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OPEN ACCESS JOURNALS

Archives of Clinical and Experimental Cardiology

Research | Vol 2 Iss 1

Effect of Maternal Heart Disease on Fetal and Maternal Outcome in Omdurman Maternity Hospital

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Received: September 02, 2024; **Accepted:** October 03, 2024; **Published:** October 15, 2024

Abstract

Pregnancy significantly impacts cardiovascular system, leading to 1% to 4% complications in women without preexisting cardiac abnormalities globally. This study aims to determine the effect of maternal heart disease on fetal and maternal outcomes. The cross-sectional study was conducted at Omdurman Maternity Hospital from February 2017 to January 2018, involving 146 patients with cardiac disease who had antenatal care in the hospital. Data was collected through a questionnaire after informed written consent, and analyzed using SPSS version 20 on a computer. The study revealed results of 146 patients, with 42.5% aged 23-35, primarily from rural areas. The majority delivered vaginally, with 32.6% undergoing a Cesarean section. The most common heart disease was rheumatic heart disease (67%), with mitral stenosis being the major lesion (41.8%). Congenital heart disease was 26%, with VSD affecting 81.6%. Acquired heart disease was seen in 7%, with 60% diagnosed as cardiomyopathies. Heart failure was the most common complications, with maternal deaths occurring in 3.4%. Perinatal complications included miscarriages (5%), terminations due to severe cardiac diseases (2%), preterm births (34.9%), IUGR (1.4%), congenital heart disease (2%), stillbirths (2%), and early neonatal deaths (2.7%). The study revealed that rheumatic heart disease and cardiomyopathies are common during pregnancy, posing significant maternal and fetal risks, including heart failure, prematurity, miscarriages, IUGR, still births, and early neonatal deaths. Future studies can focus on implementing systematic cardiac screening, enhance preconception counseling, and develop multidisciplinary protocols.

Keyword: ***Pregnancy; Maternal; Heart disease; Cardiac diseases; Fetal; Rheumatic heart disease; Neonatal; Sudan***

Citation: Elhaj RMA, Keer ZBA, Kamil KK, et al. Effect of Maternal Heart Disease on Fetal and Maternal Outcome in Omdurman Maternity Hospital. Arc Clin Exp Cardiol. 2024;2(1):107.

1. Introduction

Maternal heart disease is a significant issue in obstetrics, impacting both the mother and fetus' health (Beaton et al., 2019). It can lead to serious consequences such as preeclampsia and maternal death, while less severe issues like pulmonary edema and cardiac arrhythmias may emerge (Keepanasseril et al., 2021). Neonatal consequences include low birth weight, premature birth, and a higher chance of congenital heart disease in infants (Norman et al., 2020). Despite advancements in medical understanding and technology, maternal heart problems still burden a significant percentage of pregnancies, affecting maternal death rates worldwide (Ramlakhan et al., 2020). Cardiac diseases complicate 1% to 4% of pregnancies in women without preexisting abnormalities, increasing the risk of morbidity and mortality during pregnancy (Iftikhar & Biswas, 2019). Maternal cardiac diseases increase significantly the risk of morbidity and mortality during pregnancy resulting in around 10% to 25% of the maternal deaths every year. In the UK, maternal diseases of heart are the most frequent causes of maternal death, with 2.27 per 100,000 cases (Tubb, 2024). In Saudi Arabia, a lack of information on maternal heart disease has led to the need for newer research (Fayed et al., 2022; Zakaria et al., 2020).

The existence of maternal heart disease that leads to complications like postpartum hemorrhage, sepsis, infective endocarditis, and congestive cardiac failure, vector-borne diseases is presented in some studies in Sudan (Isogai & Kamiya, 2019; Suliman, 2011). The heart problems also cause fetal deaths through stillbirths and neonatal ones. These findings, therefore, emphasize the importance of research regarding the effect of maternal heart disease on pregnancy outcomes, especially in countries such as Sudan where this issue is still unclear. The maternal and neonatal morbidities remain high in such regions. Cardiovascular changes during pregnancy can have profound health implications both for the mother and for the fetus (Ramlakhan et al., 2020). Pregnancy leads to a significant increase in blood volume, cardiac output, and vascular resistance, often impacting existing heart disabilities or causing new complications like arrhythmia or in some cases heart failure (Ngene & Moodley, 2019; Troiano, 2018). Maternal heart disease also increases the risk of miscarriage, premature birth, intrauterine growth restriction, and congenital heart defects in the fetus (Hardee et al., 2021).

The incidence of maternal heart disease is very high in developing countries where women may be deprived of the prenatal care, specialized cardiac services that are possibly accessible in the developed world. The research in Sudan revealed that maternal heart disease accounted for more than half of maternal deaths, and lethal complications such as postpartum hemorrhage, sepsis, and congestive heart failure were more common (Mohammed et al., 2011; Mohammed et al., 2022; Organization, 2018). However, the lack of comprehensive information on maternal heart disease and its influence on pregnancy outcomes in places like Sudan highlights a crucial research gap. These findings prove the urgency to improve maternal heart disease impact on pregnancy outcome knowledge in regions like Sudan where data is not available enough, and maternal and neonatal complications are a big issue to the public health officials.

The maternal mortality rate in Sudan and South Sudan is higher than the global average, primarily due to infection, hemorrhage, obstructed labor, abortion, and hypertension. The armed conflict in Sudan has impacted maternal health services, causing challenges in accessing essential care, increased risk of complications during pregnancy and childbirth, and mental health issues among pregnant women (Alemu et al., 2019; Olaleye et al., 2023). The maternal mortality rate in Sudan and South Sudan is significantly higher than the global average, largely due to factors like infection, hemorrhage, obstructed labor, abortion, and hypertension (Alemu et al., 2019; Makuei et al., 2020). The ongoing armed conflict in Sudan further

complicates these issues, increasing the risks of complications during pregnancy and childbirth. Heart disease is a significant contributor to pregnancy complications, especially in regions with prevalent maternal and perinatal morbidities (Ramage et al., 2019).

Understanding the impact of maternal heart disease on maternal health outcomes is crucial for improving healthcare delivery and reducing mortality rates among expectant mothers. This study aims to evaluate the outcomes of mothers diagnosed with heart disease admitted for delivery and the babies delivered by these mothers at Omdurman Maternity Hospital. The findings will inform the development of healthcare practices and prenatal care strategies, ultimately aiming to reduce maternal mortality and morbidity caused by heart disease in Sudan and similar low or low-middle-income countries.

2. Literature Review

2.1 Cardiovascular impact of pregnancy

One of the most significant cardiac complications during pregnancy is the worsening of pre-existing heart diseases that are the top cause of maternal mortality. Women who are pregnant with heart disease are more vulnerable to complexities during pregnancy and postpartum. Conditions such as valvular heart diseases, chronic hypertension, and congenital heart defects are risk factors for mothers and the baby. Factors such as older maternal age, higher rate of in vitro fertilization and multiple cardiovascular risk factors have been playing the main role in this rising concern (Sahu et al., 2022). Moreover, the cardiovascular system of a healthy pregnancy itself undergoes dramatic alterations to bear with the larger size of a fetus, thus imposing a greater burden on the heart. Complications during pregnancy must be identified and managed early, and a multidisciplinary team including obstetricians, cardiologists, and other specialists, may be required to optimize management. Studies in this regard highlight the necessity of making better evidence-based guidelines and specialized care centers (Hauspurg et al., 2018).

The effect of pregnancy on the cardiovascular area goes beyond the pregnancy period itself. Women who previously experienced APOs (Adverse Pregnancy Outcomes) such as preeclampsia or gestational diabetes are more likely to develop cardiovascular disease in their future years (Lane-Cordova et al., 2019). Hypertension disorders during pregnancy (HDP) are a specific concern because studies have shown that HDP is associated with a higher risk of cardiovascular diseases later in life, such as coronary artery disease, heart failure, and valvular heart diseases (Honigberg et al., 2019). Early intervention after delivery and modification of life style can help reduce these risks. Obesity is a major factor which plays an important role in pregnancy combined with heart disease as it has been proven that obese women are at greater risk of developing different maternal cardiovascular complications. Preconception counseling including weight management and other cardiovascular risk factors must be provided to these pregnant women (Pfaller et al., 2021).

Pregnancy has a considerable effect caused by the conditions such as valvular heart disease, chronic hypertension, congenital heart defect, and non-ischemic cardiomyopathies which are comorbid conditions and the ones that increased mortality rates as well as morbidities among the fetus and the mother (Sahu et al., 2022). The occurrence of congenital heart disease because of acquired maternal age, obesity, diabetes mellitus, and hypertension are among the reasons of high prevalence (Hedermann et al., 2021; Owens et al., 2018). Adaptations of the cardiovascular system go beyond simple hemodynamic modification

during pregnancy, and these multiple hemodynamic, metabolic, and hormonal changes burden the cardiovascular system to such a degree that women may be more prone to cardiovascular disease precipitation or aggravation.

Hypertensive disorders of pregnancy (HDP) are linked with early cardiovascular aging and a broader spectrum of diseases not previously considered, such as valvular heart disease. Assessment and preventing HDP becomes an immediate need, since it leads to increased chances of well-known classic cardiovascular risk factors such as essential hypertension, renal disease, abnormal lipid profile and diabetes (Melchiorre et al., 2020). Due to a lack of guidelines to guide cardiovascular follow-up and preventive strategies after HDP, however, we propose that screening should be done as early as possible, particularly within one year of delivery. The maternal obesity also may provoke the cardiac complications in maternal women with the heart disease. Addressing obesity during preconception counseling is a key factor for such cases, as for the high-risk pregnancy.

2.2 Maternal mortality and heart disease

Maternal mortality has been the major health problem in the low- and middle-income countries (LMICs). Although obstetric direct causes (hemorrhage, hypertension, sepsis) account for most of obstetric deaths, cardiac disease is another indirect cause that is often neglected (Makuei, 2021). A review covering 47 maternal mortality reports from 29 LMICs stated the percentage of cardiac-related maternal mortality ratios as below 34% of the total maternal deaths recorded. The authors state that the number of cardiac disorders is certainly underestimated as some people, due to the lack of medical facilities, are undiagnosed in resource-poor areas (Heemelaar et al., 2020). A study conducted in Eritrea showed 2.3% of rheumatic heart disease among pregnant women who otherwise were asymptomatic and this shows that the burden of cardiac disease in pregnant population might be huge (Otto et al., 2011).

Relevant factors to increase maternal mortality from cardiac disease in LMICs are late presentation, low availability of specialized care, and poor monitoring and treatment during pregnancy. A study conducted on pregnant women in India concluded that the occurrence of maternal mortality was higher (5.45%) in women with heart disease than those without any cardiac condition and that the functional class of the heart (class with NYHA III-IV) is of high risk category and closely tied with the adverse outcomes (Khan et al., 2018; Meh et al., 2022; Sharma et al., 2022). To deal with this challenge the authors call on improving emergency obstetric care, educating midwives, and raising accessibility of cardiology diagnostics and management especially in the countryside regions. Implementing cardiac screening at antenatal care routinely and the system of referrals also might be helpful with detecting and monitoring high-risk cases.

Research on heart disease maternal mortality in low-middle income countries (LMICs) is crucial. Collaboration between medical institutions, policymakers, and researchers will develop effective initiatives to improve outcomes for pregnant women with cardiac complications (Ponikowski et al., 2014). Reinforcing health systems, educating healthcare workers, and implementing early screening and intervention strategies are key approaches to cardiac disease reduction among LMIC women. By addressing these issues, significant progress can be made on heart disease maternal mortality and global maternal health outcomes.

2.3 Maternal heart disease in Sudan

Sudan has traditionally faced a very high maternal mortality rate, with a range of 750 to over 1400 maternal deaths per every 100,000 live births (Makuei, 2021; Sharma et al., 2022). However, direct obstetric causes such as postpartum hemorrhage, obstructed labor, and sepsis account for the majority of maternal deaths and, additionally, the indirect causes like cardiac diseases are also significant factors. A community-based reproductive age mortality survey (RAMOS) conducted in Kassala State, Eastern Sudan determined that 10.9% of the maternal deaths were solely based on puerperal septicemia which would be a remnant effect of an unverified cardiac disease (Gebreweld & Tsegaye, 2018).

Another study from a referral hospital in Khartoum show that 2.7% of maternal deaths were attributed to cardiac factors (Ounsa & Mohamed, 2011). The multifactorial influences leading to high maternal mortality due to heart disease in Sudan include delays in care-seeking, transport challenges and limited availability of specialized cardiac services, particularly at the rural areas. The RAMOS study showed the rates of illiteracy to be very high among the deceased women and their partners, which had a serious implication on seeking health care services. The authors advise improving the quality of emergency obstetric care, to extend the training and coverage of midwifery services and to expand access to cardiological diagnostics especially in underserved regions. Integrating cardiac screening into the regular antenatal care check-up and improving referral systems can also be very useful for locating and treating high-risk cases (van Smoorenburg et al., 2023).

Maternal mortality in Sudan due to heart disease is a significant issue that requires improvement in emergency obstetric care, midwifery training, and cardiac diagnostics. Integrating cardiac screening into routine antenatal care and improving referral systems can help identify cases early. Addressing social determinants of health, such as literacy levels and healthcare-seeking behaviors, and strengthening healthcare systems, increasing awareness, and using evidence-based approaches can significantly reduce maternal death and improve maternal health.

3. Methodology

3.1 Study design

The study used a cross-sectional analytic hospital-based design, that is, particularly appropriate for establishing correlation between pregnancy complications and cardiovascular disease. This design helps researchers to gather data from a great number of participants during an allotted period of time and this allows them to identify patterns and recurring trends in the data (Mohajan, 2020). The study was carried out at Omdurman Maternity Hospital in Sudan, which is the first maternity hospital and the largest referral hospital in the country for obstetric cases. This setting brings a chance to collect evidence on the prevalence and consequences of cardiovascular diseases in pregnancy involving Sudanese population.

The inclusion criteria for the study concerned all pregnant women who either delivered or terminated their pregnancy in hospital with cardiac disease (either new or old) and had antenatal care at Omdurman Maternity Hospital. With this, it ensures that the sample depicts the expectation of the population of women who are pregnant with cardiac disease in Sudan. The exclusion criteria include pregnant women who didn't take prenatal care in Omdurman maternity hospital, meanwhile, the same is done in order to mitigate the biases in the data.

3.2 Data collection

Data collection was conducted using a questionnaire that covered major areas which the registrars filled during the delivery. The questionnaire consisted of five parts: demographic information, obstetric history, medical and surgical history, modes of delivery, maternal and fetal outcomes. This systematic method encompasses collection of data with regards to the medical history of the participants, their pregnancy outcomes, and other critical factors.

At the initial visit, all pregnant women with cardiac disease were clinically examined by both an obstetrician and a physician, and an ECG and echocardiogram were conducted as standard procedures. This guarantees that the data gathered is accurate and dependable because it relies on clinical assessments and objective measures.

3.3 Data analysis

Data analysis was done on the computer with SPSS version 20 (Statistical Package for Social Sciences). Descriptive frequency table was performed to determine the physiological and clinical characteristics of the participants. Chi-square tests were used in research for the correlation between different variables and to test for statistical significance (the P value). This statistical approach allows for the formulation of the sources of significant associations between variables and the identification of potential tendencies in the data.

3.4 Sample size

The sample represented 146 patients, which is a small but significant proportion of the pregnant women with cardiac disease in Sudan. This sample size was selected according to the availability of resources as well as the practicability of study implementation within the span of February 2017 and January 2017.

3.5 Ethical considerations

The research was conducted ethically and responsibly, obtaining permission from reputable bodies like Omdurman Maternity Hospital and the Sudan Medical Specialization Board. Participants' voluntary informed written consent was obtained, and confidentiality and privacy were guaranteed. The study's ethical considerations were particularly important in a healthcare-accessible setting where participants could be easily exploited. A structured questionnaire and clinical evaluations were used to provide accurate data, ensuring participants did not experience harm or discomfort.

4. Results

Within this observational period, which covered both 146 deliveries and last trimester visits, nearly two-thirds of the patients, i.e. 62 individuals (42.5%), belonged to the age group of 26 to 35 years old. This population breakdown illustrated in the FIG. 1 emphasizes the widespread representation of this age group in the patient group.

The level of patient's education varied not much, as 16 (11%) of the patients were illiterate, 54 (37%) as high school graduates and 46 (31.5%) as primary school graduates and 30 (20.5%) as university graduates, as seen in FIG. 2. The

residence data also showed separation in the patient distribution with 84 individual (57.5%) patients from a rural area and another 62 (42.5%) patients from urban areas, as it is shown on FIG. 3.

From the obstetric history, 40 patients (27.4%) were primigravida while 68 (46.6%) had a parity between 1 and 4 and the last 38 (26%) were multiparous with 5 or more pregnancies as depicted in FIG. 4. Prenatal care initiation through the trimesters demonstrated varied distribution and 64 patients (43.8%) were booked during their second trimester, 36 patients (24.7%) were booked during their first trimester, and 46 patients (31.5%) were booked during their third trimester. Among the few patients who had different booking times, the majority of them delivered after 37 weeks of gestation, 79 patients (54.1%), and ten (6.4%) experienced early delivering due to premature before 24 weeks, so it is essential to provide full antenatal care for a timely manner. Additionally, there were 108 (74%) patients among those that had not received information about the risk that can be imposed by the underlying medical condition during pregnancy which may mean that preconception care services had some gaps. On the other hand, 38 cases (26%) out of 146 total patients were counseled before conception, based on the information provided in FIG. 7. The results of the analysis revealed a complex and varied demographic and clinical profile of the patient base, thereby emphasizing the need for a personalized healthcare system with focus on better results during the perinatal period.

Rheumatic heart disease accounted for 67% of the patients in the study, making it the most common kind of cardiac disease (Figure 8). 10.3% of the patients had previously had heart surgery, with balloon valvotomy, cardiac catheterization, valve replacement, and VSD closure being the most frequently performed operations. In addition, 19.2% of the participants had previously been hospitalized for different cardiac problems, whereas 70.5% had no prior issues (FIG. 9). 28.8% of patients were classified as belonging to class I, 24% as class II, 37.6% as class III, and 9.6% as class IV according to the NYHA criteria (FIG. 10). The vast majority of patients (67.4%) gave birth vaginally; 72.5% did so spontaneously, 9.9% had an induction for medical reasons, and 17.6% used an instrument (FIG. 11 and 12). Nonetheless, 32.6% of patients underwent cesarean section; 34% of these cases were emergency cases, and 66% were elective cases (FIG. 13).

4.1 Demographics

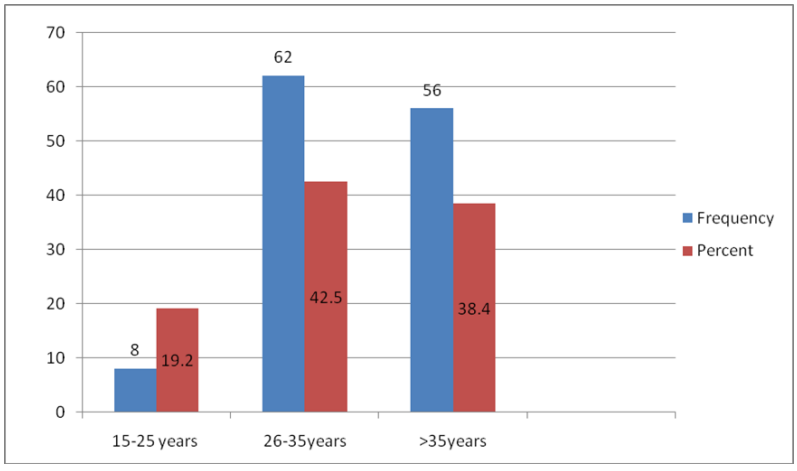

FIG. 1. **Distribution of patients according to age.**

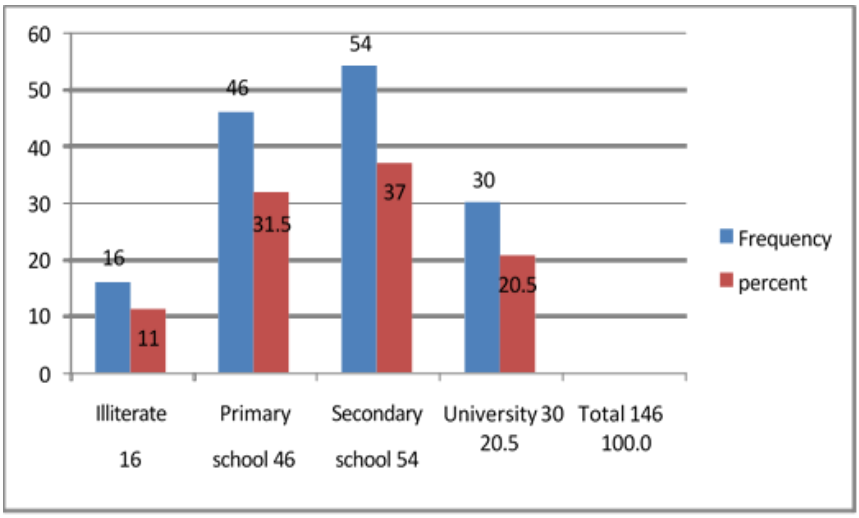

FIG. 2. **Distribution of patients according to Educational level.**

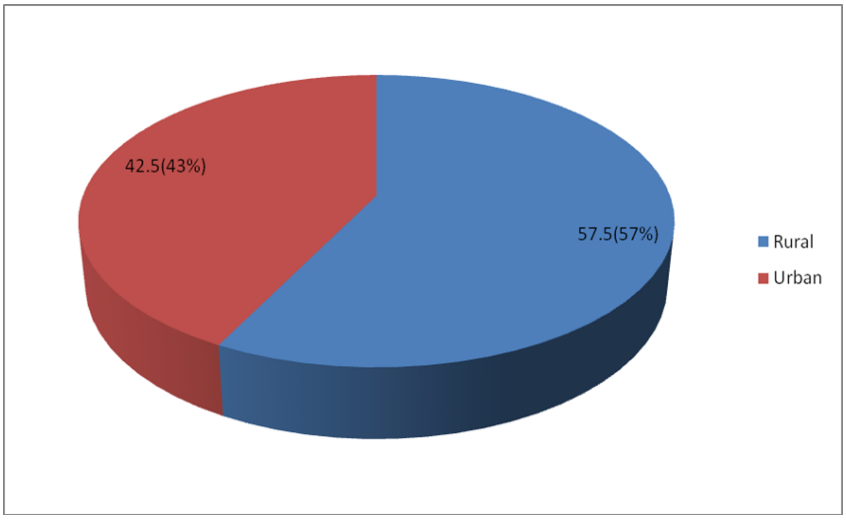

FIG. 3. **Distribution of patients according to location.**

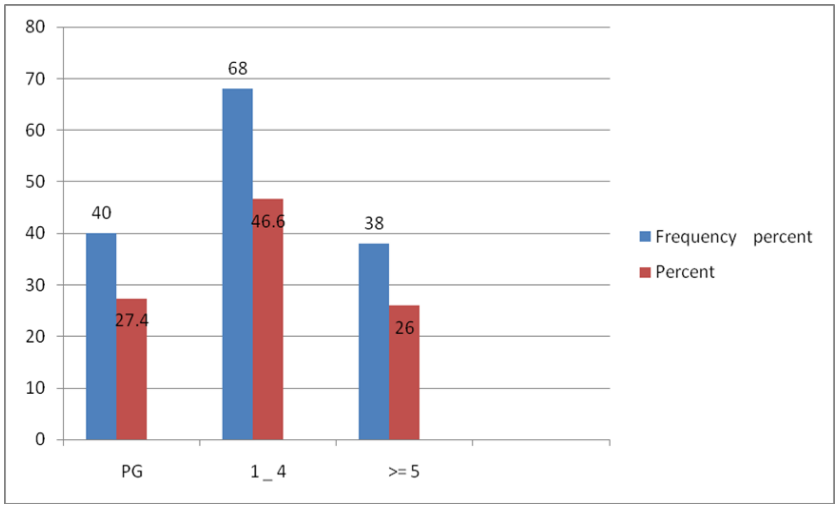

FIG. 4. **Distribution of patients according to parity.**

4.2 Obstetric history

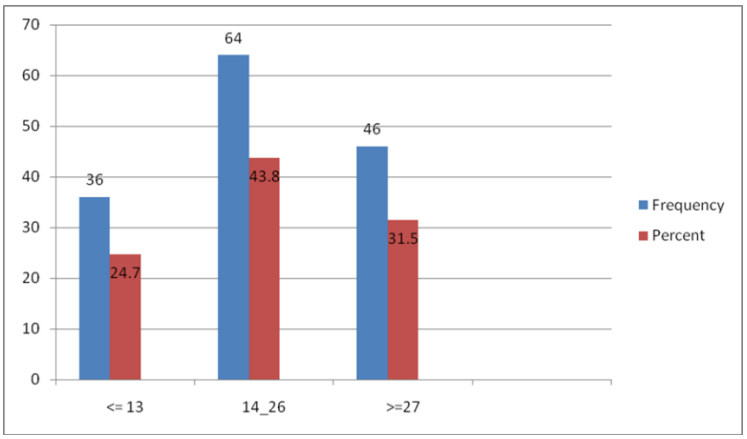

FIG. 4. **Distribution of patients according to gestational age at booking.**

4.3 Medical and surgical history

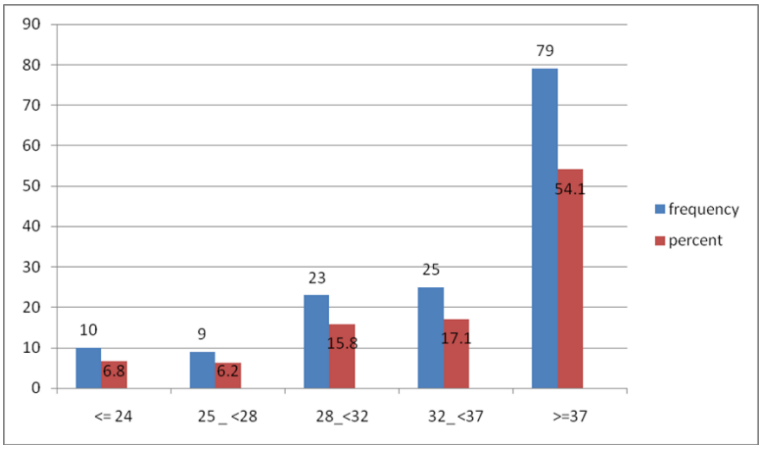

FIG. 5. **Distribution of patients according to gestational age at delivery.**

4.4 Maternal and Fetal Outcomes.

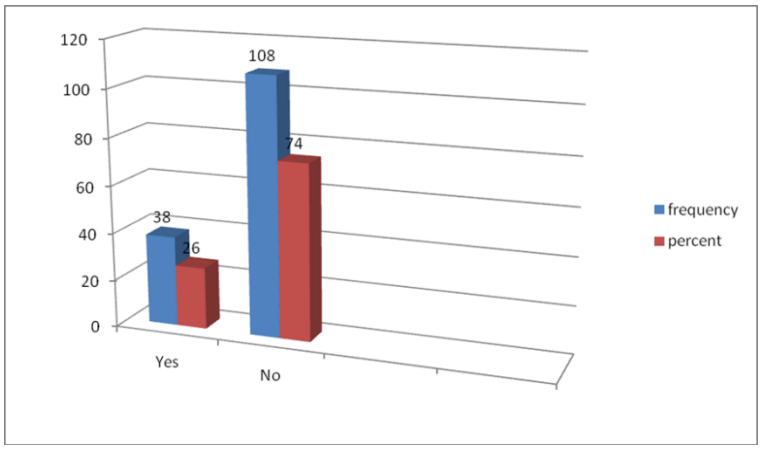

FIG. 6. **Distribution of patients according to counseling.**

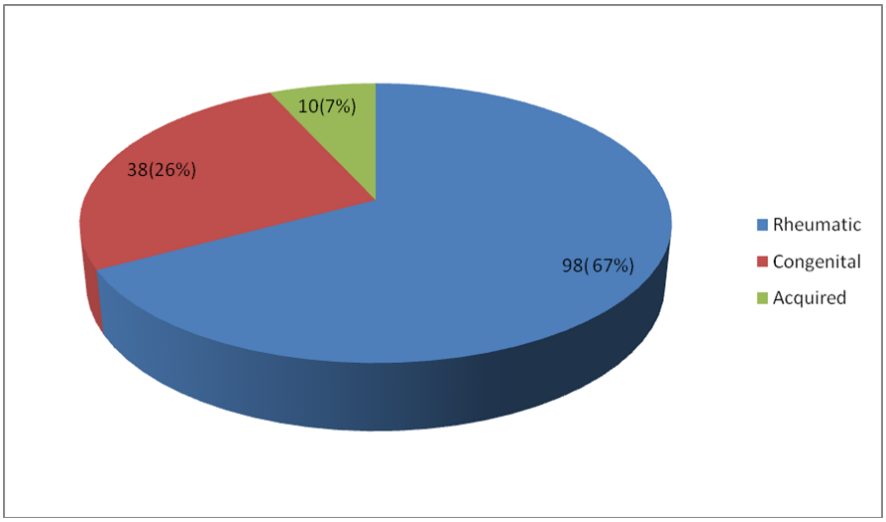

FIG. 7. **Distribution Of patients according to Etiology of disease.**

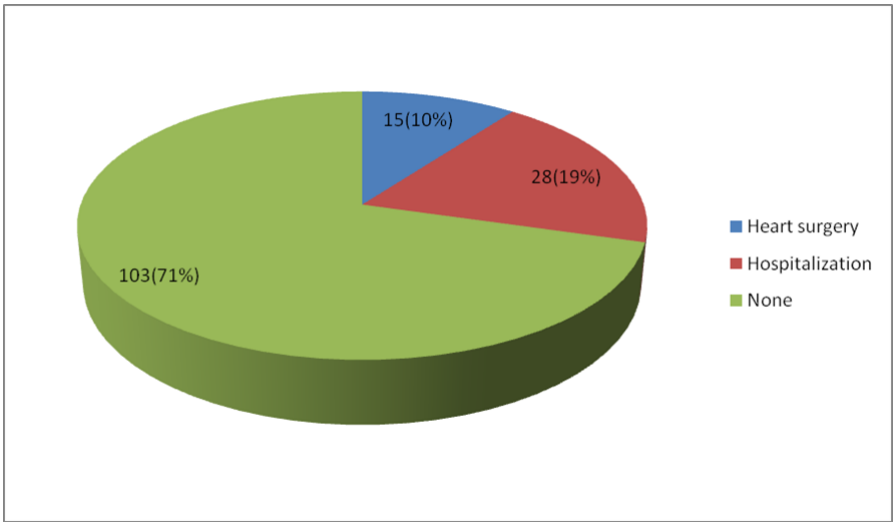

FIG. 8. **Distribution of patients according to past history of complications.**

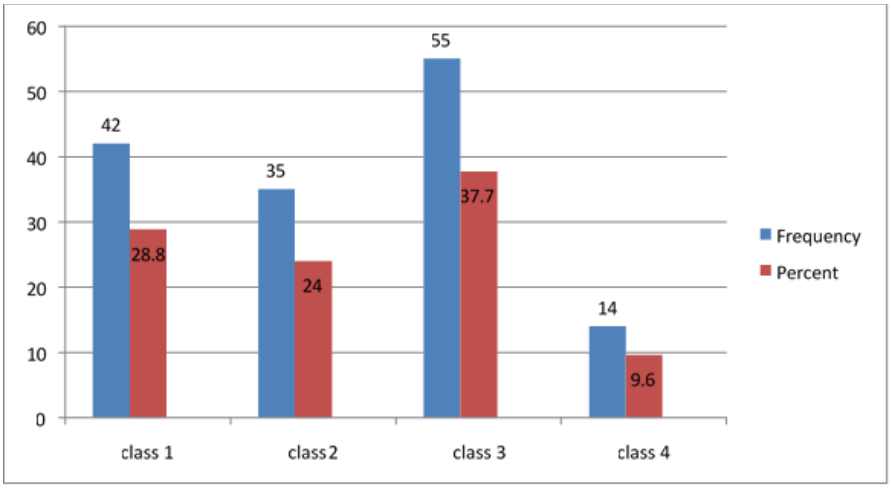

FIG. 9. **Distribution of patients according to NYHA classification.**

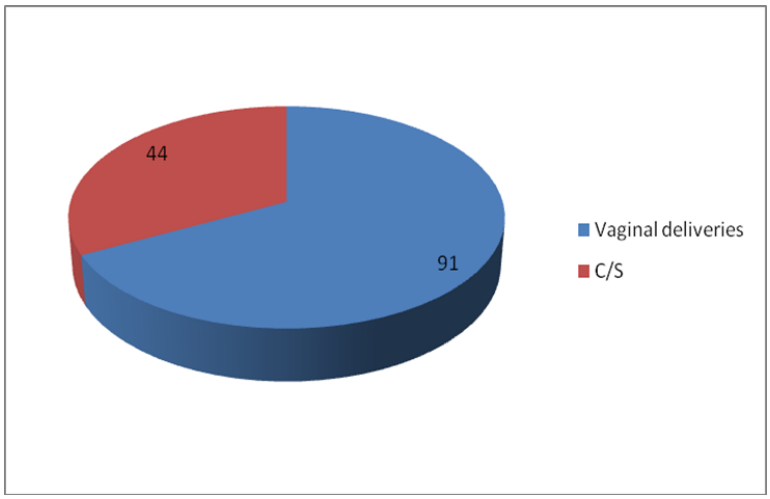

FIG. 10. **Distribution of patients according to mode of delivery.**

4.5 Modes of Delivery

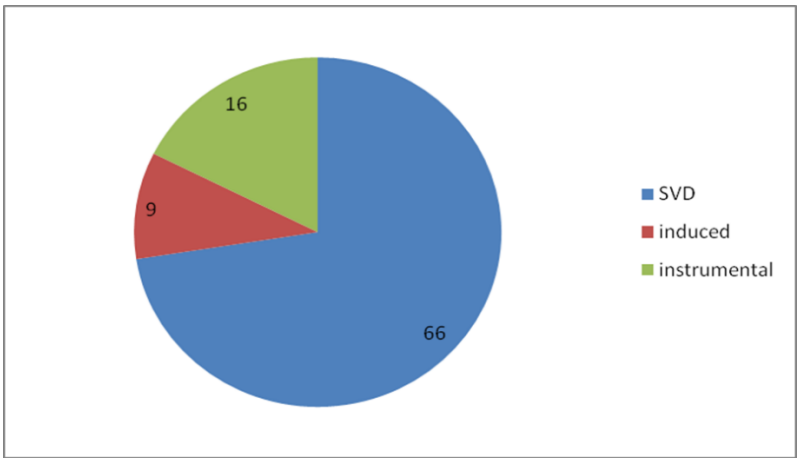

FIG. 11. **Distribution of patients according to type of vaginal delivery.**

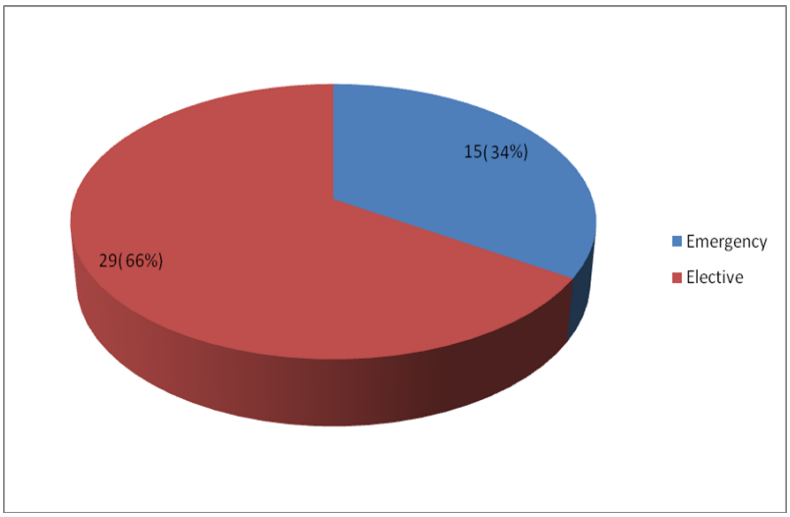

FIG. 12. **Distribution of patients according to type of cesarean section.**

The tables below include a thorough examination of maternal heart disease and its effects on pregnancy outcomes. They classify and examine data on cardiac conditions, medical variables, obstetric difficulties, perinatal outcomes, and the link between preconception counseling and complications. The methodical structuring of this data aids comprehension of the complicated relationship between mother cardiovascular health and pregnancy outcomes.

4.6 Cardiac conditions and complications

TABLE 1. **Types of Rheumatic Heart Diseases.**

Type	**n=98**	**Percent**
MS	41	41.8
MR	22	22.4
MS+AS	9	9.2
MS+AR	6	6.1
MS+TR	6	6.1
MR+TR	7	7.1
AS	2	2
AR	1	1
TR	1	1
Total	**98**	**100**

Table 1 demonstrates the proportion of various types of Rheumatic Heart Diseases (RHD) among the 98 patients. The most prevalent type is Mitral Stenosis (MS), accounting for 41.8%, then comes Mitral Regurgitation (MR) which is 22.4%. Other kinds, like the MS with AS (Aortic Stenosis) and the MS with AR (Aortic Regurgitation) each account for around 6.1% cases. The rarest types include Aortic Stenosis (AS), Aortic Regurgitation (AR), and Tricuspid Regurgitation (TR), each representing 1-2% of cases.

TABLE 2. **Congenital Heart Disease.**

Type	**n=38**	**Percent**
ASD	3	7.9
VSD	31	81.6
TOF	1	2.6
PDA	2	5.3
Pulmonary stenosis	1	2.6
Total	**38**	**100**

Table 2 shows congenital heart diseases in the 38 patients. Ventricular Septal Defect (VSD) is the most common accounting for 81.6 percent of the cases and Atrial Septal Defect (ASD) is the second following with 7.9 percent. The incidence of PDA

and TOF is 5.3% and 2.60% each. Only one patient came along with pulmonary stenosis that is equivalent to the percentage of cases of 2.6%.

TABLE 3. **Acquired Heart Diseases.**

Type	n=10	Percent
Cardiomyopathies	6	60
Ischemic Heart Disease	3	30
Pulmonary Stenosis	1	10
Total	**10**	**100**

TABLE 3 depicts acquired heart disease in 10 individuals. 60% of cases are cardiomyopathies while 30% are ischemic heart disease which is the second highest. One of the patients suffers from Pulmonary Stenosis, which is 10% of total cases.

4.7 Medical conditions and treatments

TABLE 4. **Associated Medical conditions.**

Disease	Frequency	Percent
Hypertension	8	5.5
Diabetes Mellitus	1	0.7
Thyroid	1	0.7
None	136	93.2
Total	**146**	**100**

TABLE 4 shows coexisting medical conditions among the mentioned population. Arterial hypertension is a most frequently encountered condition (5.5%), followed by diabetes mellitus and thyroid conditions, each representing 0.7% of cases. Majority of patients (93.2%) have no coexisting diseases.

TABLE 5. **Type of treatment.**

Treatment	Frequency	Percent
Antiarrhythmic	31	21.2
Anticoagulants	55	37.7
Antihypertensive	8	5.5
Diuretics	9	6.2
Beta Blockers	1	0.7
Oral Hypoglycemic	1	0.7
Thyroxine	1	0.7
None	40	27.4
Total	**146**	**100**

TABLE 5 displays the treatment types given to the patients. Anticoagulants have the highest usage at 37.7%, while antiarrhythmic drugs follow at 21.2%. The use of diuretics, antihypertensive drugs, and oral hypoglycemic agents are reduced proportionally. One third (27.4%) of people get no treatment.

4.8 Pregnancy and obstetric factors

TABLE 6. **C/S indications.**

Indication	Frequency	Percent
2PS	13	29.5
3PS	15	34.1
4PS	7	15.9
Fetal Distress	2	4.5
FOP	4	9
BOH	1	2.3
Refusal of VBAC	1	2.3
Tubal Ligation	1	2.3
Total	**44**	**100**

TABLE 6 shows the indications for Cesarean section (C-section). The most frequent reason is the 3PS (pre C/S, classical C/S or uterine rupture), which account for 34.1% of all cases, followed by the 2PS (pre C/S) at the rate of 29.5%. Other situations, including 4P (previous C/S with other high-risk factors), fetal distress, and failed operative cesarean, are of lesser occurrences.

TABLE 7. **Obstetrics Complications.**

Complication	Frequency	Percent
PPH	5	3.4
PIH	3	2.1
Sepsis	2	1.4
Death	5	3.4
None	131	89.7
Total	**146**	**100**

TABLE 7 reveals obstetric complications of women during childbirth in patients. In most instances (89.7% of the treated patients did not suffer from any complications). PPH and maternal death take place in 3.4% of cases each and PIH and sepsis happen to a smaller part of patients.

TABLE 8. **Cardiac Complications.**

Complications	Frequency	Percent
Heart Failure	20	13.6
Infective endocarditis	3	2.1
Cerebrovascular Accident	1	0.7
Respiratory Tract Infection	1	0.7
Pulmonary Hypertension	4	2.7
Pulmonary Edema	3	2.1
Arrhythmias	3	2.1
None	113	77.4
Total	**146**	**100**

TABLE 8 represents the cardiac complications that should be observed in patients. The primary complication is heart failure, and it accounts for 13.6% of all cases, coming after pulmonary hypertension and pulmonary edema, each representing 2.7% and 2.1% of cases, accordingly. Infective endocarditis, cerebral stroke, respiratory tract infection and arrhythmias drop to a lesser extent. In the majority (77.4%) of patients there were no cardiac complications.

TABLE 9. **Perinatal Complications.**

Complications	Frequency	Percent
Miscarriage	8	5.5
Termination of Pregnancy	3	2.1
IUGR	2	1.4
Premature	51	34.9
Congenital Heart disease	3	2.1
Still births	4	2.7
Early Neonatal Deaths	4	2.7
None	71	48.6
Total	**146**	**100**

TABLE 9 shows the perinatal complication among the patients. Premature birth is the leading most challenge (34.9%) followed by miscarriage at 5.5%. Other kinds of complications like, abortion, IUGRs, stillbirths, early neonatal deaths and congenital heart disease are reported at small proportions. The great majority (48.6%) of patients did not get into any perinatal complications.

4.9 Association and counseling

TABLE 10. **Association between NYHA classification and cardiac complications.**

Class	Complicated	Not complicated	Total
I	4	38	42
II	6	29	35
III	14	41	55
IV	9	5	14
Total	**33**	**113**	**146**

Chi-Square	35.115	P.V.	0.009

TABLE 10 shows the connection between NYHA classification (heart failure severity) and cardiac complications. In patients of NYHA class I, 4 of them had cardiac complications and 38 were among the ones who did not face cardiovascular complications. The association between cardiac complications and NYHA class turned out to be statistically significant and it was reflected with the p-value of 0.009.

TABLE 11. **Association between NYHA classification and perinatal complications.**

Class	Miscarriage	Termination	IUGR	Premature	Congenital Heart disease	Stillbirth	Early Neonatal l Deaths	None	Total
C. I	5	0	1	21	1	0	0	14	42
C. II	2	0	1	2	0	0	2	27	35
C. III	0	3	0	21	1	2	1	28	55
C. IV	0	0	0	7	1	2	1	2	13
Total	**7**	**3**	**2**	**51**	**3**	**4**	**4**	**71**	**146**

Chi-Square	55.198	P.V.	0.000

TABLE 11 shows the relation of NYHA group to perinatal complications. The number of newborn injuries vary among different Classes of NYHA. Class III includes most of the complications such as danger of miscarriage, termination, IUGR, premature birth, congenital heart disease, stillbirths and early neonatal deaths. The link between NYHA classification and perinatal risks is strong, given the p-value of 0.000, which is statistically significant.

TABLE 12. **Association between preconception counseling and cardiac complications.**

Preconception counseling	Heart failure	P. edema	Arrhythmias	I.E.	CVA	R.T.I.	P.HTN	None	Total
Yes	5	0	0	0	0	1	2	30	38
No	13	3	3	3	1	0	2	83	108

Total	**17**	**3**	**3**	**3**	**1**	**1**	**4**	**113**	**146**

Chi-Square	6.031	PV	0.420

TABLE 12 shows the relation between preconception counseling and cardiac events as shown in the table. Preconception counseling resulted in 5 cases of heart disease among women when compared to those who did not receive any advice which constituted 13 cases of heart disease. No important correlation was found between preconception consultation and cardiac issues worth of 0.420.

TABLE 13. **Association between preconception counseling and perinatal complications.**

Class	Miscarriage	Termination	IUGR	Premature	Congenital Heart disease	Stillbirth	Early Neonatal Deaths	None	Total
Yes	5	3	1	9	1	1	1	18	38
No	3	1	1	42	2	3	3	53	108
Total	**8**	**3**	**2**	**51**	**3**	**4**	**4**	**71**	**146**

Chi square	10.663	P.V.	.154

TABLE 13 shows the correlation between preconception counseling and perinatal problems. The case of perinatal complications including miscarriage, termination, IUGR, low birth weight due to premature births, congenital heart diseases, stillbirths, and early neonatal deaths do not show a significant association with preconception counseling but only with zero to low odds ratio (p-value of 0.154).

TABLE 14. **Association between previous complication and cardiac complication.**

Previous complications	Heart failure	P. Edema	Arrhythmias	I.E.	CVA	R.T.I.	P.HTN	None	Total
Heart surgery	4	0	0	1	1	1	3	5	15
Hospitalization	11	3	3	2	0	0	1	8	28
None	3	0	0	0	0	0	0	100	103
Total	**17**	**3**	**3**	**3**	**1**	**1**	**4**	**113**	**146**

Chi-Square	20.373	PV	0.040

TABLE 14 provides the association between previous complications and cardiac complications. Patients that have experienced heart surgery and hospitalization prior have demonstrated a greater risk of cardiac comorbidities when compared with patients without previous complications. The results indicate that the number of previous complications is associated with the occurrence of the cardiac complications at the significance level of 0.040.

5. Discussion

Rheumatic heart disease (RHD) was the most common cardiac disease complicating pregnancy in this study, affecting 67% of patients, which is comparable with results from comparable research in Sudan, Egypt, and South Africa. Mitral valve involvement, especially mitral stenosis (41.8%), was significant, but significantly lower than in Pakistan and India (Makate, 2021). Congenital cardiac problems impacted 26% of patients, including ventricular septal defect (VSD) being the most common lesion, similar to a study conducted in Khartoum Teaching Hospital six years ago (Ottaviani & Buja, 2022; Yassin et al., 2015). VSD was the most prevalent lesion (81.6%), which is greater than in India. According to one study, rheumatic heart disease is the most prevalent cardiac lesion in pregnancy, followed by isolated mitral stenosis as the most common acquired lesion and mitral valve prolapse as the main congenital heart disease (Puri et al., 2013).

Early identification and treatment of congenital cardiac disorders are critical for reducing unfavorable maternal and neonatal outcomes. These findings give useful information for healthcare policymakers and practitioners seeking to improve mother and child health outcomes in comparable settings.

This study analyzed maternal complications, focusing on cardiac and obstetrics. Postpartum hemorrhage was noted in 3.4% of cases, which is lower than India (11.9%) and Pakistan (8.8%) (Joshi et al., 2015; Rafiq et al., 2023). Pregnancy-induced hypertension was seen in 2.1% of patients. Sepsis was noticed in 1.4% of cases, both ending with death. Overall maternal mortality due to cardiac disease was 5.4% cases, with all five deaths occurring in women with unsupervised pregnancy and one antenatal care in late pregnancy.

The most common cardiac complication was heart failure complicating (13%), which often leads to maternal death. Monitoring cardiac patients for early detection and management is crucial throughout pregnancy, labor, and puerperium. Infective endocarditis was reported 2.1%, while arrhythmias complicated 2.1% lower than in a study conducted in brazil (6.82%) (Martins et al., 2016). Pulmonary edema was reported in 2.1%, and cerebral vascular accident was seen in 0.7% of cases. Fetal complications were seen in 51.4% of deliveries, with prematurity affecting being the most common (34.9%). There were 4 still births and 4 early neonatal deaths reported (2.7%), less than India's 12.1% and Netherlands' 12.1%. Out of 146 cases, eleven ended with miscarriages, 3 of which were therapeutic terminations due to severe cardiac disease.

The New York Heart Association classification showed that most patients in class I & II (52.8%) and class III & IV (47.3%) had adverse maternal and fetal outcomes (Webb et al., 2020). Cardiac disease itself could be a risk factor for maternal and fetal complications. The majority of patients did not receive preconception counseling regarding their illness (74%), suggesting that educating prospective parents and screening for heart diseases is essential to reduce the burden of the disease. Regarding previous history of cardiac surgery, 19% had undergone cardiac surgery before pregnancy, more than Khartoum teaching hospital's (13.3%) and India's (9.09%) studies. The study found that a higher rate of surgical interventions allowed patients with cardiac disease to survive to child-bearing age and cope with changes during pregnancy. However, surgical intervention before pregnancy does not guarantee free pregnancy course of complications, as 10 out 15 patients who underwent surgery had complicated pregnancies.

19.2% of patients had a previous history of hospitalization due to heart failure, arrhythmias, or other cardiac indications, which is less than what was reported in Canada (46%) (Wald et al., 2015). A significant predictor of maternal cardiac complication was found in 20 out of 28 patients with a history of previous complications. Most patients were aged between 23-35 years, with a mean of 30. In developing countries like ours, many cases tend to get missed due to lack of awareness and poor healthcare facilities. The majority of patients lived in rural areas, where health care facilities are either inappropriate or inadequate.

Educational level was lower in the study, with 31.5% or less having primary education and 75.5% or more having secondary education. Most patients delivered at more than 37 weeks' gestation (54.1%), which is lower than data from India (86.3%) (Abbasi et al., 2017). Assisted vaginal delivery with instruments was preferred to prevent maternal strain and exhaustion, with 17.6% of instrumental deliveries. Epidural analgesia was recommended for patients with short second stages of labor and without assistance. Cesarean section was performed in 30% of patients with good outcomes, but the JCS joint working group recommended it only for patients with cardiac dysfunction, hemodynamic instability, pulmonary hypertension, uncontrolled arrhythmia, mechanical valve prosthesis, and patients with cyanosis.

6. Conclusion

Rheumatic heart disease and cardiomyopathies stay among the main factors that cause cardiac complications during pregnancy as well. Heart failure is one of the major issues, causing adverse maternal outcomes such as exacerbated morbidity and mortality. Prematurity is the primary cause of the fetal complication. The course of pregnancy is determined by the maternal functional class which reflects heart failure (III or IV), maternal previous cardiac problems being a powerful predictor of adverse maternal and fetal outcomes. Regardless, an immediate diagnosis, a pre-conception management, and a favorable maternal functionality at the time of conception are among the factors that contribute to these positive maternal and neonatal outcomes. These findings highlight the priority of customizing whole care approaches while women are within the peripartum period, with particular emphasis being given to early intervention and smooth maternal health prior to conception.

7. Future Recommendations

Adequate treatment of streptococcal infections in women can reduce rheumatic heart disease incidence. Preconception counseling and regular antenatal follow-up with a multidisciplinary team can improve the outcome of pregnant cardiac patients. Proper management during labor and early detection of complications are also crucial for ensuring the best outcome for cardiac patients.

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