



COLLEGE OF HEALTH SCIENCES

SCHOOL OF MEDICINE,

DEPARTMENT OF OBSTETRICS AND GYNECOLOGY

Maternal outcome of women with cardiac disease during intrapartum and postpartum periods at TASH, A 3 years retrospective cross-sectional study.

Principal Investigator: Dr MezgebuGietnet (OBGYN Resident-III)

Advisers: Dr Mahlet Yigeremu (Ass. Professor in OBGYN and REI subspecialist)

Dr Eskinder Kebede (Asso. Professor in OBGYN, REI subspecialist)

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DECLARATION

ADDIS ABABA UNIVERSITY COLLEGE OF HEALTH SCIENCES, SCHOOL
OF MEDICINE, DEPARTMENT OF OBSTETRICS AND GYNECOLOGY

POSTGRADUATE PROGRAM

I, Dr. MezgebuGietnet, hereby declare that this research proposal entitled “**Maternal outcome of women with cardiac disease during intrapartum and postpartum periods at TASH from January, 2021 to December, 2023: A Cross-Sectional Study**” was completed in accordance with the requirements for graduate studies under the guidance of my advisors. To the best of my knowledge and effort, I have avoided plagiarism or duplicating any material without proper citation or acknowledgment. Additionally, this work has not been previously submitted for any proposal, application, or consideration.

Dr. MezgebuGietnet

Principal investigator

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I hereby certify that I have read and evaluated this research report entitled “**Maternal outcome of women with cardiac disease during intrapartum and postpartum periods at TASH from January, 2021 to December, 2023: A Cross-Sectional Study**” have overseen this work from its initial stages to its current form, ensuring it is ready for submission to the DRPC for final approval as part of the requirements for the Degree of Specialty in Obstetrics and Gynecology.

Dr. Mahlet Yigeremu

1. Advisor

Signature

Date

Dr. Eskinder Kebede

2. Advisor

Signature

Date

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Acronyms

ANC	Antenatal Care
ASD	Atrial Septal Defect
ADHF	Acute Decompensated Heart Failure
AR	Aortic regurgitation
AS	Aortic stenosis
AVSD	Atrioventricular Septal Defect
CD	Cesarean Delivery
CHD	Congenital Heart Disease
CICU	Cardiac Intensive Care Unite
CPD	Cephalopelvic Disproportion
CS	Cesarean section
CV	Cerebrovascular
CVD	Cardiovascular Disease
DM	Diabetes Mellitus
EA	Epidural Anesthesia
ECG	Electrocardiogram
EGOPD	Emergency of Gynecology and Obstetrics Outpatient Department
GA	Gestational Age/General Anesthesia
HD	Heart Disease
HHD	Hypertensive Heart Disease
HF	Heart Failure

HTN	Hypertension
IUGR	Intrauterine Fetal Demise
LW	Labor Ward
MICU	Medical Intensive Care Unit
MR	Mitral stenosis
MS	Mitral Stenosis
NRFHRS	Non-Reassuring Fetal Heart Rate status
NYHA	New York Heart Association
OBGYN	Obstetrics and Gynecology
OVD	Operative Vaginal Delivery
PCMP	Peripartum Cardiomyopathy
PDA	Patent Ductus Arteriosus
PTHN	Pulmonary Hypertension
PI	Principal Investigator
PIH	Pregnancy Induced Hypertension
RHD	Rheumatic Heart Disease
RVI	Retroviral Infection
SA	Spinal Anesthesia
SCAP	Sever Community Acquired Pneumonia
SVD	Spontaneous Vaginal Delivery
TASH	Tikur Anbessa Specialized Hospital
TR	Tricuspid regurgitation
VHD	Valvular Heart Disease
VSD	Ventricular Septal Defect

ABSTRACT

Background: Heart disease affects between 1% and 4% of pregnancies and continues to be a leading cause of maternal death worldwide, affecting women in both high-income and low- to middle-income countries. The maternal mortality rate due to cardiac conditions is approximately 9% in developed nations and 36% in developing regions. However, there is limited research in Ethiopia to fully understand the impact of heart disease on pregnant women and its effect on maternal outcomes.

Objective: The purpose of this research is to evaluate how cardiac disease affects maternal outcomes in women with heart conditions during labor, delivery, and the postpartum period up until they are discharged from the hospital. The ultimate goal is to enhance their health and overall well-being.

Methods: The study retrospectively enrolled 92/127 women with cardiac illness, who received labor and delivery service at Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia, from Jan 1st, 2021 to Dec 31, 2023. Census sampling method was applied to include study participants. The data entered and analyzed using Epi-info version 7.0 and SPSS version 25.0. Bivariable regression done and variables with p-value ≤ 0.25 analyzed with multivariable logistic regression with a level of significance <0.05 .

Results: In this study, 92 participants that fulfill the inclusion criteria were enrolled following review of their medical charts. Majority of the study participants (65.2%) found in the age group of 25-34 years with mean $\pm$ SD of 28.1 ± 5.2 . Almost one-third of the participants were primiparous and 63% were from the rural area. This study shows the significant cause of heart disease is acquired causes (84.8%, n=78). Majority of patients (40.2%, n=37) have a functional status of NYHA class II. Mitral valve is the most commonly affected valve with 80.5% (n=74) contribution. Majority (46.7%, n=43) of deliveries were via operative vaginal deliveries and 34.8% (n=32) were delivered via C/S. Composite adverse maternal outcome was found in 28%, (26/92) participants. Heart failure and pulmonary edema were the two most common acute cardiac events each contributing 10.9% respectively.

Key words: cardiac disease, maternal outcome, Ethiopia

1. Introduction

1.1 Background

Heart disease affects between 1% and 4% of pregnancies, and over the past 20 years, it has been responsible for 10-15% of all pregnancy-related deaths. Maternal mortality rates due to cardiac disease are around 9% in developed countries and can reach up to 36% in developing nations. [10] In 2017, Ethiopia recorded 7,451 maternal deaths, with a maternal mortality rate of 401 per 100,000 live births. According to a study conducted in three hospitals in Addis Ababa, heart disease accounts for approximately 15.5% of these maternal deaths. [26, 30]

Etiologically, cardiac diseases are categorised as congenital or acquired. Acquired heart diseases are further classified into valvular heart diseases, coronary artery diseases, hypertensive heart disease and cardiomyopathies and others. Whereas, Congenital heart diseases (CHD) are classified as cyanotic or acyanotic. [14]

Due to the physiological changes that occur during pregnancy to meet increased metabolic demands, women with cardiovascular diseases become more susceptible to negative heart-related events. Pregnancy can accelerate the progression of these conditions, either by revealing previously undetected heart issues or by worsening the severity of existing ones.[4] These clinical situations can negatively affect both the mother's health and that of the unborn baby. The periods of labor, delivery, and postpartum involve sudden changes in blood flow, which can lead to maternal health complications. However, with proper management, many women with serious heart conditions can still have positive outcomes and should not be discouraged from pursuing pregnancy. [11]

Rheumatic heart disease (RHD) is the leading cause of valvular disease in developing countries. In fact, 90% of all heart conditions in women of childbearing age in non-industrialized areas are caused by rheumatic heart disease. [21]

Around 80% of maternal deaths happen in regions with high birth rates and limited access to healthcare. [26] For instance, women in sub-Saharan Africa, where healthcare is among the poorest

globally, face a much higher risk of dying from pregnancy-related complications. Uncontrolled preexisting heart conditions, such as cardiomyopathy and hypertension during pregnancy, are major contributors to the high maternal mortality rates in low- and middle-income countries. Cardiovascular disease is the leading cause of indirect maternal deaths, responsible for over 33% of pregnancy-related fatalities. [\[28\]](#), [\[10\]](#)

Heart disease during pregnancy can lead to a range of complications for both the mother and the baby. Maternal complications may include congestive heart failure, arrhythmias, pulmonary edema, and pre-eclampsia. For the baby, risks include preterm delivery, low birth weight, intrauterine growth restriction, and even fetal loss. In severe cases, neonatal mortality and maternal mortality can also occur. [\[5\]](#)

It is believed that up to 68% of pregnancy-related deaths due to cardiovascular conditions can be prevented. This can be accomplished by raising awareness and implementing preventive strategies, such as preconception care, early and consistent antenatal care, multidisciplinary management, and access to specialized treatment. Understanding the risks linked to cardiovascular disease during pregnancy is crucial for improving outcomes. [\[25\]](#)

1.2 Statement of the problem

Cardiovascular diseases (CVDs) are responsible for over a third of pregnancy-related deaths worldwide and are one of the leading causes of indirect maternal mortality. [2] The impact of CVDs varies significantly across different regions, with low- and middle-income countries, including Ethiopia, experiencing a disproportionately high number of these deaths. This is largely due to the prevalence of conditions like rheumatic fever and rheumatic heart disease in these areas. [1]

Rheumatic heart disease is the most common heart condition seen in pregnant women and is a major cause of both maternal and perinatal complications. Pregnant women with this condition face a higher risk of problems like heart arrhythmias and heart failure, as the increased blood volume during pregnancy puts extra strain on the heart valves. Many women may not even realize they have rheumatic heart disease until they become pregnant. [20, 23]

In developing countries like Ethiopia, where preconception counseling is limited (16.27%) and antenatal care is often inadequate, pregnancy outcomes can vary significantly in resource-constrained settings. However, there is a lack of studies that provide a comprehensive understanding of pregnancy outcomes for women with cardiovascular diseases in the Ethiopian context. [29], [50]

1.3 Significance of the study

This article can shed light on the burden of cardiac disease on pregnancy, as well as risk for adverse outcomes for the mother. By studying the experiences and negative adverse outcomes of pregnant women with cardiac disease, we can generate local evidence to develop tailored evidence-based guidelines and protocols for managing their condition effectively during delivery and postpartum. Ultimately, it leads to improved healthcare services, better decision-making, and enhanced support for women with cardiac disease during pregnancy.

2. Literature Review

A study conducted in the United States involving 2,284,044 delivery admissions found that 3,871 women had heart disease.[2] In South Asia, the prevalence of heart disease among pregnant women was 1.46%.[18] Similarly, research at Jimma University Medical Center revealed that 6.4% of pregnant women receiving antenatal care had cardiac conditions. [26] At Saint Paul's Hospital in Addis Ababa, 10.3% of expectant mothers attending antenatal follow-ups were diagnosed with cardiovascular disease. [5]

In the United States, among women with heart disease, 17% were diagnosed with cardiomyopathy, 40% had valvular heart disease, 35% had congenital heart disease as adults, and 8% were affected by pulmonary hypertension. [2] A study conducted in Iraq on pregnant women with heart disease found that 34.1% had valvular heart disease, 30.5% had congenital heart disease, 29.8% were diagnosed with cardiomyopathy, 4% had pulmonary hypertension, and 1.6% were affected by ischemic heart disease. Among those with cardiomyopathies, 76% of cases were due to peripartum cardiomyopathy. [9] In South Africa, organic valve lesions complicated 63.5% of pregnancies, with prosthetic valves found in 20.1% of cases. A combination of both organic lesions and prosthetic valves was seen in 7.9%, while 9.0% of pregnancies were affected by congenital heart disease.[16] Research carried out in Jimma revealed that 3.2% of pregnant women attending antenatal care had chronic rheumatic heart disease, 1.9% were found to have atrial septal aneurysm, and 1.3% had hypertensive heart disease.[4]

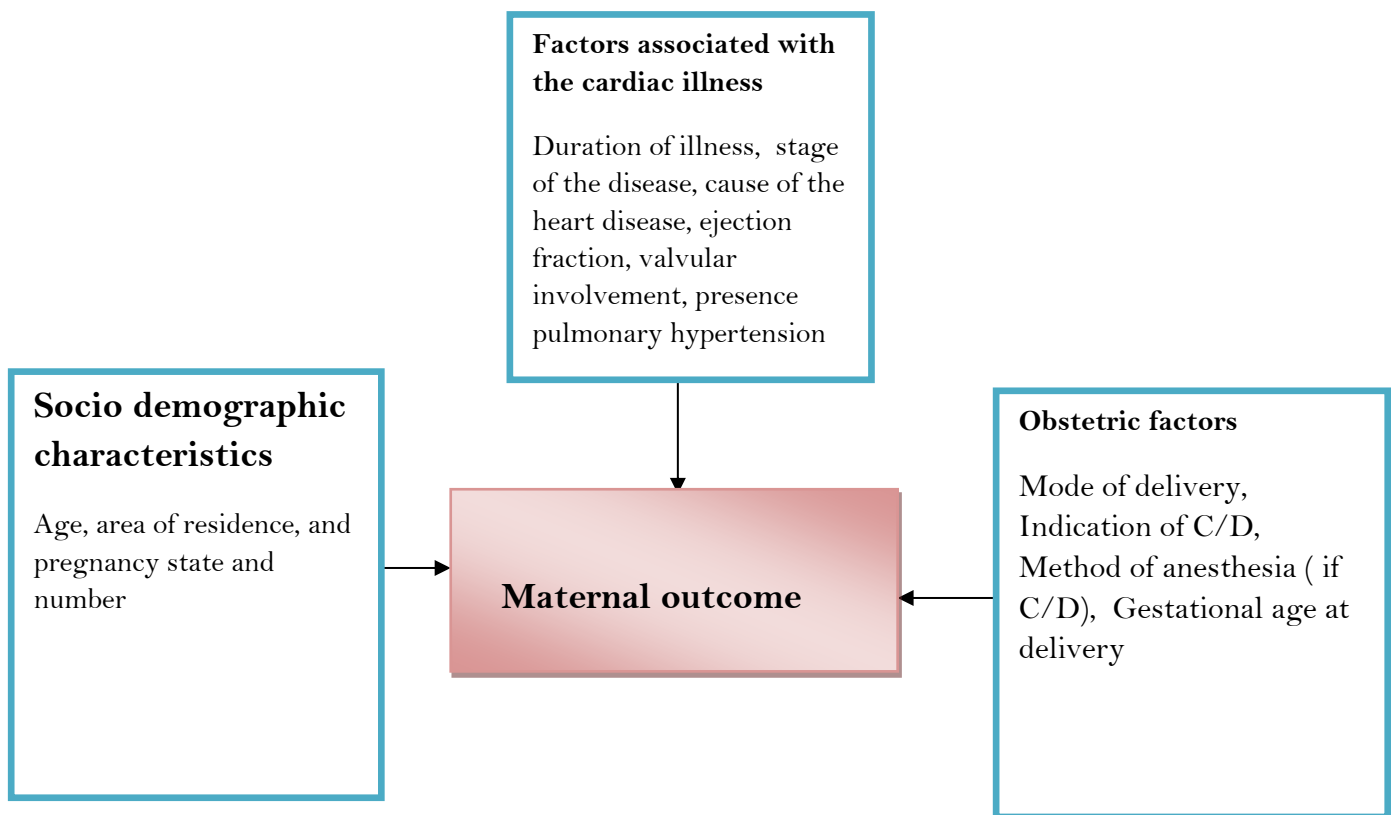
In Central Vietnam, 32.1% of pregnant women were diagnosed with mitral valve disease, 23.9% had rhythm disorders, 9.0% had aortic valve disease, and 3.0% had both mitral and aortic valve conditions. [13] In India, 80.5% of women with heart conditions had a single valve affected, with mitral stenosis (MS) being the most common at 48.5%. [6] In Western Kenya, a study found that half of the women had mitral stenosis, and of those, one-third had severe cases. Pulmonary hypertension was present in 61% of the cases. [19] In Jimma, Ethiopia, mitral valve disease was the most common (89.7%), followed by aortic (55.2%) and tricuspid (44.8%) valve disease. Isolated mitral valve lesions were observed in 13.9% of women. The most frequent combination

of valve issues included mitral stenosis (MS) with mitral regurgitation (MR) and aortic regurgitation (AR) (13.8%), followed by mitral stenosis with tricuspid regurgitation (TR) (10.3%). [14]

In Vietnam, 28% of women with heart disease were classified as New York Heart Association (NYHA) class III or IV, with 66.5% of cases diagnosed during their current pregnancy. Among these women, 73.5% had a vaginal delivery, and 15% required labor induction. [13] In India, 61.4% of women with heart disease were in NYHA class III or IV, and only 53.8% had been diagnosed with a cardiac condition before becoming pregnant. [6] At a tertiary center in Jimma, Ethiopia, 44.8% of women had been diagnosed with valvular heart disease (VHD) before their current pregnancy. [14]

A study included different countries across Asia, Africa and Europe, maternal mortality (overall 0.6%) was highest for those with the pulmonary arterial hypertension group (9%). [22] In Kenya, maternal deaths were 12.2% and 8.8% of adverse events needed admission to the ICU. [17] In selected hospitals of Addis Ababa, Ethiopia, 8.1% of the pregnancies with cardiac illness ended with maternal death. [15] In Jimma, Ethiopia, maternal deaths occurred in 6.9% and both of them died during post-partum period. In both of the cases, cause of death was cardiogenic shock followed by cardiac arrest. [14] In multicenter study included different regions of the world, HF occurred in 11%, arrhythmias in 2%. [22] The study done in Kenya, maternal cardiac events found in 60% of women, with highest complication being heart failure (23.3%) of all cardiac events, followed by pulmonary edema in 16.7% and arrhythmias in 15.6%. Cardiac arrest in 4.4% of women and pulmonary edema in 18.5% during postpartum period. [17] From pregnant women with HD attending selected hospitals in Addis Ababa; there were 25.5% HF events and 18.7% life threatening arrhythmia events. [15] In Jimma, Ethiopia, the commonest complication was worsening of HF (75.9%). [14]

2.1 Conceptual Framework



3. Objectives of the study

3.1 General objective

To assess maternal outcome of patients with cardiac disease during intrapartum and postpartum periods until discharge from the hospital at Tikur Anbessa Specialized Hospital from January 1st, 2021 to December 31, 2023

3.2 Specific objective

- To describe the socio-demographic and obstetrics characteristics of women with cardiac disease who gave birth during the study period at TASH.
- To describe the types of cardiac disease in women with cardiac illness who gave birth during the study period.
- To evaluate the magnitude of maternal adverse outcomes in terms of CICU admission and death during intrapartum and postpartum periods until discharge.
- To assess the magnitude of acute cardiac events among those with cardiac diseases during intrapartum and postpartum period up to discharge from the hospital.
- To identify factors that contributed to acute cardiac events in those women with cardiac disease who gave birth during the study period.

4. Methods

4.1 Study Area

Tikur Anbessa Specialized Hospital was established in 1972 G.C located in Addis Ababa, Ethiopia. There are about 3,400 workers, from these 1,100 physicians and 930 nurses. The hospital is serving patients who come from all over of the country and as the data from the hospital shows , there were about half a million patients who visited the hospital in the year 2010 E.C in all departments and based on the data in 2022, there are about 4,000 deliveries per year in OBGYN department. The hospital has different units of services capable of giving specialty level care for women with CVD. These include the Cardiology Unit in the Internal Medicine Department, the Cardiothoracic Unit in the Surgery Department and the Cardiac ICU and Critical Care Unit in the Anesthesiology Department. The Obstetrics and Gynecology department is staffed with Maternal and Fetal Medicine specialists to give care for pregnant mothers with cardiac illness and other high risk mothers. For these reasons many pregnant women with cardiac illness from all parts of the country including from rural areas referred to this hospital for multidisciplinary team management as there are only few hospitals in the country equipped with such specialties and services. This makes Tikur Anbessa Specialized Hospital the right place to study the topic of interest in my research

4.2 Study Period

The study period is from Jan 1st, 2021 to Dec 31, 2023

4.3 Study design

A three years retrospective cross-sectional study design was applied.

4.4 Population

4.4.1 Source population

All Women who gave birth at TASH from January 01, 2021 to December 31, 2023

4.4.2 Study population (sample)

All women with cardiac disease who gave birth at TASH from January 01, 2021 to December 31, 2023.

4.5 Inclusion and exclusion criteria

4.5.1 Inclusion criteria

Women with diagnosed cardiac disease who gave birth at TASH whose GA at delivery is ≥ 28 weeks and/or birth weight of ≥ 1 kg if gestational age is not available

4.5.2 Exclusion criteria

Patients with undiagnosed cardiac illness or with lost medical records or incomplete medical records.

4.6 Sample Size Determination and Sampling Procedure

4.6.1 Sample size Determination

Sample size was calculated using a single population formula. The formula and calculation procedure is indicated below:

$$n = \frac{(Z\alpha/2)^2 p (1-p)}{d^2}$$

Where n is sample size

Z is standard normal distribution value at 95% confidence level = 1.96 (from significance level $\alpha = 5\%$)

P is 8.1% (Is taken from maternal death of women with cardiac illness in selected hospitals)[9]

d = margin of error = 5%.

The sample size is calculated as:

$$n = \frac{(1.96)^2 (0.081) (1-0.081)}{(0.05)^2} = 115$$

We then added 10% for absent documentation and the minimum sample size will be **127**.

4.6.2 Sampling Procedure

Census method was applied to collect the sample population in which all cardiac patients who were given labor and delivery service in Tikur Anbessa Specialized Hospital from Jan 2021 to Dec 2023 were included. These patients' card numbers and their names were collected from EGOPD, LW, CICU and MICU log books to retrieve their medical records (charts) and we were able to collect **108** patients' card number and names, and 6 cards were missed, 10 charts had incomplete medical record and we were able to collect **92** patients' charts with complete documentation.

4.7 Study variables

4.7.1 Dependent variables

Maternal severe adverse outcomes/ *primary outcome*

- Maternal death
- CICU admission

Acute cardiac events/secondary outcome

- Pulmonary edema
- Arrhythmia requiring treatment
- Cardiogenic shock
- Maternal collapse
- Heart failure
- Cardio-embolic stroke

4.7.2 Independent variables

- Socio-demographic factors
- Cause of heart disease
- Stage of heart disease(NYHA classification)
- Duration of illness since diagnosis
- Indication of C/D

- Method of anesthesia (if C/D)
- Gestational age at delivery
- Length of hospital stay after delivery
- Echocardiogram status
- Valvular lesions

4.8 Operational definition

Heart Disease

Diagnosed if a woman presents with complaints coupled with echocardiography and chest radiograph and ECG findings, showing cardiac lesions/ abnormalities

Adverse Maternal Outcome

Maternal death, CICU admission

Acute cardiac events

Pulmonary edema, arrhythmia requiring treatment, cardiogenic shock, maternal collapse, heart failure, CV accidents

4.9 Data Collection, Analysis and Management

4.9.1 Data collection procedures

Ethical Approval was obtained from the Department Of Obstetrics and Gynecology Research and Publication Committee. The Tikur Anbessa specialized Hospital was requested to grant access to medical log books and medical charts.

Each member of the study population name and card number was collected from EGOPD, Labor and Delivery, CICU and MICU registration log books. Their chart was collected based on their card number and name. Identified charts were the source of the data on a semi-structured questionnaire administered by two year I OBGYN residents.

Data cleaning procedure was done to ensure the accuracy and reliability of the collected data. All collected data was carefully evaluated for consistency and completeness by PI. Any inconsistencies or discrepancies in the data was thoroughly investigated and resolved through cross-validation with the data source.

4.9.2 Data collection tool

A semi-structured questionnaire was created after several literature reviews completed globally were reviewed in order to gather sociodemographic and clinical parameters related to heart disease. All the variables were included in a semi-structured pretested questionnaire that was used to gather the required data from medical records. The most senior physician's patient evaluation note contained all the information needed from the charts and computerized record system, and it was further enhanced by investigation results and follow-up sheets from the internal medicine and obstetrics departments.

4.10 Data analysis

The collected data was loaded into the version 7.0 of EPI-info. Then, for data administration and additional statistical analysis, the cleaned and coded data will be exported to SPSS (Statistical Package for Social Science) version 25. The study population's clinical and demographic features were compiled using descriptive statistics. The means of continuous variables were displayed alongside their standard deviations. Frequencies and percentages were used to represent categorical variables. Bivariant logistic regression was used to examine the data, with a P-value of 0.25. Then, using multivariable logistic regression with a P-value of 0.05, the variables for those below the bivariable analysis's cut off significance were examined in order to evaluate the relationship between cardiac conditions and maternal outcomes as well as to calculate the odds ratios and 95% confidence intervals for unfavorable outcomes.

4.11 Ethical considerations

After receiving ethical approval from the research and publication committee of the Department of Obstetrics and Gynecology at Addis Ababa University's College of Health Science, the study was carried out. Throughout the project, confidentiality was upheld and only the principal investigator had access to the material gathered.

4.12 Dissemination of findings

After completion, the report of the study was submitted to Addis Ababa University College of Medicine and Health Science and the findings will be reported to the Department of Obstetrics and

Gynecology. Attempts will be made to share the findings with other stakeholders through publication and through presentations at conferences.

5. Results

5.1 Demographic and obstetric characteristics of the study participants

In this study, 92 (72% of the calculated minimum sample size) participants that fulfill the inclusion criteria were enrolled following a review of medical charts as 16 charts were not included because of missed cards (n=6) and incomplete medical record (n=10). Majority of the study participants (65.2%) were found in the age group of 25-34 years with mean $\pm$ SD of 28.1 $\pm$ 5.2. Almost one-third of the participants were primiparous and 63% were from the rural area as shown the table 1 below. Other sociodemographic variables like income, educational status, and marital status e.t.c were not available from the medical charts reviewed.

Table 1: The socio-demographic characteristics of cardiac patients who gave birth at TASH from January 01, 2021 to December 31, 2023 GC.

Variable	Frequency	Percent
Maternal age of the study of participants (Yrs.)		
19-24	14	15.2
25-34	60	65.2
35-44	18	19.6
Parity		
Primipara	33	35.9
Multipara	45	48.9
Grand multipara	14	15.2
Area of Residence		
Urban	58	63
Rural	34	37

5.2 Cardiac illness related characteristics of the study participants

More than half (51.1%) of the participants had 1-5 years of cardiac illness duration with mean and SD 6.5 ± 2.4 years respectively. Fifty-one percent of the participants had one affected heart valve and 84.8% of patients were caused by acquired HD and from these, CRHVD accounts 81.5%. Mitral valve stenosis is the commonest (41, 44.6%) affected valve and most study participants (40.2%) were in NYHA class II functional status.

Table 2: Cardiac illness related characteristics of the study participants

variable	frequency	Percent
Duration of cardiac illness in years		
<1	12	13
1-5	47	51.1
6-10	17	18.5
>10	16	17.4
Causes of HD		
CHD	14	15.2
Acquired HD	78	84.8
NYHA classification		
NYHA Class 1	28	30.4
NYHA Class 2	37	40.2
NYHA Class 3	25	27.2
NYHA Class 4	2	2.2
Number of Heart valves affected (CRVHD)		
1 valve	49/75	65.3
2 valves	37/75	49.3
3 valves	6/75	8

5.3 Presence of valve lesions during index pregnancy

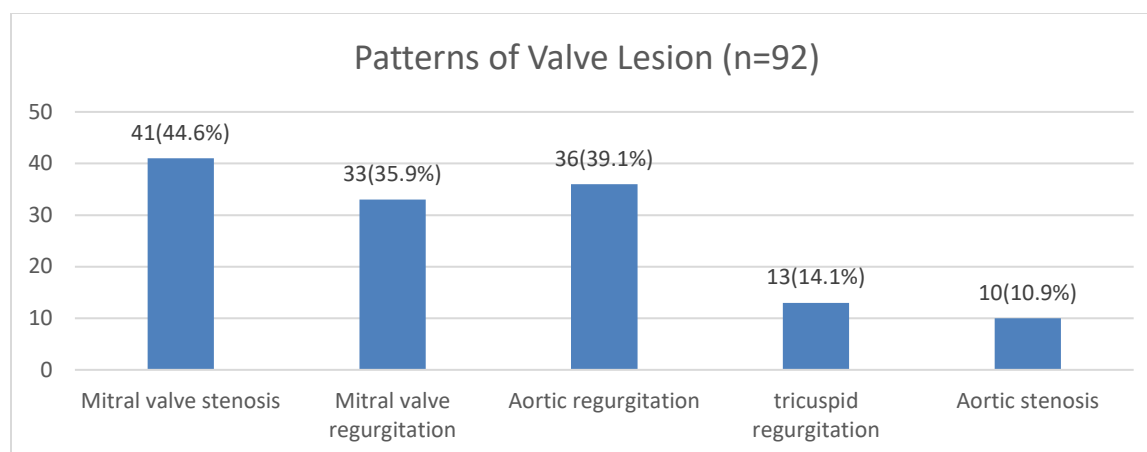


Figure 1. The patterns of valve lesion.

5.4 The cardiac valves lesion severity and echocardiogram findings during index pregnancy

Table 3: , The cardiac valves lesion severity PHTN, ward admission and ejection fraction of study participants during index pregnancy from recent echocardiogram finding

Variable	Frequency	Percent
Severity of mitral valve regurgitation (n=33)		
Mild	13	39.4
Moderate	13	39.4
severe	7	21.2
Severity of Mitral valve stenosis (n=41)		
Mild	12	29.3
Moderate	22	53.7
severe	7	17.1
Severity of tricuspid valve regurgitation (n=13)		
Mild	6	46.2
Moderate	6	46.2
severe	1	7.7
Severity of aortic regurgitation (n=36)		
Mild	11	30.6
Moderate	17	47.2
severe	8	22.2
Severity of aortic stenosis(n=10)		
Mild	3	30
Moderate	4	40

severe	3	30
Presence of PHTN		
Yes	36	39.1
no	56	60.9
Degree of pulmonary hypertension (n=36)		
Mild	20	55.6
Moderate	12	33.3
severe	4	11.1
Ward admission during index pregnancy		
Yes	19	20.7
No	73	79.3
Reason for ward admission (n=19)		
HF	7	36.8
Sever CAP	4	21.1
Cardiogenic shock	2	10.5
Cardioembolic stroke	6	31.6
Ejection friction		
40-49	2	2.2
50-59	2	2.2
>=60	88	95.7

5.5 The study participants' obstetric characteristics

Fifty-four percent of the participants were delivered at a gestational age of 39 – 40+6 weeks and 51.1% were delivered by operative vaginal delivery and 34.8% were delivered by cesarean section. From those of delivered by cesarean n section, 46.9% were done by epidural anesthesia and 56.25% of the C/S indication was NRFHBP as shown in the table below.

Table 4: The study participants' obstetric characteristics

Variable	Frequency	Percent
Gestational age at delivery		
<37 weeks	17	18.5
37 – 38 ⁺⁶ weeks	13	14.2
39 – 40 ⁺⁶ weeks	50	54.4
41 – 41 ⁺⁶ weeks	12	13
Mode of delivery		
Spontaneous vaginal delivery	13	14.1
Cesarean section	32	34.8
Operated vaginal delivery (Forceps delivery)	47	51.1
Types of anesthesia for those delivered by caesarian section (n=32)		
GA	11	34.4

Spinal	6	18.8
Epidural	15	46.9
Indication for caesarian section (N=32)		
NRFHBP	18	56.25
Previous CS scar	8	25
IUGR	2	6.25
CPD	1	3.1
Severe PHTN	1	3.1
Severe AS	1	3.1
ADHF	1	3.1
Length of hospital stays after delivery		
With in 3 days	32	34.8
3 - 5 days	34	37.0
6 - 10 days	12	13.0
11 - 15 days	8	8.7
> 15 days	6	6.5

5.6 Adverse Maternal Outcomes related characteristics the participants

The figure below showed that 28% of the participants had adverse maternal outcome.

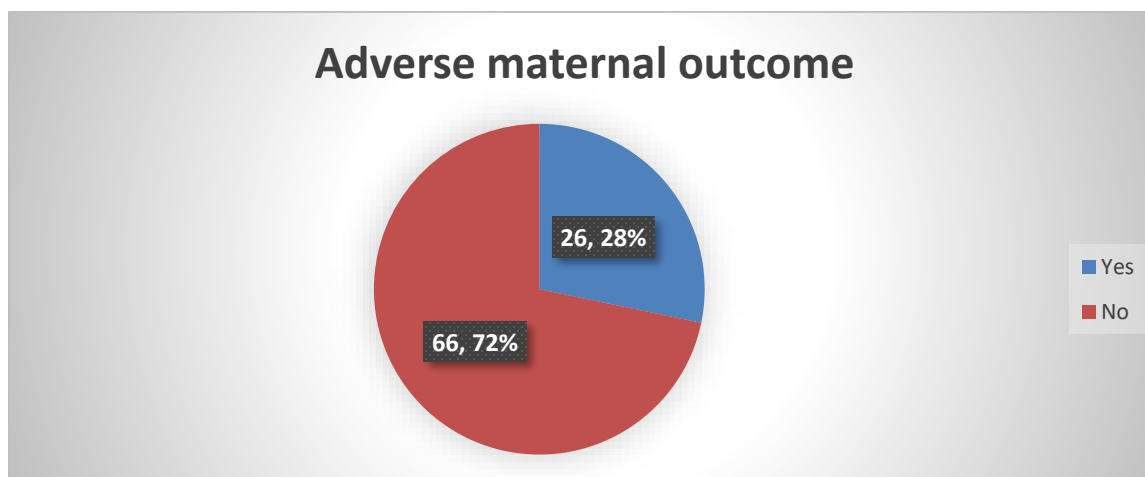


Figure 2. Adverse maternal outcome women having cardiac illness.

Twenty-six percent of the participants were admitted in to cardiac ICU postpartum and a mother (1.1%, 1/92) died after vaginal delivery. The mother was initially admitted to CICU for heart failure at GA of 33+2 weeks and she developed labor after 5 days of admission and she delivered in CICU vaginally a 1.2 kg neonate which eventually died after admitted to NICU. Following her delivery, there was worsening of the cardiac condition and she died on her 3rd postpartum day with cardiogenic shock complicated by cardiac arrest.

Table 5.The characteristics of adverse maternal outcome

variable	frequency	Percent
Cardiac ICU admission		
Yes	26	27.2
No	66	72.8
Maternal death		
Yes	1	1.1
No	91	98.9

5.7 The determinants of maternal adverse maternal outcomes

The finding of the study revealed area of residency, parity and cause of HD had an association with adverse maternal outcome by bivariate logistic regression. The multivariate logistic regression showed study participates who were from rural area had 8.3 folds increase in adverse maternal outcome compared to those from urban area (AOR=8.3, 95%CI=2.21, 31.09). Study participants having two and three affected valves had 5.0 and 18.4 folds increase in adverse maternal outcome compared to those of having only one affected valve (AOR=5.0, 95%CI=1.21, 20.89& AOR=18.4, 95%CI=1.76, 92.67) respectively.

Table 6.The bivariate and multivariate logistic regression of association between adverse maternal outcomes and independent variables.

Variable	Adverse Maternal outcomes		p-value	COR with 95%CI	p-value	COR with 95%CI
	Yes	No				
Area of residence						
Urban	8	50	1		1	
Rural	18	16	0.000	7.1(2.57, 19.21)	0.002	8.3(2.21, 31.09)
Parity						
Primipara	7	26	1		1	
Multipara	10	35	0.915	1.1(0.36, 3.16)	0.581	0.68(0.17, 2.68)
Grand multipara	9	5	0.007	6.7(1.69, 26.45)	0.108	4.2(0.73, 24.83)
Number of affect valve						
One	7	40	1		1	
Two	13	23	0.026	3.2(1.13, 8.25)	0.026	5.0(1.21, 20.89)
Three	6	3	0.003	11.4(2.30, 56.70)	0.015	18.4(1.76, 92.67)
Cause of HD						
CHD	8	6	0.013	4.4(1.36, 14.49)	0.254	2.8(0.48, 15.90)
AHD	18	60	1		1	
Mitral valve stenosis						

Yes	15	26	0.115	2.1(0.84, 5.27)	0.735	0.80(0.22, 2.87)
no	11	40	1		1	
Presence of PHTN						
Yes	11	25	0.195	1.5(0.48, 3.03)	0.128	0.32(0.07, 1.39)
no	15	41	1		1	

5.8 The study participants characteristics of acute cardiac events

The figure below showed the magnitude of acute cardiac events were 22% (95%CI=10.9, 28.2)

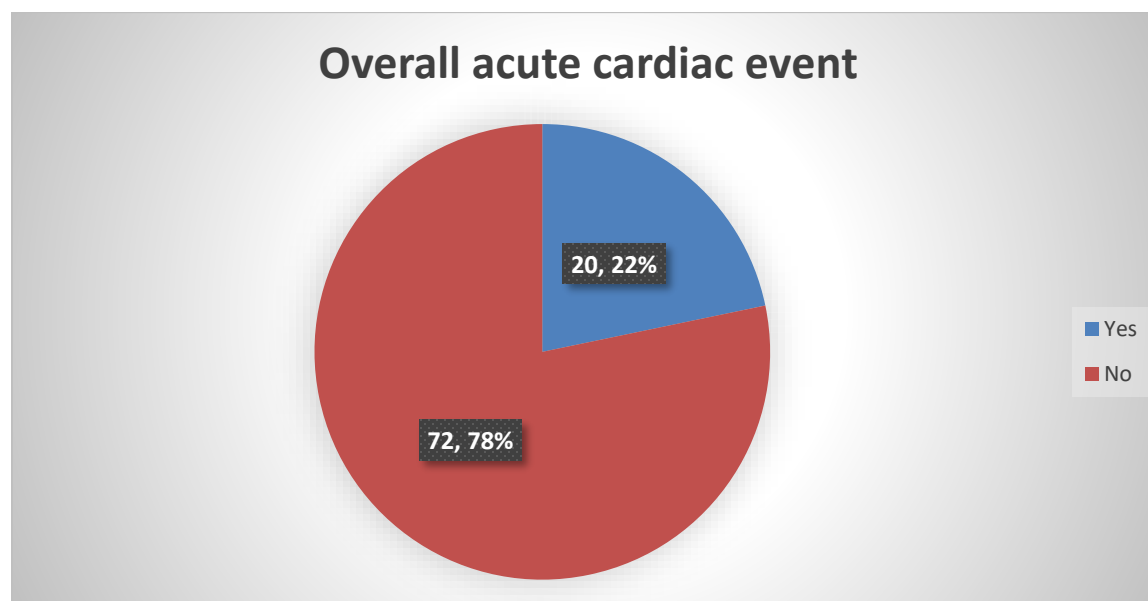


Figure 3. The magnitude of acute cardiac events among women who gave birth in TASH.

5.9 The acute cardiac event related characteristics of study participants

Almost eleven percent of the patients were diagnosed and treated for pulmonary edema in the postpartum period and 2.2% were diagnosis thrombotic stroke. More than five percent of the participants had arrhythmia and from those 60% of them had atrial fibrillation and 60% were diagnosis during labor. Eleven percent of the participants had heart failure and 5.4% of the participants had cardiogenic shock.

Table 7. The acute cardiac event related characteristics of study participants

variable	frequency	percent
Diagnosis of pulmonary edema		
Yes	10	10.9
no	82	89.1
Time of diagnosis		
Postpartum period	10	100
Diagnosis of thrombotic stroke		

Yes	2	2.2
no	90	97.8
Time of diagnosis		
Postpartum period	2	100
Diagnosis of arrhythmia		
Yes	5	5.4
no	87	97.6
Types of arrhythmias		
Atrial fibrillation	3	60
Supraventricular tachycardia	2	40
Time of diagnosis		
During labor	3	60
Postpartum period	2	40
Diagnosis of heart failure		
Yes	10	10.9
no	82	89.1
Time of diagnosis		
During labour	5	50
Postpartum period	5	50
Diagnosis of cardiogenic shock		
Yes	5	5.4
No	87	94.6
Time of diagnosis		
During labour	5	100

5.10 Determinant factors of acute cardiac events

Parity, number of affected valves, indication for CD and aortic regurgitation had association with acute cardiac events by bivariate logistic regression. The multivariate logistic regression revealed that study patients with three affected valves had 2.6 folds increase in acute cardiac event compared to those of having only one affected valve (AOR=2.6, 95%CI=1.38, 18.49) and those having AR had 1.9 folds increase its acute cardiac event compared to those of its opposite compartment (AOR=1.9, 95%CI=1.46, 8.21). Study participants who were delivered through spontaneous vaginal delivery had 2.9 folds increase its acute cardiac event compared to those of delivered by operated vaginal delivery (AOR=1.58, 15.42).

Table 8. The bivariate and multivariate logistic regression of association between acute cardiac events and independent variables

Variable	Acute cardiac events		P-value	COR with 95%CI	P-value	AOR with 95%CI
	Yes	No				
Residency						
Urban	10	48	1		1	
Rural	10	24	0.176	2.0(0.73, 5.46)	0.686	1.3(0.34, 5.06)
Parity						
Primipara	5	28	1		1	
Multipara	8	37	0.759	1.2(0.36, 4.10)	0.846	0.86(0.19, 3.85)
Grand multipara	7	7	0.017	5.6(1.36, 23.06)	0.250	3.4(0.43, 26.68)
Number of affected valves						
One	8	39	1		1	
Two	7	29	0.776	1.2(0.38, 3.62)	0.660	0.74(0.19, 2.79)
three	5	4	0.020	6.1(1.33, 27.83)	0.029	2.6(1.38, 18.49)
Cause of HD						
CHD	7	7	0.009	5(1.49, 16.69)	0.247	2.5(0.54, 11.33)
AHD	13	65	1		1	
Mitral valve stenosis						
Yes	12	29	0.121	2.2(0.81, 6.11)	0.522	1.6(0.39, 6.24)
No	8	43	1		1	
Aortic regurgitation						
yes	12	24	0.035	3.0(1.08, 8.32)	0.012	1.9(1.46, 8.21)

No	8	48	1		1	
Mode of delivery						
Spontaneous vaginal delivery	5	8	0.070	3.6(0.90, 14.14)	0.029	2.9(1.58, 15.42)
Caesarian delivery	8	24	0.265	1.9(0.61, 5.92)	0.879	0.89(0.20, 3.91)
Operated vaginal delivery	7	40	1		1	

5. DISCUSSION

In our study, about 2/3rd of the participants found in the age group of 25-24 years. More than half of the patients (48.9%) were multiparous, 35.9% were primiparous and 15.2% grand multiparous. A study done Addis Ababa showed comparable results with 62.1% in the same age group.[5] Another study done in the same city shows about 52.3% mothers were multiparous and 31.3% were primiparous and 16.4% were grand multiparous. [4] These studies showed nearly similar sociodemographic characteristics with our study. In our study participants, most (66.3%) came from urban areas. In a study done in the same city, 62% were also from rural area which is comparable to our study. [4]

From the results of study, the primary outcomes were CICU admission and maternal death and secondary outcomes were acute cardiac events. One third (28%) of patients were admitted to CICU and all were admitted after delivery. From all the study participants 1.1% (n=1) mother died after delivery. In hospitals of Addis Ababa, Ethiopia, 8.1% of the pregnancies with CVD ended with maternal mortality. [15] In Jimma, Ethiopia, (6.9%) maternal deaths happened and both were died during post-partum period. In both cases, cause was cardiogenic shock which later complicated by cardiac arrest. [14] In Kenya, there were 12.2% of maternal mortality; 8.8% of acute cardiac events needed ICU admission. [17] Rate of Maternal death in our study is much lower than other comparative studies because, our study participants were most with mild diseases and had good functional status and our study focused only on intrapartum and postpartum events in the hospital.

The study also investigates the occurrence of different acute cardiac events. Based on the finding, 10.9% experienced pulmonary edema, 10.9% heart failure, 5.4% were diagnosed for cardiogenic shock, 5.4% were diagnosed and treated for arrhythmia, and 2.2% patient was diagnosed with

cardio-embolic stroke after delivery. In selected hospitals of Addis Ababa; 25.5% had heart failure events and 18.7% had life threatening arrhythmia.[15] According to a study conducted in Kenya, 60% of women experienced maternal cardiac events. Heart failure (HF) accounted for 23.3% of all cardiac events, with pulmonary edema (16.7%) and arrhythmias (15.6%) following closely behind. In the postpartum period, pulmonary edema was 18.5% and maternal cardiac arrest was 4.4% of women. [17] These discrepancies might be due to a single valve being affected, a small sample size, a restricted study period (from the start of delivery to discharge from a single hospital), and the fact that the majority of our patients had better cardiac functional status.

In our study, 81.5% mothers delivered at or >37 weeks where as 18.5% were delivered preterm. Majority (46.7%) of deliveries were forceps assisted vaginal deliveries and 34.8% (n=32) of them were delivered via C/S. A study done in Addis Ababa, about two-fifths (39.6%) of the mothers delivered at preterm and 49.2% delivered at term and 11.2% of the pregnancies had post term delivery. While two-fifths (39.6%) delivered vaginally, the rest were either emergency or elective cesarean deliveries (26%).[4] A study done in India shows most (60%) of the deliveries were done via C/S while 40% were vaginal deliveries and majority (66%) were delivered at term whereas 34% was contributed by preterm deliveries. [21] Another study done in Germany, 26.2% delivered below 37 weeks with mean GA at delivery of 37.5 ± 2.8 weeks. Most (54.8%) of the deliveries were via C/S while 45.2% were vaginal deliveries. [24] In general, the rate of preterm delivery is relatively lower in our study and the rate of C/S deliveries is comparable in similar setting but much lower than other countries’

When it comes to the number of heart valves affected, over half of the patients (65.3%) only have one damaged, 49.3% have two, and 8% have three. With an 80.5% contribution, the mitral valve is the most often affected valve. 44.6% of patients had mitral valve stenosis, followed by AR (39.1%), MR (35.9%), TR (14.1%), and AS (10.9%). The mitral valve was most frequently impacted by CRVHD in Jimma, Ethiopia (89.7%), followed by the aortic (55.2%) and tricuspid (44.8%) valves. In women, isolated mitral valve lesions were discovered in 13.9% of cases [14]. According to a study conducted in Western Kenya, one-third of those with mitral stenosis were severe. [19] In India, 48.5% of women had major mitral stenosis (MS), while 80.5% of women had single valve involvement. [6]

This study reveals 13% patients were found to have HD during the current pregnancy. Majority of patients 40.2% have a functional status of NYHA class II, 27.2% in NYHA class 3 and 2.2% were in NYHA class 4. Tertiary Center in Jimma, Ethiopia, (44.8 %) has been diagnosed with VHD during the current pregnancy.[14] In India, 61.4% were in NYHA class III or IV. Half of the patients (53.8%) were found to have the cardiac illness prior to the incident pregnancy. [6] In Vietnam, 28% of women with cardiac disease were in New York Heart Association (NYHA) class III and IV and 66.5% were diagnosed during index pregnancy.[13] In our study, the proportion of women who were diagnosed with the cardiac illness during index pregnancy is much lower than other studies and also very small number of patients in NYHA class III or IV functional status had pregnancy. These discrepancies might be because of smaller sample size, limited study area and period or better screening, antenatal care risk assessment and pre conception care, especially in other countries, as they diagnose more patients during pregnancy and patients with more advanced cardiac disease allowed to be pregnant with better health care set up.

Negative maternal outcomes were significantly associated with those who reside in rural areas. Residence location was substantially linked to negative results in a global survey of low- and middle-income nations, with 100% of rural women reporting some kind of negative consequence. [17, 15]

7. Limitations and strengths of the study

Limitations of the study

- As it was based on retrospective hospital data, information on some sociodemographic and perinatal-related variables was not collected.
- Patients who were discharged after delivery were excluded from the study, so many patients could have faced adverse maternal outcomes after these time and missed from the study.

8 CONCLUSION

The finding of the study showed the proportion of adverse maternal outcome and acute cardiac event were 28% and 22% respectively. The patterns of cardiac valve lesion were mitral valve stenosis (44.6%) followed by AR (39.1%), MR (35.9%), TR (14.1%) and AS(10.9%). The determinant factors of adverse maternal outcome were rural in residency (AOR=8.3), having two and three (AOR=5.0, & AOR=18.4) respectively. On the other hand, the determinant factors of acute cardiac events were having three affected valves (AOR=2.6, 95%CI=1.38, 18.49), having AR (AOR=1.9, 95%CI=1.46, 8.21) and delivered through vaginal delivery (AOR=1.58, 15.42).

9. RECOMMENDATION

Further prospective research with large sample size and inclusion of postpartum patients after discharge to assess the impact of cardiac illness in pregnancy and implement targeted interventions to improve outcomes for this high-risk population.

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Annex I

Research Questionnaire

Name of data collector _____ Signature _____

DD/MM/YY: ---- ----, --- ----,----- ----

Questionnaire Code: T001_____

Name of the supervisor _____ Signature _____ Checking Date _____

Section I : Sociodemographic characteristics

No.	Questions	Answers	Codes	
Q101	Age of the participant?	-----Years (age in completed years)		
Q102	Area of residence	1. Urban 2. Rural		
Q103	Parity?	-----?		

Section II: Factors associated with the cardiac illness

No.	Questions	Answers	Codes	
Q201	Duration of illness?	-----days / months/years		
Q202	Cause of the heart disease	1) Congenital 2) Acquired		
Q203	Presence of valve lesions (more than one answer possible)	1) Mitral stenosis 2) Aortic stenosis 3) Mitral regurgitation 4) Aortic regurgitation 5) Tricuspid regurgitation 6) Prosthetic valve		
Q204	Severity of valve lesions during admission to labor ward?	1) Sever MS 2) Sever AS 3) Moderate MS 4) Moderate AS 5) Mild MS 6) Mild AS 7) other (specify)		
Q206	Ejection fraction of the Echo available at the time of delivery?	-----?		
Q207	Presence of pulmonary hypertension?	1) Yes 2) No (IF NO skip to Q211)		
Q208	Degree of pulmonary hypertension?	-----?		

Q209	Ward admission due to cardiac events during the index pregnancy?	1) Yes 2) No (IF NO skip to next section)		
Q210	Cause of cardiac event leading to ward admission?	-----?		
Q211	Outcome of cardiac events?	1) Dead 2) Improved with medication. surgical intervention, obstetrics management 3) Same 4) Unknown		
Q212	Length of hospital stays after delivery?	1) Within 3 days 2) 3 to 5 days 3) 5 to 7 days 4) 1 to 2 weeks 5) More than 2 weeks		
Q213	Functional status based on NYHA classification from recent evaluation	_____?		

Section III: OBSTETRIC FACTORS

No.	Questions	Answers	Codes	
Q301	Gestational age at delivery?	-----weeks?		
Q302	Mode of delivery?	1) Spontaneous VD 2) Induced VD 3) Elective C/D 4) Emergency C/D 5) OVD (forceps or vacuum) 6) Assisted breech delivery		

Q303	Method of anesthesia (if C/D)?	1) Spinal anesthesia 2) Epidural anesthesia 3) General anesthesia 4) Others (specify)		
Q304	Indication of C/D?	1) Decompensated congestive heart failure 2) Sever pulmonary hypertension 3) sever MS and/or sever AS 4) Failed induction 5) NRFHRS 6) Previous scar 7) Abnormal presentation/ lie 8) Fetal growth abnormalities 9) Twin 10) APH (specify) 11) Other (specify)		

Section IV: ADVERSE MATERNAL OUTCOMES

No.	Questions	Answers	Codes	
Q401	Was there Maternal death?	1) YES 2) No (if no skip to 606)		
Q402	When was the maternal death?	1) During labour 2) During delivery 3) After delivery		
Q403	What was the cause of death?	1) Heart failure 2) VTE 3) Sepsis 4) Obstetric Hemorrhage 5) Anesthesia complication 6) Cerebrovascular accident 7) Eclampsia 8) Other (specify)-----		

Q404	CICU admission?	1) YES 2) No(if no skip to Q708)		
Q405	When was the CICU admission?	1) During delivery 2) After delivery		

Section V: ACUTE CARDIAC EVENTS				
No.	Questions	Answers (Circle your choices)	Codes	
Q501	Pulmonary edema?	1) YES 2) No(if no, skip to 703)		
Q502	When did it happen?	1) During labour 2) during delivery 3) postpartum		
Q503	Diagnosis and treatment of cardio-embolic stroke?	3) YES 4) No(if no skip to 705)		
Q504	When was it?	1) During labour 2) during delivery 3) Postpartum		

Q505	Diagnosed and treated for arrhythmia?	1) YES 2) No(if no skip to Q708)		
Q506	When was it?	1) During labour 2) During delivery 3) After delivery		
Q507	Which type of arrhythmia was it?	1) Atrial fibrillation 2) Bradyarrhythmia 3) Ventricular tachycardia 4) Supraventricular tachycardia		
Q508	Maternal collapse?	1) YES 2) No(if no skip to Q710)		
Q509	When did it happen?	1) During labour 2) During delivery 3) After delivery		
Q510	Diagnosis and management of heart failure?	1) YES 2) No(if no skip to Q712)		
Q511	When was it?	1) During labour 2) During delivery 3) After delivery		
Q512	Diagnosis and management of cardiogenic shock?	1) YES (if yes, proceed to Q713) 2) No		
Q513	When was it?	1) During labour 2) During delivery 3) After delivery		

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