ARB and/or diuretics pre-pregnancy, and diuretics during pregnancy, experienced significantly more cardiac events compared to those without these factors. Discontinuation of ACE-I/ARB upon conception, owing to potential fetal renal damage, highlighted the need for careful monitoring post-cessation.[8]

Elevated BNP levels before, during, and after pregnancy correlated with peripartum cardiac events, though the study didn't establish a specific cut-off value. Previous research suggested that a BNP >100 pg/ml during pregnancy was observed in all women with pregnancy-associated cardiac events, indicating its potential as a predictive marker for adverse events. Diastolic dysfunction, particularly a restrictive pattern identified by Doppler echocardiography, emerged as a risk factor for peripartum cardiac events. The onset of heart failure, primarily occurring after 31 weeks of gestation, coincided with the peak increase in plasma volume during late pregnancy. [8]

Regarding beta-blocker use, while it's been effective in other conditions during pregnancy, its influence on pregnant women with DCM remains unclear. In this study, beta-blockers were linked to lower LVEF and larger ventricular diameter, indicating usage among patients with more severe disease, though no significant change in LVEF or cardiac event rates was observed between users and non-users during pregnancy. Long-term prognosis after pregnancy revealed a nearly 10% decline in LVEF among patients on average, four years post-delivery. Patients with peripartum cardiac events displayed a propensity for repeat events within three years postpartum, suggesting a need for vigilant, extended monitoring for both cardiac dysfunction and arrhythmias. [8]

The development of cardiovascular events during pregnancy significantly increased the likelihood of future cardiovascular events within three years postpartum. This aligns with research in congenital heart disease, indicating that adverse cardiac events during pregnancy signify an elevated risk of late cardiac events. Monitoring patients with a history of peripartum cardiac events post-delivery remains crucial due to their potential heightened risk for cardiovascular complications. [8]

In Billebeau study, 25% of pregnancies in women with HCM experienced adverse maternal cardiovascular events, with one maternal fatality. This rate was slightly lower than those reported in other studies (ranging from 28% to 73%). Compared to Tanaka et al.'s recent report, our study showed fewer cardiovascular events related to arrhythmias, potentially attributed to a higher percentage of women on beta-blockers or antiarrhythmic drugs before pregnancy. However, the single maternal death in our HCM pregnancies was linked to sudden cardiac arrest in a woman without any ICD or medication at the pregnancy's onset, underscoring the importance of maintaining or initiating beta-blocker treatment during pregnancy, as recommended by recent European Society of Cardiology guidelines on HCM.[3]

Pregnancies in women with ARVC seem to be well-tolerated based on limited literature. However, Billebeau et al observations align with some previous reports, showing a low incidence of maternal cardiac events in ARVC-related pregnancies. We conducted a retrospective analysis of various clinical scores' predictive role, revealing that the Carpreg score was more suitable for predicting adverse outcomes in pregnancies with cardiomyopathies. A high Carpreg score correlated with a higher incidence of maternal cardiovascular adverse events, emphasizing its relevance in identifying high-risk pregnancies. However, even pregnancies with a baseline score of 0 faced a significantly higher complication rate than anticipated, suggesting the need for a more refined scoring system to discern low-risk pregnancies better.[3]

Among the clinical score components, prior cardiac episodes and severe dyspnea before pregnancy (NYHA class III/IV) emerged as the most predictive risk factors for adverse maternal cardiovascular events in our study. LV dysfunction ≤ 40% was less discriminating. Additionally, optimal and early multidisciplinary medical care during pregnancy was highlighted as crucial, as three maternal cardiovascular deaths occurred in women lacking appropriate care.

Fetal/neonatal morbidity in our study was notably higher (65%) than previously reported, with low birth weight, hypoglycemia, and premature delivery being the most frequent complications. The severity of maternal cardiac conditions strongly influenced fetal/neonatal outcomes, emphasizing the importance of managing the mother's cardiac disease optimally, preferably through multidisciplinary care involving both cardiologists and obstetricians.

Cardiomyopathy emerged as the most prevalent cardiac condition in Soomro et al study, affecting 12 out of 28 patients. Peripartum cardiomyopathy typically arises within a month before or after childbirth, while dilated cardiomyopathy tends to manifest by the second trimester.[9] Mortality rates associated with peripartum cardiomyopathy vary significantly, ranging from less than 2% to as high as 50%.[10] Heart failure and arrhythmias constitute the primary complications linked with cardiomyopathy during pregnancy. Risk factors such as obesity, diabetes, hypertension, stress during pregnancy, and advanced maternal age contribute to the increased incidence of cardiomyopathy.[9]

Rheumatic heart disease emerged as the second most prevalent cardiac ailment in our study. Globally, it remains the leading cause of maternal cardiac complications during pregnancy. Since symptoms of rheumatic fever typically arise later in life, the physiological changes during pregnancy may lead up to 25% of affected women experiencing symptoms for the first time during gestation.[11]

Encouraging an ethos of early detection and meticulous monitoring is crucial to enhance maternal resilience against the increased cardiovascular stress inherent in pregnancy. Such an approach not only supports neonatal survival but also fosters fetal growth. Providing individualized attention and counseling to pregnant women with pre-existing heart conditions is essential. By identifying and addressing risk factors associated with cardiac diseases during pregnancy, we can effectively reduce both maternal and fetal mortality rates.

CONCLUSION

The study of pregnant women in Canadian obstetric centers revealed that cardiac issues affect around 16% of pregnancies, primarily with arrhythmias and heart failure, even in lower-risk cases. Complications often arose before birth, with specific periods of risk for different problems. Although overall cardiac complication rates remained steady, incidents of pulmonary edema reduced over time. Late pregnancy assessments proved crucial, leading to a new CARPREG II risk index that considers maternal factors for better prediction. While maternal cardiac mortality remained rare but higher than in the general population, the study's precision in evaluating pregnancy-related cardiac risks was notable.

Tailored surveillance for various cardiac conditions was highlighted, alongside potential improvements from specialized care, seen in reduced pulmonary edema frequency. The study advanced risk assessment understanding, emphasizing individualized evaluations and timely referrals to specialized centers for pregnant women with heart disease. The ROPAC registry highlighted higher maternal mortality rates, especially in heart failure cases, stressing the need for vigilant management throughout pregnancy and after delivery in high-risk women. Across different heart conditions, outcomes varied, with some, like Ischemic Heart Disease (IHD), showing more favorable results. The study emphasized the need for early assessment, continuous vigilance, and specialized care, advocating ongoing research for better management strategies. Overall, it significantly contributed to understanding cardiac disease implications in pregnancy, emphasizing the necessity for specialized care and research advancements in this field.

REFERENCES

[1] Eggleton EJ, McMurrugh KJ, Aiken CE. Maternal pregnancy outcomes in women with cardiomyopathy: a systematic review and meta-analysis. Am J Obstet Gynecol. 2022;227(4):582-592. doi:10.1016/j.ajog.2022.05.039

[2] Chattopadhyay R, Olwell B, Bhagra CJ. Maternal cardiac disease in pregnancy. Obstet Gynaecol Reprod Med 2022;32:1–7.

[3] Billebeau G, Etienne M, Cheikh-Khelifa R, et al. Pregnancy in women with a cardiomyopathy: outcomes and predictors from a retrospective cohort. Arch Cardiovasc Dis 2018;111:199–209.

[4] Owens A, Yang J, Nie L, Lima F, Avila C, Stergiopoulos K. Neonatal and maternal outcomes in pregnant women with cardiac disease. J Am Heart Assoc 2018;7:e009395.

[5]   Silversides CK, Grewal J, Mason J, et al. Pregnancy outcomes in women with heart disease: the CARPREG II study. J Am Coll Cardiol 2018;71:2419–30.

[6]   Boulé S, Ovart L, Marquié C, et al. Pregnancy in women with an implantable cardioverterdefibrillator: is it safe? Europace 2014;16:1587–94.

[7]   Jolien Roos-Hesselink, Lucia Baris, Mark Johnson, Julie De Backer, Catherine Otto, Ariane Marelli, Guillaume Jondeau, Werner Budts, Jasmine Grewal, Karen Sliwa, William Parsonage, Aldo P Maggioni, Iris van Hagen, Alec Vahanian, Luigi Tavazzi, Uri Elkayam, Eric Boersma, Roger Hall, on behalf of the ROPAC Investigators, Pregnancy outcomes in women with cardiovascular disease: evolving trends over 10 years in the ESC Registry Of Pregnancy And Cardiac disease (ROPAC), European Heart Journal, Volume 40, Issue 47, 14 December 2019, Pages 3848–3855, https://doi.org/10.1093/eurheartj/ehz136

[8]   Yokouchi-Konishi, T., Kamiya, C. A., Shionoiri, T., Nakanishi, A., Iwanaga, N., Izumi, C., … Yoshimatsu, J. (2020). Pregnancy outcomes in women with dilated cardiomyopathy: Peripartum cardiovascular events predict post delivery prognosis. Journal of Cardiology. doi:10.1016/j.jjcc.2020.07.007

[9]   Soomro S, Kumar R, Shaikh A A (October 30, 2019) Twenty-eight Pregnant Women with Cardiac Diseases: A Review of Maternal and Fetal Outcomes in Pakistan. Cureus 11(10): e6034. doi:10.7759/cureus.6034

[10]   Schaufelberger M: Cardiomyopathy and pregnancy. Heart. 2019, 105:1543-1551. 10.1136/heartjnl-2018-313476

[11]   Mitchelson JB, Cleveland DE: Optimal management of a pregnant patient with rheumatic heart disease . Kans J Med. 2018, 11:80-82.