(RESEARCH ARTICLE)

Analysis of Antenatal Care (ANC) quality on morbidity and mortality of heart disease in pregnancy at Dr. Soetomo General Hospital

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Abstract

Introduction: Heart disease in pregnancy is one of the factors of morbidity and mortality among pregnant women worldwide. In Indonesia, it ranks third in prevalence at 15.7%, following preeclampsia (33.1%) and hemorrhage (27.03%). According to the literature review and past research, heart disease during pregnancy can be preventable through early detection and appropriate intervention with quality antenatal care (ANC). The objective of is to analyze the quality of ANC in heart disease morbidity and mortality in pregnancy at Dr. Soetomo General Hospital.

Method: This research employs an observational design with a retrospective study approach. 102 pregnant women patients during January–December 2023 were selected using the total sampling method. The independent variable is the quality of ANC, including the first visit (K1), the frequency, the place, and the health services during ANC. The dependent variables are the morbidity and mortality of heart diseases in pregnancy. Medical records are used as the instrument using the Fisher's Exact test with a significance level ($\alpha < 0,05$) to analyze the data.

Results: The prevalence of heart disease morbidity at Dr. Soetomo General Hospital is very high. The heart disease morbidity and mortality in pregnancy have a significant correlation with the quality of the health services during ANC ($p < 0,05$). Meanwhile, there is no significant correlation between the heart disease morbidity and mortality in pregnancy and the K1 ANC ($p < 0,05$), the frequency of ANC ($p < 0,05$), and the place of ANC ($p < 0,05$).

Conclusion: The quality of health service during ANC and morbidity and mortality of heart disease in pregnancy, where good services can identify morbidity and give appropriate intervention to prevent mortality.

Keywords: Antenatal care; Heart disease in pregnancy; Morbidity; Mortality; Quality

1. Introduction

Heart disease remains a serious global issue. According to WHO, heart disease happens to 620 million people worldwide, and an estimated 32% of deaths worldwide are caused by heart disease (17,9 million cases) (1). Heart disease can impact anyone, including pregnant women. This is due to an increase in cardiac output (30-50%), blood pressure (20%), and a decrease in systemic vascular resistance by 35% and increases particularly in the second and third trimester (2). Heart disease in pregnancy is a significant cause of morbidity worldwide. Its prevalence varying from 1-4% of all pregnancies, with higher rates in developed countries (3). In South Asia and low-income and middle-income countries, the prevalence of heart disease is about 1.46% of all pregnancies. Besides morbidity, this disease can also cause maternal maternity. Globally, it remains the leading cause of pregnancy with an estimated cause-specific mortality rate of 4.23% per 100,000 pregnancies (4). According to the Centers for Disease Control and Prevention (CDC), heart disease was the leading cause of death among pregnant women from 2017 to 2019, with a prevalence of 32.4%

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(5). In Indonesia, maternal complications resulting in death from heart disease ranked third with a prevalence of 15.7%, following preeclampsia at 33.1% and hemorrhage at 27.03% (6).

Heart disease is a significant cause of maternal morbidity and mortality, and it is essential to monitor and address this issue during pregnancy. To reduce the prevalence of heart disease morbidity and mortality in pregnancy, one effective effort is the implementation of adequate antenatal care (ANC). Regular antenatal care visits are crucial for early detection, intervention, and prevention of complications, also for appropriate referrals. Good quality antenatal care can identify abnormalities early because chest auscultation and blood pressure measurements are conducted. Common clinical manifestations include palpitations (63.38%), shortness of breath (23.59%), leg edema (8.45%), and chest pain (8.1%) can be found (7). However, it is evident that antenatal care is often carried out too late, and there is a lack of guidance on risk signs and complications prevention during pregnancy. Moreover, many midwives, who are the primary providers of antenatal care, do not provide comprehensive services (8).

Previous studies at Dr. Soetomo General Hospital indicated a significant number of maternal visits with indications of heart disease each year, including in 2023. A study at Dr. Soetomo General Hospital in 2021 showed that the prevalence of heart disease in pregnancy between January and December 2019 was 5.19%, which is 69 cases out of 1328 births. Additionally, a study in 2019 showed that the prevalence of heart disease was 92 cases with 10 maternal mortalities out of the case total. This study also revealed several risk factors of maternal mortalities due to heart disease such as ANC visits that are less than WHO recommendation according to gestational age (4 cases) and late detection (9 cases). Therefore, the objective of this research is to analyze the quality of antenatal care (ANC) in relation to morbidity and mortality of heart disease in pregnancy. The findings of this study contribute to evaluating the quality of ANC thus complications that occur can be minimized and the patient's rate of improvement may increase.

2. Material and methods

This research is conducted at Dr. Soetomo General Hospital using an analytical observational design with a retrospective approach. The population of this study is all pregnant women diagnosed with heart disease between January and December 2023. The sample is determined using the total sampling technique, where the whole population is the sample. The inclusion criterion of this study is pregnant women diagnosed with heart disease during January-December 2023, while the exclusion criterion is incomplete patient medical record data.

The data are collected using secondary sources, specifically patient medical records. Out of 147 medical records of pregnant patients with heart disease, 102 records met the inclusion and exclusion criteria and were selected as research samples. The study variables consist of independent variables, namely the first ANC visit (K1), the frequency of ANC, the location of ANC, and the health services quality, while the dependent variable is the morbidity and mortality of heart disease in pregnancy.

The hypothesis for this study is that the quality of antenatal care (ANC) is associated with morbidity and mortality of heart disease in pregnancy. This study employed univariate and bivariate analysis. The univariate analysis included a test of data characteristics to determine the percentage of each research variable. The bivariate analysis was carried out to analyze the relationship between the independent and dependent variables using the Fisher's Exact test with a significance level of 5% ($\alpha < 0.05$). The hypothesis was accepted if the test results showed a p-value <0.05 and rejected if the test results p-value>0.05.

3. Results

In this study, a total of 102 patients diagnosed with heart disease during pregnancy were included as the research sample. Univariate analysis was conducted to describe the frequency distribution of characteristics and each research variable. The results of the analysis are presented in Table 1.

Table 1 Patient Characteristics

Variable	Frequence (n)	Percentage (%)
Age		
20–35 years old	59	57.8%
>35 years old	43	42.2%

Employment Status		
Unemployed	71	69.6%
Employed	31	30.4%
Parity		
Nullipara	30	29.4%
Primipara	32	31.4%
Multipara	39	38.2%
Grande multipara	1	1.0%
Body Mass Index (BMI)		
Underweight	4	3.9%
Normal weight	23	22.5%
Overweight	31	30.4%
Obesity	44	43.1%
Family disease history		
None	99	97.1%
Yes	3	2.9%
Maternal disease history		
None	48	47.1%
Yes	54	52.9%
First visit (K1) of ANC		
>12 weeks	15	14.7%
≤12 weeks	87	85.3%
Frequence of ANC		
<6 times	40	39.2%
≥6 times	62	60.8%
Location of ANC		
Inconsistent	85	83.3%
Consistent	17	16.7%
Health Services Quality		
Poor	16	15.7%
Less	45	44.1%
Good	41	40.2%
Morbidity		
Hypertension	66	64.7%
Atrial septal defect (ASD)	13	12.7%
Cardiomyopathy	7	6.9%
Heart valve disease	12	11.8%
Cardiomegaly	4	3.9%

Mortality		
Yes	4	3.9%
No	98	96.1%

Table 1 shows that most of the sample falls within the 20–35 age group, considered the low-risk pregnancy category, accounting for 59 individuals or 57.8%. Most patients were unemployed or housewives, comprising 71 individuals or 69.6%. Based on parity or the number of children born, most of the samples were multiparas (>1 child), totaling 39 individuals (38.2%), while the smallest group was grand multiparas (≥4 children), totaling 1 individual (1.0%). Most pregnant patients had a BMI status categorized as obese, with 44 individuals (43.1%). Almost all patients had no family history of heart disease, with 99 individuals (97.1%), yet more than half had a personal history of heart disease, totaling 54 individuals (52.9%). Regarding antenatal care (ANC) status, most patients had their first ANC visit (K1) following the Ministry of Health's recommendations during gestational age ≤12 weeks, with 8 individuals (85.3%) and an adequate frequency of visits (≥6 times) totaling 62 individuals (60.8%). However, most patients received ANC at multiple healthcare facilities, with 85 individuals (83.3%), and most of the healthcare services were categorized as inadequate, with 45 individuals (44.1%). Additionally, some patients received poor-quality services, totaling 16 individuals (15.7%). The majority of heart disease morbidity experienced was hypertension, affecting 66 individuals (64.7%), while the least common condition was cardiomegaly, affecting 4 individuals (3.9%). Complications from morbidity, such as maternal mortality, were observed in 4 individuals (3.9%), while nearly all patients experienced improved conditions, totaling 98 individuals (96.1%).

Table 2 First Antenatal Care Visit (K1 ANC) and Morbidity and Mortality of Heart Disease in Pregnancy

Variable	First visit (K1) of ANC				p-value
	>12 weeks		≤12 weeks		
	f	%	f	%	
Morbidity					
Hypertension					
Yes	11	10.8%	55	53.9%	0.565
None	4	3.9%	32	31.4%	
Atrial septal defect (ASD)					
Yes	1	1.0%	12	11.8%	0.686
None	14	13.7%	75	73.5%	
Cardiomyopathy					
Yes	0	0.0%	7	6.9%	0.590
None	15	14.7%	80	78.4%	
Heart valve disease					
Yes	3	2.9%	9	8.8%	0.378
None	12	11.8%	78	76.5%	
Cardiomegaly					
Yes	0	0.0%	4	3.9%	1.000
None	15	14.7%	83	81.4%	
Mortality					
Yes	0	0.0%	4	3.9%	1.000
None	15	14.7%	83	81.4%	

Table 2 shows that the first antenatal care visit (K1 ANC), whether conducted within the first trimester (gestational age ≤12 weeks) or after the first trimester (gestational age >12 weeks), still indicates morbidity and all mortality cases were experienced by pregnant patients with K1 ANC ≤12 weeks. The statistical test results using Fisher's Exact test show that all p-values are greater than α (p>0.05), suggesting that K1 ANC is not significantly associated with morbidity and mortality.

Table 3 Frequency of Antenatal Care (ANC) Visits and Morbidity and Mortality of Heart Disease in Pregnancy

Variable	Frequence of ANC				p-value
	<6 times		≥6 times		
	f	%	f	%	
Morbidity					
Hypertension					
Yes	28	27.5%	38	37.3%	0.403
None	12	11.8%	24	23.5%	
Atrial septal defect (ASD)					
Yes	4	3.9%	9	8.8%	0.560
None	36	35.3%	53	52.0%	
Cardiomyopathy					
Yes	2	2.0%	5	4.9%	0.702
None	38	37.3%	57	55.9%	
Heart valve disease					
Yes	5	4.9%	7	6.9%	1.000
None	35	34.3%	55	53.9%	
Cardiomegaly					
Yes	1	1.0%	3	2.9%	1.000
None	39	38.2%	59	57.8%	
Mortality					
Yes	2	2.0%	2	2.0%	0.644
None	38	37.3%	60	58.8%	

Table 3 shows that all pregnant patients with an ANC frequency under the Ministry of Health of Indonesia's recommendation (≥6 visits) or those with insufficient frequency (<6 visits) did not show significant differences in morbidity findings. Furthermore, the frequency did not show any difference in mortality findings. The statistical test results using Fisher's Exact test reveal that all p-values are greater than α (p>0.05), indicating that ANC frequency is not significantly associated with morbidity and mortality.

Table 4 shows that mothers who received antenatal care (ANC) at multiple locations experienced higher rates of heart disease morbidity during pregnancy compared to those with consistent ANC locations. Maternal mortality was observed in all pregnant women who had ANC at multiple locations. The statistical test results using Fisher's Exact test show that all p-values are greater than α (p>0.05), indicating that the location of ANC is not significantly associated with morbidity and mortality.

Table 4 Location of Antenatal Care (ANC) and Morbidity and Mortality of Heart Disease in Pregnancy

Variable	Location of ANC				p-value
	Inconsistent		Consistent		
	f	%	f	%	
Morbidity					
Hypertension					
Yes	54	52.9%	12	11.8%	0.782
None	31	30.4%	5	4.9%	
Atrial septal defect (ASD)					
Yes	12	11.8%	1	1.0%	0.690
None	73	71.6%	16	15.7%	
Cardiomyopathy					
Yes	5	4.9%	2	2.0%	0.330
None	80	78.4%	15	14.7%	
Heart valve disease					
Yes	11	10.8%	1	1.0%	0.685
None	74	72.5%	16	15.7%	
Cardiomegaly					
Yes	3	2.9%	1	1.0%	0.524
None	82	80.4%	16	15.7%	
Mortality					
Yes	4	3.9%	0	0.0%	1.000
None	81	79.4%	17	16.7%	

Table 5 Healthcare Services Quality and Morbidity and Mortality of Heart Disease in Pregnancy

Variable	Health Services Quality						p-value
	Poor		Less		Good		
	f	%	f	%	f	%	
Morbidity							
Hypertension							
Yes	3	2.9%	29	28.4%	34	33.3%	0.000*
None	13	12.7%	16	15.7%	7	6.9%	
Atrial septal defect (ASD)							
Yes	7	6.9%	3	2.9%	3	2.9%	0.002*
None	9	8.8%	42	41.2%	38	37.3%	
Cardiomyopathy							
Yes	3	2.9%	2	2.0%	2	2.0%	0.132

None	13	12.7%	43	42.2%	39	38.2%	
Heart valve disease							
Yes	2	2.0%	9	8.8%	1	1.0%	0.025*
None	14	13.7%	36	35.3%	40	39.2%	
Cardiomegaly							
Yes	1	1.0%	2	2.0%	1	1.0%	0.809
None	15	14.7%	43	42.2%	40	39.2%	
Mortality							
Yes	3	2.9%	1	1.0%	0	0.0%	0.012*
None	13	12.7%	44	43.1%	41	40.2%	

*Significant results

Table 5 shows that there is variation in the healthcare services received during ANC for each type of heart disease morbidity, whether categorized as good, inadequate, or poor. Maternal mortality was found to be more common in cases where healthcare services were poor or inadequate. The results of the statistical test using Fisher's Exact test indicate a significant relationship between healthcare services and hypertension (p-value=0.000), atrial septal defect (ASD) (p-value=0.002), and valvular heart disease (p-value=0.025). Variables that were not significantly related include cardiomyopathy (p-value=0.132) and cardiomegaly (p-value=0.809). Additionally, a relationship was found between healthcare services and mortality (p-value=0.012). It can be concluded that healthcare services during ANC are significantly related to specific morbidities and mortality.

4. Discussion

4.1. The Relationship Between the First Antenatal Care Visit (K1 ANC) and Morbidity and Mortality of Heart Disease in Pregnancy

No significant relationship was found between the first antenatal care visit (K1 ANC) and morbidity and mortality of heart disease in pregnancy, as indicated by all p-values greater than 0.05. The National Institute for Health and Care Excellence (NICE) recommends that the first ANC visit (K1) be conducted as early as possible (within 12 weeks) to identify potential problems early in pregnancy (9). Based on the study results, most patients had their K1 ANC visits within the recommended time frame (≤12 weeks of gestation).

Timely first visits increase the likelihood of adhering to clinically indicated testing schedules and provide enough time for doctors to detect diseases and give interventions (10). However, the recommended K1 ANC visit did not reduce morbidity and mortality rates. This could be a significant issue to address, questioning whether the quality of care received by pregnant women during their first visit was adequate. A low-quality first visit would certainly fail to detect pregnancy abnormalities early on, leading to delays in diagnosis and intervention. This is consistent with research indicating that attending ANC appointments does not guarantee effective screening and treatment for pregnant women, even if the pregnancy experience criteria are met (11).

4.2. The Relationship Between ANC Frequency and Morbidity and Mortality of Heart Disease in Pregnancy

No significant relationship was found between ANC frequency and morbidity and mortality of heart disease in pregnancy, as indicated by all p-values greater than 0.05. The WHO's 2016 ANC model recommends at least eight ANC visits to reduce morbidity and mortality and improve the overall pregnancy experience (12). The Ministry of Health of the Republic of Indonesia recommends a minimum of six ANC visits throughout the pregnancy: one in the first trimester, two in the second trimester, and three in the third trimester (6).

The study results suggest that ANC frequency, which did not correlate with morbidity or mortality of heart disease in pregnancy, might indicate that quantity does not always align with quality. Ideally, more frequent ANC visits should help detect heart disease morbidity early, thus reducing the severity of the disease and minimizing the risk of other maternal complications. This finding is consistent with research conducted at Dr. Soetomo General Hospital in 2022, which concluded that ANC frequency was not affiliated with maternal morbidity and mortality (13). Additionally, this study aligns with research conducted in India in 2022, which showed that the quantity of ANC visits did not correlate

with their quality. Despite many pregnant women meeting the recommended number of visits, inadequate care, such as inconsistent blood pressure measurements, weight checks, and counseling on pregnancy complications, signaled insufficient healthcare services (14).

4.3. The Relationship Between ANC Location and Morbidity and Mortality of Heart Disease in Pregnancy

No significant relationship was found between ANC location and morbidity and mortality of heart disease in pregnancy, as indicated by all p-values greater than 0.05. The study found that ANC visits at locations with inconsistent care were associated with higher morbidity, and all mortality cases were observed in this group, compared to those with consistent ANC locations. Conducting ANC at varying locations can lead to poor coordination among healthcare professionals and a lack of continuity in managing pregnancy risks. However, even with consistent ANC locations, heart disease morbidity during pregnancy was still evident.

This study is in line with research in 2022 that one of the problems and challenges in providing ANC services in health facilities includes limited training for health workers and deficiencies in effective risk management, whether in consistent or inconsistent locations if weaknesses and limitations in services are not addressed, it will result in unsatisfactory pregnancy outcomes (15).

4.4. The Relationship Between Healthcare Services and Morbidity and Mortality of Heart Disease in Pregnancy

There is a significant relationship between healthcare services and the morbidity of heart disease, such as hypertension, atrial septal defect (ASD), and valvular heart disease, as well as mortality, indicated by p-values less than 0.05. However, no significant relationship was found between healthcare services and cardiomyopathy or cardiomegaly, as shown by p-values greater than 0.05. Pregnant women with a history of heart disease (either congenital or from previous pregnancies) should receive early interventions, starting from preconception care, which includes decisions on whether to continue the pregnancy or not. All pregnant women should receive collaborative care from obstetricians specializing in high-risk pregnancies and cardiologists (16).

The quality of preconception care will influence the quality of antenatal care (ANC) services. However, the results of this study suggest that most healthcare services were categorized as poor or inadequate, and this correlates with higher morbidity and mortality rates. This finding is consistent with a study conducted in Ghana in 2022, which indicated that women who received ANC of lower quality had a higher likelihood of experiencing heart disease (17). Poor or inadequate healthcare services lead to delayed early detection, diagnosis, and intervention, which ultimately results in poor pregnancy outcomes. Effective healthcare services are expected to prevent adverse conditions for pregnant women with heart disease.

This study also aligns with research in Sri Lanka, which demonstrated that maternal mortality rates from heart disease could be reduced with better antenatal care, particularly for women with hypertension-related complications from the early stages of pregnancy (18).

The prevalence of heart disease in pregnancy at Dr. Soetomo General Hospital shows significant rates, highlighting the need for further attention. The quality of ANC services is associated with morbidity and mortality in heart disease during pregnancy. Therefore, early identification of risk factors through adequate ANC services and timely interventions is essential in reducing maternal morbidity and mortality.

Recommendations include the implementation of comprehensive training programs and protocols for ANC services to help healthcare facilities diagnose and intervene early. Continuous evaluation of ANC services is also necessary, focusing not only on the quantity of visits but also on improving the quality of care with each visit. This study contributes significantly to the evaluation of ANC quality, particularly in relation to heart disease morbidity and mortality, and provides valuable insights for stakeholders in shaping policies to improve ANC services.

However, this study has limitations in the retrospective approach and medical record data collection because the data's completeness and accuracy can affect the analysis results. Therefore, it is recommended that future studies consider a cohort approach and direct interviews to make the data obtained more accurate.

5. Conclusion

The prevalence of heart disease during pregnancy at Dr. Soetomo General Hospital shows a significant figure and has become an issue that requires attention. The quality of antenatal care (ANC) is linked to the morbidity and mortality of heart disease during pregnancy. Therefore, early identification of various risk factors through improved or adequate

ANC services is crucial for early interventions aimed at reducing morbidity and maternal mortality. Recommendations include the need for training programs or more comprehensive ANC service planning protocols to enable healthcare facilities to diagnose and intervene early. Additionally, continuous evaluation of the services during antenatal visits is expected, ensuring that each visit focuses not only on quantity but also on the improvement of quality.

Compliance with ethical standards

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Disclosure of Conflict of interest

Author would like to express gratitude to everyone involved in this research.

Statement of ethical approval

This study has received ethical approval from the Ethics Committee of Dr. Soetomo General Hospital, under reference number 2819/104/4/III/2024.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

References

[1] WHO. Cardiovascular diseases (CVDs). 2021 [cited 2023 Nov 16]. Cardiovascular diseases (CVDs). Available from: https://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds)

[2] Jones B, Bhatia K. Cardiac disease in pregnancy. Anaesthesia & Intensive Care Medicine. 2022 Aug;23(8):448–54.

[3] Iftikhar SF, Biswas M. Cardiac Disease in Pregnancy. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 [cited 2023 Dec 3]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK537261/

[4] Chang SA, Khakh P, Janzen M, Lee T, Kiess M, Rychel V, et al. Trending Cardiac Biomarkers During Pregnancy in Women With Cardiovascular Disease. Circ: Heart Failure [Internet]. 2022 Aug [cited 2023 Nov 16];15(8). Available from: https://www.ahajournals.org/doi/10.1161/CIRCHEARTFAILURE.121.009018

[5] CDC. Pregnancy Mortality Surveillance System. 2023 [cited 2023 Nov 16]. Pregnancy Mortality Surveillance System. Available from: https://www.cdc.gov/reproductivehealth/maternal-mortality/pregnancy-mortality-surveillance-system.htm

[6] Kemenkes RI. Pedoman Pelayanan Antenatal Terpadu. 3rd ed. Jakarta: Kemenkes RI; 2020.

[7] Nguyen Manh T, Bui Van N, Le Thi H, Vo Hoang L, Nguyen Si Anh H, Trinh Thi Thu H, et al. Pregnancy with Heart Disease: Maternal Outcomes and Risk Factors for Fetal Growth Restriction. IJERPH. 2019 Jun 12;16(12):2075.

[8] Millington S, Magarey J, Dekker GA, Clark RA. Cardiac conditions in pregnancy and the role of midwives: A discussion paper. Nursing Open. 2019 Jul;6(3):722–32.

[9] NICE. Antenatal care | NICE Guideline. National Institute for Health and Care Excellence; 2021.

[10] Kitaw TA, Haile RN. Time to first antenatal care booking and its determinants among pregnant women in Ethiopia: survival analysis of recent evidence from EDHS 2019. BMC Pregnancy Childbirth. 2022 Dec 9;22(1):921.

[11] Girotra S, Malik M, Roy S, Basu S. Utilization and determinants of adequate quality antenatal care services in India: evidence from the National Family Health Survey (NFHS-5) (2019-21). BMC Pregnancy Childbirth. 2023 Nov 17;23(1):800.

[12] WHO. WHO recommendations on antenatal care for a positive pregnancy experience. World Health Organization; 2016.

[13] Mardiyah N, Ernawati E, Anis W. ANTENATAL CARE AND MATERNAL OUTCOME OF PREECLAMPSIA. IMHSJ. 2022 Jul 28;6(3):298–309.

[14] Radovich E, Chaudhry M, Penn-Kekana L, Raju KRK, Mishra A, Vallabhuni R, et al. Measuring the quality of antenatal care in a context of high utilisation: evidence from Telangana, India. BMC Pregnancy Childbirth. 2022 Nov 25;22(1):876.

[15] Gamberini C, Angeli F, Ambrosino E. Exploring solutions to improve antenatal care in resource-limited settings: an expert consultation. BMC Pregnancy Childbirth. 2022 Dec;22(1):449.

[16] Elkayam U, Goland S, Pieper PG, Silversides CK. High-Risk Cardiac Disease in Pregnancy. Journal of the American College of Cardiology. 2016 Jul;68(4):396–410.

[17] Amponsah-Tabi S, Dassah ET, Asubonteng GO, Ankobea F, Annan JJK, Senu E, et al. An assessment of the quality of antenatal care and pregnancy outcomes in a tertiary hospital in Ghana. Abdel Ghafar MT, editor. PLoS ONE. 2022 Oct 12;17(10):e0275933.

[18] Hettiarachchi A, Jayaratne K, De Silva C, Senanayake H, Lokunarangoda N, Agampodi S. Heart disease complicating pregnancy as a leading cause of maternal deaths in LMIC settings: the Sri Lankan experience. The Lancet Regional Health - Southeast Asia. 2023 Aug; 15:100223.