

# Divergent Paths: A Survey of Cardiologist and Obstetrician Decision-Making in High-Risk Pregnancies with Cardiovascular Disease

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**Background:** During pregnancy, there is a physiologic increase in heart rate and blood flow rate along with an increase in plasma volume. Although these changes are physiological, pregnant women with congenital cyanotic heart disease are known to have an increased risk of maternal heart failure, premature birth, intrauterine growth retardation, increased number of cesarean sections, and even maternal death. According to the World Health Organization, cardiovascular diseases (CVD) are the most common cause of indirect maternal deaths. The aim of this study was to assess how well obstetricians and cardiologists manage the care of a pregnant woman with cardiovascular disease.

**Methods:** This survey-based study included 45 obstetricians and 30 cardiologists. There is no ready-made scale or survey on the relevant subject. Therefore, the survey questions were created by us as a result of the literature review. In the survey, questions were asked to examine clinical decision-making tendencies and attitudes of obstetrics and cardiology doctors about recommending induced abortion in the first trimester in pregnant women with various heart diseases and about vaginal labor or cesarean section and infective endocarditis prophylaxis in term pregnancy.

**Results:** Survey responses from obstetricians and cardiologists revealed significant differences in management approaches. Regarding first-trimester elective termination, cardiologists overwhelmingly recommended it for most conditions (eg, 100% for pulmonary arterial hypertension, 96.7% for EF < 30%/Class III–IV heart failure), whereas obstetricians showed greater hesitation or preference for cardiology consultation (eg, 48.9% had “no opinion” for Marfan syndrome with aortic dilatation). For mode of delivery at term, cardiologists predominantly recommended cesarean section, often with infective endocarditis prophylaxis, for specific high-risk conditions (eg, 100% for prosthetic valve, 96.7% for severe PAH). In stark contrast, the majority of obstetricians (ranging from 53.3% to 80.0% across various CVDs) opted to defer the decision by seeking a cardiology consultation. Statistical analysis confirmed significant differences ( $p < 0.05$ ) between the two specialist groups in most management decisions.

**Discussion:** CVDs are the most common cause of non-direct maternal deaths. Patients should be closely monitored during pregnancy, labor and puerperium. Pregnant women with CVD should be evaluated by a multidisciplinary committee of competent physicians.

**Keywords:** cardiovascular disease, clinical decision-making, physician attitude, infective endocarditis prophylaxis, induced abortion, non-direct maternal mortality

## Introduction

Cesarean section is an important problem in the healthcare system due to its constant increase worldwide. Similar to the rest of the world, cesarean section rates are increasing in Turkey. In 2021, Turkey ranks first among Organization for Economic Co-operation and Development (OECD) countries in terms of cesarean section rates,<sup>1</sup> a trend also reflected in national health statistics.<sup>2</sup> However, cesarean section has certain risks, both maternal and fetal, and these risks are more likely to be encountered if a pregnant woman has an unnecessary cesarean section. However, cesarean section carries inherent maternal and neonatal risks such as infection, hemorrhage, and anesthesia complications.<sup>3</sup> In addition to these

general risks, the presence of maternal cardiovascular disease significantly amplifies perinatal risk, necessitating specialized care pathways.<sup>4,5</sup> Given these risks, it is extremely important to get the indication for cesarean section right.

In a healthy pregnancy, maternal cardiovascular adaptation is required to maintain circulation between mother and fetus. Although cardiac output and heart rate increase throughout pregnancy, blood pressure decreases in the first two trimesters with the effect of pregnancy hormones. However, in the last trimester, there is a 30–50% increase compared to the beginning of pregnancy due to the increase in cardiac ejection fraction and heart rate.<sup>6</sup>

Plasma volume also increases throughout pregnancy.<sup>7</sup> These hemodynamic changes result in an increase in end-diastolic volume, imposing an additional cardiac workload. During labor, uterine contractions are crucial for the increased oxygen demand and additional increase in cardiac output. With the delivery of the baby and placenta, there's an approximately 500 cc increase in blood circulation, accompanied by a sudden rise in systemic vascular resistance. Consequently, ventricular filling pressure increases. The return to normalcy of these changes may extend up to six weeks postpartum.<sup>6</sup>

Cardiovascular diseases (CVD), the most common cause of non-direct maternal mortality, complicate approximately 1–4% of all pregnancies. Moreover, adverse pregnancy outcomes themselves are now recognized as significant risk markers for future maternal cardiovascular disease, highlighting the critical importance of meticulous care during this period.<sup>8</sup> The risk of maternal death varies significantly depending on heart function and specific pathology. According to the World Health Organization's (WHO) revised classification of cardiovascular disease in pregnancy, the risk increases from minimal in class I to extremely high in class IV. Within class IV, conditions such as Eisenmenger syndrome, severe pulmonary arterial hypertension, or severe systolic dysfunction are associated with maternal mortality rates that can approach 100% if pregnancy occurs, as highlighted in current reviews.<sup>6</sup> In recent years, the prevalence of pregnancies complicated by CVD has been increasing. This is due to factors such as the number of women with congenital heart disease (CHD) reaching childbearing age, the increase in advanced maternal age pregnancies and the increased prevalence of cardiac risk factors (such as obesity, diabetes mellitus, hypertension, multiple pregnancies and pre-eclampsia) among young adults.<sup>9</sup> Therefore, women with CHD planning pregnancy should receive comprehensive pre-pregnancy counselling.<sup>10</sup> The pregnancy process of pregnant women with CVD should be evaluated by a team of obstetricians and cardiologists.

In the management of pregnancy complicated with CVD, the decision on mode of delivery and, if necessary, prophylaxis for infective endocarditis (IE) are very important. This study aims to evaluate the process management and decisions made by obstetric and cardiology doctors in pregnant women with CVD.

## Method

This study was approved by the Hamidiye Scientific Research Ethics Committee of the Health Sciences University, to which Konya City Hospital is affiliated (Decision Date: 30.09.2022 - Number: 22/424). The corresponding author was working at Konya City Hospital during the year the study was conducted. All procedures in the conduct of the study were in accordance with the provisions of the 1995 Declaration of Helsinki (Brazil, revised in 2013). Following ethical approval, the survey was distributed to participants, and data collection took place between October 2022 and March 2023.

This study included doctors specialised in cardiology and obstetrics who volunteered to participate. All of these physicians were cardiologists and obstetricians working in tertiary centres where pregnancies complicated by cardiovascular disease can be managed. Doctors working in hospitals with different equipment were not included in the study. Additionally, doctors outside these two groups were also excluded from the study.

## Survey Development and Content

A structured, self-administered online survey was developed specifically for this study based on a comprehensive review of the current guidelines and literature on the management of cardiovascular diseases in pregnancy.<sup>7,11–13</sup> The survey was explicitly designed to address the study's primary aim: to evaluate the clinical decision-making tendencies and attitudes of specialists regarding key, high-stakes decision points in the management of pregnant women with CVD. It comprised three main sections:

### Demographic and Professional Information

This section collected data on the participants' specialty (obstetrics/cardiology), age, gender, and years of experience.

## Attitudes Towards Pregnancy Continuation

This section presented five high-risk cardiovascular conditions (severe pulmonary arterial hypertension, Marfan syndrome with aortic dilation, etc). For each condition, participants were asked whether they would recommend medically indicated induced abortion in the first trimester (Response options: *Yes, No, No idea*). This section directly addresses the critical initial management decision following diagnosis.

## Management Decisions at Term

This section presented two sets of clinical scenarios encompassing 13 different cardiovascular conditions or situations (eg, prosthetic valve, history of endocarditis, dilated aortic root, recent MI, etc). For each scenario, participants were asked to decide on the preferred mode of delivery (Normal vaginal labor, Cesarean section, Cesarean section with IE prophylaxis) or to indicate they would seek a cardiology consultation. This section targets the pivotal peripartum management decisions.

The selection of conditions was guided by the modified World Health Organization (mWHO) classification for pregnancy risk in cardiac disease, focusing on conditions classified as high risk (mWHO class III) or very high risk/pregnancy contraindicated (mWHO class IV). Thus, the survey was intentionally focused on these critical decision-making nodes to provide clear, actionable insights into practice variation, which aligns with the core aim of the study. The complete survey form is provided as [Figure 1](#).

**A**

### Section A

|                                                                                                                         |        |    |         |
|-------------------------------------------------------------------------------------------------------------------------|--------|----|---------|
| Age                                                                                                                     | Gender |    |         |
| Institution                                                                                                             | Clinic |    |         |
| If you encounter the following diseases in the 1st trimester of a pregnant woman, would you recommend induced abortion? |        |    |         |
|                                                                                                                         | YES    | NO | NO IDEA |
| EF<30% or Class III/IV heart failure                                                                                    |        |    |         |
| Congenital cyanotic heart disease                                                                                       |        |    |         |
| Severe valve stenosis (Mitral, Aortic)                                                                                  |        |    |         |
| Aortic diameter > 45 mm with Marfan syndrome, Aortic diameter > 50 mm with bicuspid aortic valve                        |        |    |         |
| Pulmonary arterial hypertension                                                                                         |        |    |         |
| EF; Ejection Fraction                                                                                                   |        |    |         |

**B**

### Section B

|                                                                                                                                         |                      |                  |                                                        |                                    |
|-----------------------------------------------------------------------------------------------------------------------------------------|----------------------|------------------|--------------------------------------------------------|------------------------------------|
| If you encounter a term pregnant woman with one of the following cardiovascular diseases, which method of delivery would you recommend? |                      |                  |                                                        |                                    |
| Disease or Different Situation                                                                                                          | Normal Vaginal Labor | Cesarean Section | Caesarean Section + Infective Endocarditis Prophylaxis | I Want a Cardiology Consultation * |
| Dilated aortic root >40mm / history of aortic aneurysm / dissection                                                                     |                      |                  |                                                        |                                    |
| Acute severe congestive heart failure                                                                                                   |                      |                  |                                                        |                                    |
| Recent history of MI                                                                                                                    |                      |                  |                                                        |                                    |
| Severe symptomatic AD                                                                                                                   |                      |                  |                                                        |                                    |
| Severe PAH                                                                                                                              |                      |                  |                                                        |                                    |
| Warfarin use within 2 weeks before birth                                                                                                |                      |                  |                                                        |                                    |
| Need for urgent valve replacement after birth                                                                                           |                      |                  |                                                        |                                    |
| The patient has a prosthetic valve                                                                                                      |                      |                  |                                                        |                                    |
| History of endocarditis                                                                                                                 |                      |                  |                                                        |                                    |
| Unrepaired cyanotic heart disease (including palliative repairs)                                                                        |                      |                  |                                                        |                                    |
| Repaired but residual defect                                                                                                            |                      |                  |                                                        |                                    |
| History of cardiac transplantation                                                                                                      |                      |                  |                                                        |                                    |
| Congenital heart disease repaired with prosthetic material within the last 6 months                                                     |                      |                  |                                                        |                                    |
| MI: Myocardial infarction, AD: Aortic dilatation, PAH: Pulmonary arterial hypertension                                                  |                      |                  |                                                        |                                    |
| *For obstetricians only.                                                                                                                |                      |                  |                                                        |                                    |

**Figure 1** Survey form: section A (A) and section B (B).

**Notes:** Survey Form: Divergent Paths: A Survey of Cardiologist and Obstetrician Decision-Making in High-Risk Pregnancies with Cardiovascular Disease. (A) Section A: Demographic and occupational information of participants and attitudes toward continuing pregnancy in high-risk cardiac scenarios. (B) Section B: Clinical decision-making scenarios regarding mode of delivery and the use of infective endocarditis prophylaxis in late pregnancy.

The survey was created via Google and delivered to participants online. The first number of cardiologists reached was 67, and the number of obstetricians was 63. However, the number of doctors participating in the survey was 44.7% of cardiologists and 71.4% of obstetricians.

# Statistical Analysis

Statistical analyses were performed using MedCalc Statistical Software (MedCalc Software Ltd, Ostend, Belgium). Categorical variables (eg, recommendations for induced abortion, choice of delivery mode, consultation preference) are presented as frequencies and percentages (n, %). Continuous variables (eg, age) are presented as mean ± standard deviation or median (min-max), as appropriate. The primary aim of the statistical analysis was to compare the responses of cardiologists and obstetricians across the various clinical scenarios. For this purpose: 1. The independent variable was the specialty of the physician (Cardiologist vs Obstetrician). 2. The dependent variables were the categorical responses to the survey questions (eg, “Yes / No / No idea” for induced abortion; “Vaginal delivery / Cesarean / Cesarean + prophylaxis / Consultation” for delivery mode).

Comparisons between the two specialist groups for each clinical scenario were performed using the Chi-square test (or Fisher’s exact test when expected cell counts were less than 5). A two-sided *p* value of <0.05 was considered statistically significant.

# Results

This survey-based study had 45 obstetricians and 30 cardiologists who volunteered to participate. It was carried out between September 1, 2022, and March 1, 2023. The age and gender distributions of the participating doctors are shown in Table 1. The mean age of cardiologists was 37.1 years, with equal numbers of men and women. The mean age of obstetricians was lower (35). The number of male obstetricians (53%) was higher than the number of female obstetricians (47%) (Table 1).

Recommendations for induced abortion in the first trimester across various CVDs are shown in Table 2. Cardiologists overwhelmingly recommended abortion for most conditions, whereas obstetricians showed greater variability in their responses, with a substantial proportion opting for cardiology consultation or expressing no opinion, particularly in complex cases such as Marfan syndrome with aortic dilatation (48.9% had no opinion). Statistically significant differences (*p*<0.05) were observed between the two specialties for all conditions listed.

Management decisions regarding the mode of delivery in various acute and structural cardiovascular conditions are summarized in Table 3. A sharp contrast was observed between the groups: Cardiologists made definitive recommendations and mostly preferred cesarean delivery for high-risk scenarios (eg, 96.7% for severe PAH, 80.3% for acute severe heart failure). In contrast, the vast majority of obstetricians (75.6% to 80.0% of all cases) reported that they would postpone the decision by requesting a cardiology consultation.

**Table 1** Demographic Data of Doctors

| Cardiologists (n=30) |        | Min–Max   | Median | Mean±SD/n (%) |
|----------------------|--------|-----------|--------|---------------|
| Age (years)          |        | 27.0–53.0 | 37.0   | 37.1±5.02     |
| Gender               | Male   |           |        | 15 (50)       |
|                      | Female |           |        | 15 (50)       |
| Obstetricians (n=45) |        |           |        |               |
| Age (years)          |        | 26.0–52.0 | 34.0   | 35.0±5.0      |
| Gender               | Male   |           |        | 24 (53)       |
|                      | Female |           |        | 21 (47)       |

**Table 2** Doctors' "Would You Decide on Induced Abortion in the Following Cardio-Vascular Diseases?" Answer to the Question

| Question: Would You Decide on Abortion in the Following Cardio-Vascular Diseases?                |         | Cardiologists (n:30) (%) | Obstetricians (n:45) (%) | p value                      |
|--------------------------------------------------------------------------------------------------|---------|--------------------------|--------------------------|------------------------------|
| EF<30% or Class III/IV heart failure                                                             | Yes     | 29 (97)                  | 36 (80)                  | <b>p&lt;0.05<sup>a</sup></b> |
|                                                                                                  | No      | 1 (3)                    | 5 (11)                   |                              |
|                                                                                                  | No idea | 0 (0)                    | 4 (9)                    |                              |
| Congenital cyanotic heart disease                                                                | Yes     | 28 (93)                  | 19 (42)                  | <b>p&lt;0.05<sup>a</sup></b> |
|                                                                                                  | No      | 0 (0)                    | 18 (40)                  |                              |
|                                                                                                  | No idea | 2 (7)                    | 8 (18)                   |                              |
| Severe valve stenosis (Mitral, Aortic)                                                           | Yes     | 29 (97)                  | 29 (64)                  | <b>p&lt;0.05<sup>a</sup></b> |
|                                                                                                  | No      | 0 (0)                    | 13 (29)                  |                              |
|                                                                                                  | No idea | 1 (3)                    | 3 (7)                    |                              |
| Aortic diameter > 45 mm with Marfan syndrome, Aortic diameter > 50 mm with bicuspid aortic valve | Yes     | 21 (70)                  | 16 (36)                  | <b>p&lt;0.05<sup>a</sup></b> |
|                                                                                                  | No      | 3 (10)                   | 7 (15)                   |                              |
|                                                                                                  | No idea | 6 (20)                   | 22 (49)                  |                              |
| Pulmonary arterial hypertension                                                                  | Yes     | 30 (100)                 | 27 (60)                  | <b>p&lt;0.05<sup>a</sup></b> |
|                                                                                                  | No      | 0 (0)                    | 10 (22)                  |                              |
|                                                                                                  | No idea | 0 (0)                    | 8 (18)                   |                              |

**Notes:** <sup>a</sup>Two-way Chi-squared test, Statistical significance was determined at  $p<0.05$ . Bold values are statistically significant.

**Abbreviations:** EF, Ejection Fraction; SD, Standard Deviation.

**Table 3** Doctors' Decision on Mode of Delivery in Various Cardio-Vascular Diseases I

| Various Cardio-Vascular Diseases                                | Cardiologists (n:30) (%) |                  |                                                          | Obstetricians (n:45) (%) |                  |                                                          |                                   | p value                      |
|-----------------------------------------------------------------|--------------------------|------------------|----------------------------------------------------------|--------------------------|------------------|----------------------------------------------------------|-----------------------------------|------------------------------|
|                                                                 | Vaginal Labor            | Cesarean Section | Caesarean Section and Infective Endocarditis Prophylaxis | Vaginal Labor            | Cesarean Section | Caesarean Section and Infective Endocarditis Prophylaxis | I Want a Cardiology Consultation* |                              |
| Dilated aortic root >40mm/history of aortic aneurysm/dissection | 4 (13)                   | 22 (74)          | 4 (13)                                                   | 2 (5)                    | 6 (13)           | 1 (2)                                                    | 36 (80)                           | <b>p&gt;0.05<sup>a</sup></b> |
| Acute severe congestive heart failure                           | 3 (10)                   | 25 (83)          | 2 (7)                                                    | 3 (7)                    | 7 (15)           | 0 (0)                                                    | 35 (78)                           | <b>p&gt;0.05<sup>a</sup></b> |
| Recent history of MI                                            | 6 (20)                   | 21 (70)          | 3 (10)                                                   | 4 (9)                    | 9 (20)           | 1 (2)                                                    | 31 (69)                           | <b>p&gt;0.05<sup>a</sup></b> |
| Severe symptomatic AD                                           | 0 (0)                    | 0 (0)            | 30 (100)                                                 | 1 (2)                    | 7 (16)           | 1 (2)                                                    | 36 (80)                           | <b>p&lt;0.05<sup>a</sup></b> |
| Severe PAH                                                      | 0 (0)                    | 29 (97)          | 1 (3)                                                    | 0 (0)                    | 10 (22)          | 1 (2)                                                    | 34 (76)                           | <b>p&gt;0.05<sup>a</sup></b> |

(Continued)

**Table 3** (Continued).

| Various Cardio-Vascular Diseases              | Cardiologists (n:30) (%) |                  |                                                          | Obstetricians (n:45) (%) |                  |                                                          |                                   | p value                             |
|-----------------------------------------------|--------------------------|------------------|----------------------------------------------------------|--------------------------|------------------|----------------------------------------------------------|-----------------------------------|-------------------------------------|
|                                               | Vaginal Labor            | Cesarean Section | Caesarean Section and Infective Endocarditis Prophylaxis | Vaginal Labor            | Cesarean Section | Caesarean Section and Infective Endocarditis Prophylaxis | I Want a Cardiology Consultation* |                                     |
| Warfarin use within 2 weeks before birth      | 11 (37)                  | 19 (63)          | 0 (0)                                                    | 0 (0)                    | 17 (38)          | 0 (0)                                                    | 28 (62)                           | <b><i>p&lt;0.05<sup>a</sup></i></b> |
| Need for urgent valve replacement after birth | 3 (10)                   | 5 (17)           | 22 (73)                                                  | 4 (9)                    | 5 (11)           | 2 (4)                                                    | 34 (76)                           | <b><i>p&lt;0.05<sup>a</sup></i></b> |

**Notes:** \*This option was only offered to obstetricians. <sup>a</sup>Two-way Chi-squared test, Statistical significance was determined at  $p<0.05$ . Bold values are statistically significant.

**Abbreviations:** MI, Myocardial infarction; AD, Aortic dilatation; PAH, Pulmonary arterial hypertension.

Decisions regarding the mode of delivery in patients with prosthetic material, prior interventions, or a history of organ transplantation are detailed in Table 4. The results were consistent with the scenarios in Table 3: Cardiologists almost universally recommended cesarean delivery with IE prophylaxis for patients with prosthetic valves (100%) or permanent heart defects (100%), while obstetricians again mostly preferred cardiology consultation (in 53.3% to 75.6% of cases).

**Table 4** Doctors' Decision on Mode of Delivery in Various Cardio-Vascular Diseases 2

| Various Cardio-Vascular Diseases                                                    | Cardiologists (n:30) (%) |                  |                                                          | Obstetricians (n:45) (%) |                  |                                                          |                                   | p value                             |
|-------------------------------------------------------------------------------------|--------------------------|------------------|----------------------------------------------------------|--------------------------|------------------|----------------------------------------------------------|-----------------------------------|-------------------------------------|
|                                                                                     | Vaginal Labor            | Cesarean Section | Caesarean Section and Infective Endocarditis Prophylaxis | Vaginal Labor            | Cesarean Section | Caesarean Section and Infective Endocarditis Prophylaxis | I Want a Cardiology Consultation* |                                     |
| The patient has a prosthetic valve                                                  | 0 (0)                    | 0 (0)            | 30 (100)                                                 | 7 (16)                   | 1 (2)            | 12 (26)                                                  | 25 (56)                           | <b><i>p&lt;0.05<sup>a</sup></i></b> |
| History of endocarditis                                                             | 4 (13)                   | 0 (0)            | 26 (87)                                                  | 6 (13)                   | 0 (0)            | 15 (33)                                                  | 24 (54)                           | <b><i>p&lt;0.05<sup>a</sup></i></b> |
| Unrepaired cyanotic heart disease (including palliative repairs)                    | 2 (7)                    | 7 (23)           | 21 (70)                                                  | 4 (9)                    | 3 (7)            | 4 (9)                                                    | 34 (75)                           | <b><i>p&lt;0.05<sup>a</sup></i></b> |
| Repaired but residual defect                                                        | 0 (0)                    | 0 (0)            | 30 (100)                                                 | 6 (13)                   | 2 (5)            | 9 (20)                                                   | 28 (62)                           | <b><i>p&lt;0.05<sup>a</sup></i></b> |
| History of cardiac transplantation                                                  | 0 (0)                    | 16 (53)          | 14 (47)                                                  | 4 (9)                    | 3 (7)            | 4 (9)                                                    | 34 (75)                           | <b><i>p&lt;0.05<sup>a</sup></i></b> |
| Congenital heart disease repaired with prosthetic material within the last 6 months | 0 (0)                    | 3 (10)           | 27 (90)                                                  | 6 (13)                   | 2 (5)            | 5 (11)                                                   | 32 (71)                           | <b><i>p&lt;0.05<sup>a</sup></i></b> |

**Notes:** \*This option was only offered to obstetricians. <sup>a</sup>Two-way Chi-squared test, Statistical significance was determined at  $p<0.05$ . Bold values are statistically significant.

## Discussion

This study revealed a fundamental difference in how cardiologists and obstetricians approach high-risk decisions in pregnancies complicated by cardiovascular disease. The main findings are a strong tendency among obstetricians to leave decisions to cardiology consultation and a more decisive, interventionist approach among cardiologists, particularly regarding termination of pregnancy and cesarean delivery. The following discussion interprets these patterns within the context of current literature and clinical practice.

The main finding of this study is that obstetricians tend to request cardiology consultation in 53.3% to 80% of critical decisions such as first trimester-induced abortion and mode of delivery in term pregnant women with high-risk CVD. This high rate shows that obstetricians have a natural caution and seek to share responsibility in such complex cases that fall outside their area of expertise and carry a risk of maternal mortality. The current studies finding is in full agreement with the strong emphasis of the European Society of Cardiology (ESC) guidelines that pregnant women with CVD should be monitored by an “experienced multidisciplinary team” and that the time and mode of delivery should be decided with a “multidisciplinary approach”.<sup>9</sup> Similarly, the mWHO classification recommends that high-risk (Class III–IV) patients be managed in tertiary care centers, which implicitly means centers where teamwork exists or can exist.<sup>14</sup> While this tendency of obstetricians to consult is a positive step, it does not actually replace a structured and regular team model. When the results of this study are interpreted, it is suggested that the differences in approach between cardiologists and obstetricians can only be overcome with a formal, regularly meeting structure such as a “Cardiac-Pregnancy Multidisciplinary Team” that develops common management protocols. The effectiveness of such dedicated cardio-obstetrics programs in standardizing care and improving outcomes has been demonstrated in recent studies.<sup>5,14</sup> In this way, it is thought that decision-making processes can be accelerated and consistency between different disciplines can be ensured.

This survey study revealed a striking contrast in first-trimester pregnancy management in scenarios where maternal risk is highest. The fact that almost all cardiologists recommended induced abortion in cases such as pulmonary arterial hypertension (100%) and severe heart failure (96.7%) directly reflects the high mortality data highlighted by current literature reviews and guidelines, which contraindicate pregnancy in these patients, a stance supported by studies documenting severe maternal morbidity in high-risk conditions such as Marfan syndrome with aortopathy<sup>15</sup> and other lesions like severe mitral stenosis.<sup>16</sup> This result may indicate a risk-averse attitude based on the fundamental principles of cardiology. In contrast, the responses of obstetricians showed a significantly more heterogeneous distribution. Their recommendations for congenital cyanotic heart disease were almost equally divided, and in cases of Marfan syndrome with aortic dilation, approximately half (48.9%) stated “I have no opinion”. This hesitation likely stems from several factors related to obstetric practice: a focus on fetal well-being and the continuation of a desired pregnancy, a feeling of inadequacy in directly managing life-threatening cardiac decompensations, and the ethical issues of recommending termination. In addition, obstetricians may perceive these decisions as primarily falling within the realm of cardiology. They may view their own responsibility as implementing a shared plan rather than independently making a high-risk termination decision. This difference underscores the fact that a patient’s ultimate outcome may depend heavily on which specialist they first consult. It also highlights the urgent need for structured, early multidisciplinary consultation to share a common understanding of risk and ensure consistent patient information.

In term pregnancies, a consistent and striking difference in trends was observed between the two specialties in terms of specialists’ decisions regarding the mode of delivery and IE prophylaxis. Cardiologists overwhelmingly recommended cesarean delivery, along with IE prophylaxis, in cases such as prosthetic valves (100%), a history of endocarditis (86.7%), or congenital heart disease repaired with prosthetic material in the last six months (90%). This approach shows that the guidelines strictly adhere to the recommendation of prophylaxis in these high-risk groups and that the primary focus of cardiologists is to protect against the long-term cardiac consequences (prosthetic valve infection, systemic embolism) of bacteremia that may occur during the delivery,<sup>17</sup> although the evidence base for the efficacy of prophylaxis in this specific context continues to be evaluated.<sup>18</sup> The approach of obstetricians, however, was fundamentally different. Even in the same high-risk scenarios, the majority of obstetricians (between 53.3% and 75.6%) preferred to request a cardiology consultation rather than making an independent decision about delivery method and prophylaxis. This behavior may stem from the fact that obstetricians’ primary focus is on safe labor and perinatal outcomes. A specific medical-cardiac protection strategy, such

as IE prophylaxis, is not central to routine obstetric practice, unlike emergency obstetric case management and delivery processes. Therefore, this decision may represent a “specialization boundary” for them, triggering a tendency to delegate responsibility to a specialist. This finding highlights the necessity of clearly and preemptively planning peripartum care protocols for pregnant women with high-risk cardiac disease by multidisciplinary teams, clearly defining both the mode of delivery, prophylaxis and other critical aspects such as peripartum anticoagulation management.<sup>19</sup> Otherwise, it seems possible that this critical decision-making stage may be skipped or delayed once labor begins.

This study has several limitations. Firstly, there is no existing valid scale or questionnaire specific to the topic. Another limitation is that the participants did not represent all obstetricians and cardiologists. To the extent of our knowledge, this is the first study on the attitude and management of cardiologists and obstetricians in pregnancies complicated with cardiovascular diseases, which is the strength of the study. Pregnancies complicated by CVD are not only within the purview of obstetricians and cardiologists, but also of anesthesiologists. Therefore, future studies could include larger-scale research involving anesthesiologists. The inclusion of anesthesiologists in the multidisciplinary team highlighted in this study could facilitate patient management.

## Conclusion

As a conclusion, cardiovascular diseases are the most common cause of non-direct maternal mortality. These patients should be followed closely during pregnancy, labour and postnatal period. The evaluation of patients should be performed by a multidisciplinary committee, a care model shown to optimize outcomes for pregnant women with cardiovascular disease.<sup>5,20</sup>

## Abbreviations

ACOG, American College of Obstetricians and Gynecologists; AHA, American Heart Association; CCHD, Congenital Cyanotic Heart Disease; CHD, Congenital Heart Disease; CVD, Cardiovascular Disease; EF, Ejection Fraction; ESC, European Society of Cardiology; IE, Infective Endocarditis; MI, Myocardial Infarction; mWHO, modified World Health Organization; NYHA, New York Heart Association; OECD, Organization for Economic Co-operation and Development; PAH, Pulmonary Arterial Hypertension; WHO, World Health Organization.

## Data Sharing Statement

The datasets used in this study are available from the corresponding author upon request.

## Ethics Approval and Consent to Participate

The objectives of the study were explained in detail to the study participants. The collection of demographic information and the data obtained from all patients participating in this research were done after obtaining informed consent and willingness to participate in the study. Also, all the information remained confidential and the results were published anonymously and only statistically. Approval for this study was obtained from the Local Ethics Committee (30.09.2022-22/7) and all procedures complied with the provisions of the 1995 Declaration of Helsinki (Brazil as revised in 2013).

## Consent for Publication

Written informed consent was obtained from all participants for this study.

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We would like to thank all participants who contributed to the creation of this study.

## Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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## Disclosure

The authors declare no conflicts of interest in this work.

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