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Maternal health in Namibia: Lessons learned from obstetric surveillance

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Citation

Heemelaar, S. (2023, April 18). *Maternal health in Namibia: Lessons learned from obstetric surveillance*. Retrieved from <https://hdl.handle.net/1887/3594162>

Version: Publisher's Version

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Downloaded from: <https://hdl.handle.net/1887/3594162>

Note: To cite this publication please use the final published version (if applicable).

Chapter 6.

Experiences of a dedicated Heart and Maternal Health Service providing multidisciplinary care to pregnant women with cardiac disease in a tertiary centre in Namibia

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Trop Med Int Health. 2022 Sep;27(9):803–14

Abstract

Objective

Firstly, to describe the implementation process, benefits and challenges of a multidisciplinary service for pregnant women with cardiac disease in Namibia. Secondly, to assess pregnancy outcomes in this population.

Methods

In a tertiary hospital in Namibia, a multidisciplinary service was implemented by staff of obstetric and cardiology departments and included preconception counselling, provision of antenatal care and reliable contraception. Management guidelines developed for high-income settings were used, since no locally adapted guidelines were available. A cohort study was performed to assess cardiac, obstetric, and fetal outcomes. Included were pregnant women with cardiac disease, referred to this service between 1 August 2016 and 31 July 2018.

Results

Important benefits of this service were the integrated approach, improved access to reliable contraception and insight into drivers of poor outcome. Several challenges with use of available guidelines were encountered, as contextual factors specific to lower-income settings were not taken into consideration, such as higher rates of infection or barriers to access care. The cohort consisted of 65 women. Cardiac disease was diagnosed for the first time in sixteen (24.6%) women, of whom eleven had pre-existing cardiac disease. These women presented more often with heart failure compared to women with known heart disease (75.0% vs 6.1%, RR 12.5, 95% CI 3.9-38.0). Five women died. Cardiac events occurred in 22 women of whom eight developed thromboembolic events and two endocarditis. The majority had no indication for prophylaxis, based on available guidelines. Fetal events occurred in 36 pregnancies. After pregnancy more than half of women (35/65, 53.8%) were using long-acting reversible contraception.

Conclusion

Despite several barriers, it was possible to implement a multidisciplinary service in a high-burden setting. Cardiac and fetal event rate in this cohort were high. To improve outcomes focus should be on availability of context-specific guidelines and better detection of cardiac disease.

Introduction

Cardiac disease in pregnancy is an important contributor to maternal deaths globally. In many high-income countries cardiac disease is now the most common cause of maternal mortality, whilst in low- and middle-income countries (LMICs) its contribution to maternal mortality is increasing.¹⁻⁴

Risk prediction tools and management guidelines have been developed for women with cardiovascular disease, who are planning pregnancy or already pregnant.⁵⁻⁹ These recommendations are based mainly on findings from high-income countries, as data from LMICs are scarce.^{7,8,10} Recommendations are, therefore, not easily applied to low- and middle-income settings due to the limited availability, accessibility and affordability of diagnostic and therapeutic resources, and differences in the epidemiology and severity of underlying cardiac disease.¹¹⁻¹⁴ In LMICs, there is still a high prevalence of rheumatic heart disease (RHD), whereas congenital heart disease is the most prevalent diagnosis in high-income countries.^{7,8,10,11,13-15} Furthermore, more advanced disease is seen in LMICs.^{12,14,16} The modified World Health Organisation (mWHO) risk classification, based on the underlying cardiac diagnosis, is considered the most accurate system for maternal cardiovascular risk assessment.^{9,17-20} However, it did not perform adequately in middle-income countries, as high rates of complications were seen in pregnancies classified as low risk.¹²

In Namibia, a middle-income sub-Saharan African country, cardiac disease was one of the most common causes of maternal deaths in 2012-2015.²¹ In the national referral hospital in Windhoek, the capital city, staff noted a high rate of unintended pregnancies and a high rate of complications among pregnant women with cardiac disease. However, as no data were captured, the impact of cardiac disease on maternal and fetal outcome was unclear.

To address this, a dedicated Heart and Maternal Health Service (HMH) was established by staff of the cardiology and obstetrics and gynaecology departments of Windhoek Central Hospital in 2016. The aim was to implement a multidisciplinary service for women with cardiac disease in Namibia, providing care from preconception to postpartum. A two-year prospective cohort study was performed to assess the spectrum of cardiac disease in pregnant women referred to this dedicated service and to assess cardiac, obstetric and fetal outcomes of these pregnancies. The focus of this paper is twofold: to describe the implementation process of this service, including the encountered benefits and challenges, and to present the findings of the cohort study.

Methods

Setting

This study was performed at Windhoek Central Hospital, the tertiary public hospital of Namibia, serving a population of 2.3 million.²² This facility has approximately 12 000 births per annum.²² During the study period the number of available obstetrician-gynaecologists ranged from three to six. This was the only public health facility in the country with availability of consultant cardiologists (2), cardiothoracic surgeons (2), and cardiac technologists (2) and where transcatheter cardiac interventions and cardiac surgeries were performed. At one regional hospital in northern Namibia (Oshakati), about 700 kilometres from Windhoek, two cardiologists employed in the private sector provided cardiac care for patients that were referred to them.

Patients presenting to any public health facility in Namibia, pay a minimum fee (about US\$ 0.65) for each healthcare visit and no additional costs are incurred for diagnostics or treatments including admissions, interventions or surgeries. Those living outside Windhoek in need of elective specialist care, such as a consultation at the cardiac outpatient department or admission for surgery, were transferred from district hospitals to Windhoek by a free bus service, once per week, provided by the Ministry of Health and Social Services.

Reproductive health services, including contraceptive services, are free of charge. Most facilities had combined oral contraceptives and progestogen-only injectables routinely available. The United Nations Population Fund made a once off donation of hormonal implants and intra-uterine devices to the Ministry of Health and Social Services of Namibia in 2016 so these contraceptive devices were available at the study site and some other hospitals for the duration of the study.

Design and inclusion criteria of cohort study

For this two-year prospective observational cohort study all pregnant and postpartum women with cardiac disease referred to the HMH Service were included between 1st of August 2016 and 31st of July 2018. We included both women with cardiac disease diagnosed prior to conception, as well as those newly diagnosed during pregnancy or within 42 days postpartum.

Implementation of the Heart and Maternal Health Service

The HMH Service was a comprehensive service for women of reproductive age with cardiac disease. A multidisciplinary team provided antenatal, intrapartum and postpartum care for women with cardiac disease. Every two weeks this team, consisting of one or more obstetricians, cardiologist, sonographers,

echocardiographers and anaesthesiologists, was available at the antenatal clinic. Guidelines on the management of cardiovascular diseases during pregnancy of the European Society of Cardiology of 2011 were adhered to, as no local or LMICs-adapted guidelines were available at that time.¹⁷ Based on clinical condition, severity of cardiac disease and obstetric history, each woman received an individualized management plan which outlined the frequency of follow-up visits, obstetric ultrasounds, maternal echocardiograms and birth plan. Information on postpartum contraception was provided during antenatal visits. Women who presented with newly diagnosed cardiac disease were scheduled for the earliest available clinic day if haemodynamically stable or assessed as inpatients if haemodynamically unstable. Maternal risk was assessed using the mWHO risk classification, which stratifies maternal cardiovascular risk into four classes: class I (no increased risk of maternal mortality and no/mild increase in morbidity) up to class IV (extremely high risk, pregnancy contra-indicated).¹⁷ Risk stratification for cardiac disease not specifically mentioned in the classification, was done by a consultant cardiologist (CH) and a physician (TAU) with extensive experience in cardiology.

For women with an indication for anticoagulation, the vitamin K antagonist warfarin, unfractionated and low molecular weight heparin were available in the public health sector. If she presented early in the first trimester, a woman using warfarin was counselled about the option to change to low molecular weight heparins in the first trimester. However, dose adjustment with anti-Xa monitoring was not possible. The international normalized ratio was used to manage warfarin treatment.

In Namibia, termination of pregnancy up to 26 weeks of gestational age is legally permitted for significant maternal conditions and certain fetal conditions. Because reported cardiac event rates are 19-27% for women classified as WHO III and 40-100% for women in mWHO IV, compared to 2.5-5% for mWHO I and 5.7-10.5% for mWHO II, the option of termination of pregnancy was included in the counselling for all women classified as mWHO III and advised for women classified as mWHO IV (if they presented before 26 weeks of gestation).⁶

The HMH Service followed up all women at six weeks and at six months after the end of pregnancy. On clinical indication, the follow up period was extended up to a year. Placement of long acting reversible family planning was offered directly after birth for women who had difficulties attending follow up visits and at six weeks after birth for all other women. If a HMH visit was not feasible for the woman, the six-month follow-up was done by phone. At the last follow-up visit, all women were referred to the Cardiology service.

The HMH Service also provided preconception counselling at the cardiac outpatient department. All women of childbearing age were educated about their cardiac diagnosis, peripartum risk as determined by the mWHO risk classification and reliable contraception. A specifically designed patient information leaflet was provided to the women (Appendix 1). After counselling the woman was seen by a doctor for her cardiac follow-up and any further concerns were addressed. Women who opted for long-acting reversible contraceptives (e.g. hormonal implant or intrauterine contraceptive devices) and who had no contra-indication for these methods, could have them placed on the same day. These women were referred to the gynaecology department, as only doctors from this department had the expertise and equipment for placement of these devices. When the HMH Service was introduced, it was planned that these contraceptive devices would be placed by nursing staff of the cardiac outpatient department. This turned out to be unattainable due to an already high workload of these nurses and lack of training resources.

Due to staff shortages across all departments the integrated HMH Service ended in June 2017 and cardiac and obstetric care was continued at the respective departments. Patient assessments and management were discussed in close communication between the departments and high-risk women were discussed during multidisciplinary meetings. The provision of preconception counselling continued and long-acting reversible contraceptives could be provided on the same day at the gynaecology department.

There was no specific budget available for the HMH Service. All members of the HMH Service were employed by the Ministry of Health and Social Services and the HMH Service was part of their clinical duties. The patient information leaflet was printed by the United Nations Population Fund.

Data collection and outcome

Structured forms were developed for the HMH Service to record the women's antenatal visits and maternal and fetal outcomes. Data collected included socio-demographic characteristics, cardiac history, obstetric history, cardiac and obstetric outcome. All women were asked whether it was a planned or unplanned pregnancy and if continuation was desired.

Primary outcomes were underlying cardiac diagnoses of women referred to the HMH Service, severity of cardiac disease, risk assessment based on mWHO classification, and condition at first presentation based on the New York Heart Association (NYHA) class. Secondary outcomes were the incidences of cardiac, obstetric and fetal events. Cardiac event was defined as heart failure requiring admission or modifications

in medication, thromboembolic event, new onset or exacerbated arrhythmia, endocarditis, or a cardiac intervention during pregnancy or within 6 months after the end of pregnancy. Obstetric events that were documented included postpartum haemorrhage more than 1000 mL, pre-eclampsia or eclampsia as defined by the World Health Organisation.²³ Fetal event was defined as miscarriage or termination of pregnancy < 26 weeks of gestation, stillbirth from 26 weeks of gestation or, if the gestational age was unknown, birthweight >1000g and documented as either fresh or macerated in the medical file, premature birth <37 weeks gestation, small-for-gestational age birthweight (<10th centile), born alive with congenital anomalies or neonatal death (within 28 days after birth). Maternal death was defined as death of a woman while pregnant or within 42 days of termination of pregnancy or birth, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes.²⁴ Late maternal death was defined as the death of a woman from direct or indirect causes more than 42 days but less than one year after the end of pregnancy.²⁴

The association between events and several risk factors was assessed. Risk factors were selected when listed in the guidelines of the European Society of Cardiology or identified in studies from similar settings and present in at least ten percent of our cohort.^{6,16,25}

Data analysis

Data analysis consisted of frequencies of demographic and clinical variables. Data were double entered and cross checked in Epidata version 3.1 and analysed with SPSS version 26. Continuous variables are presented as means with standard deviations and differences were assessed with student t-test. Missing data regarding medical history were assumed to be 'no', whereas complete case analysis was used to handle missing data regarding outcome measures of the current pregnancy. Categorical variables are presented as percentages. Differences were assessed using chi-square test or Fisher's Exact test when indicated and risk ratio (RR) and 95% confidence interval (CI) are presented. Statistical significance was assumed at a two-sided value of $p < 0.05$. All results are presented in the tables and figures and therefore not published in a separate online database. We followed the STROBE reporting guidelines.

This study was reviewed and approved by the ethics research unit of the Namibian Ministry of Health and Social Services, Reference 17/3/3 SH. Women were informed about the purpose of the cohort and verbally offered to opt out of her anonymous data being used for research purposes.

Results

Sixty-five pregnancies of women with cardiac disease were included in this cohort. Table 1 summarizes baseline characteristics according to mWHO classes of the included women. Thirty six women lived in Khomas region where the study site is located, 29 were from other regions representing nearly all 14 regions of Namibia and one woman lived in Angola. Figure 1 is a map of Namibia, indicating the study site and home regions of all women included in the cohort.

Table 1. Baseline characteristics of 65 pregnant women with cardiac disease referred to the HMH service

Variables	Overall (N = 65)	mWHO I (N = 6)	mWHO II (N = 12)	mWHO III (N = 26)	mWHO IV (N = 21)	P-value
Age, years	30.0± 7.6	23.8± 6.1	30.2± 7.7	30.9± 7.3	30.5± 8.1	0.22
Nulliparous	22 (33.8)	4 (66.7)	4 (33.3)	8 (30.8)	6 (28.6)	0.4
Married/cohabiting	22 (33.8)	1 (16.7)	5 (41.7)	9 (34.6)	7 (33.3)	0.96
Attitude towards pregnancy						0.69
Desired and planned	22 (33.8)	2 (33.3)	3 (25.0)	10 (38.5)	7 (33.3)	
Desired and unplanned	20 (30.8)	3 (50.0)	6 (50.0)	6 (23.1)	5 (23.8)	
Undesired	22 (33.8)	1 (16.7)	3 (25.0)	10 (38.5)	8 (38.1)	
BMI, kg/m ²	25.3± 6.9	21.1± 4.6	28.9± 8.2	24.9± 7.4	25.1± 5.3	0.15
Pre-existing hypertension	10 (15.4)	1 (16.7)	2 (16.7)	2 (7.7)	5 (23.8)	0.43
HIV	7 (10.8)	0 (0.0)	2 (16.7)	3 (11.5)	2 (9.5)	0.83
Tuberculosis	4 (6.2)	0 (0.0)	0 (0.0)	3 (11.5)	1 (4.8)	0.68
Cardiac disorder						0.02
Congenital	12 (18.5)	3 (50.0)	4 (33.3)	3 (11.5)	2 (9.5)	
RHD	31 (47.7)	2 (33.3)	7 (58.3)	15 (57.7)	7 (33.3)	
PPCM, current pregnancy	5 (7.7)	0 (0.0)	0 (0.0)	2 (7.7)	3 (14.3)	
PPCM, previous pregnancy	9 (13.8)	0 (0.0)	0 (0.0)	6 (23.1)	3 (14.3)	
Cardiomyopathy other	5 (7.7)	0 (0.0)	0 (0.0)	0 (0.0)	5 (23.8)	
Arrhythmia	1 (1.5)	0 (0.0)	1 (8.3)	0 (0.0)	0 (0.0)	
Mixed	1 (1.5)	1 (16.7)	0 (0.0)	0 (0.0)	0 (0.0)	
Pulmonary hypertension	1 (1.5)	0 (0.0)	0 (0.0)	0 (0.0)	1 (4.8)	
Previous cardiac surgery	14 (21.5)	2 (33.3)	3 (25.0)	9 (34.6)	0 (0.0)	0.01
Previous cardiac event	27 (41.5)	0 (0.0)	5 (41.7)	16 (61.5)	6 (28.6)	0.03
NYHA III-IV at presentation	15 (23.1)	0 (0.0)	0 (0.0)	3 (11.5)	12 (57.1)	<0.001
Newly diagnosed heart condition	16 (24.6)	2 (33.3)	0 (0.0)	3 (11.5)	11 (52.4)	0.001

Values are mean ± standard deviation or n (%).

HMH, Heart and Maternal Health service; mWHO, modified World Health Organization risk classification; BMI, body mass index; HIV, human immunodeficiency virus; RHD, rheumatic heart disease; PPCM, peripartum cardiomyopathy; NYHA, New York Heart Association Functional classification

with NYHA III or IV more often than women diagnosed with cardiac disease prior to pregnancy (75.0% vs 6.1%, RR 12.5, 95% CI 3.9-38.0). Women living within Khomas region were less likely to be newly diagnosed compared to women from other regions (11.1% vs 41.4%, RR 0.3, 95% CI 0.1-0.7). Over two thirds of the cohort had a high-risk cardiac condition as 47 women (72.3%) were classified as mWHO III or IV.

Cardiac events

The incidence of cardiac events was high (22/61, 36.1%), and threefold higher among women with newly diagnosed cardiac conditions compared to women with cardiac disease diagnosed before pregnancy, (13/16 vs 9/45, RR 4.1 95% CI 2.2-7.6).

The most common event was new onset heart failure (18/61, 29.5%). This occurred in two women in the second trimester, five in the third trimester and eleven postpartum. One woman with heart failure secondary to peripartum cardiomyopathy survived a cardiac arrest. Eight women had a thromboembolic event (thrombus in the left ventricle (4), stroke (2), pulmonary embolism (1) and mechanical valve thrombosis (1)). One stroke and the valve thrombosis occurred in the first trimester and the remaining six thromboembolic events occurred postpartum. Five women with a thromboembolic event had no indication for anticoagulation according to guidelines that were adhered to.¹⁷ The remaining three women had an indication for anticoagulation, which was omitted in one case and inadequately monitored in the other two cases. Table 2 summarizes the characteristics and outcomes of women using anticoagulation during pregnancy. Three of these women developed cardiac events and there were fetal events for six of these pregnancies. Two women, who had RHD, developed infective endocarditis postpartum, both of whom died.

In this cohort five women died: two had developed peripartum cardiomyopathy and three had RHD. Three of the five deaths occurred more than 42 days after the end of pregnancy. Table 3 summarizes details of these five maternal deaths.

Table 2. Details of all women using anticoagulation during pregnancy										
Diagnosis	mWHO	Age	Parity	Attitude pregnancy	Indication warfarin	GA at presentation	1st trimester	Mode of birth	Maternal outcome	Fetal outcome
RHD, MVR	III	43	2	Desired & unplanned	AF	12 weeks	Warfarin 5 mg	Caesarean section	Death	Small-for-gestational age, alive at 6 months
RHD, MVR	III	40	4	Undesired	Mechanical valve	12 weeks	None ^a	Termination of pregnancy	Valve thrombosis	Medical abortion at 12 weeks
Cardiomyopathy	IV	28	0	Desired & planned	Previous DVT needing thrombectomy	8 weeks	None ^b	Caesarean section	CCF	Hydrocephalus, alive at 6 months
RHD, AVR	III	21	0	Unwanted	Mechanical valve	Post miscarriage	None ^c	Miscarriage	No events	Miscarriage
DCMO, EF 38%	IV	29	1	Desired & unplanned	PE prior to onset pregnancy	29 weeks	None ^d	Assisted vaginal birth	No events	Small-for-gestational age, alive at 6 months
Cardiomyopathy	IV	36	3	Undesired	Previous stroke	25 weeks	Warfarin 5 mg	Caesarean section	No events	Preterm birth at 35 weeks due to APH, alive at 6 months
RHD, AVR	III	20	0	Desired & planned	Mechanical valve	8 weeks	LMWH	Vaginal birth	No events	Alive, no complications
RHD, AVR	III	37	2	Undesired	Mechanical valve, previous stroke	23 weeks	Warfarin 7.5 mg	Vaginal birth	No events	Alive, no complications

mWHO, modified World Health Organization risk classification; GA, gestational age; RHD, rheumatic heart disease; MVR, mitral valve replacement; AF, atrial fibrillation; DCMO, dilated cardiomyopathy; DVT, deep venous thrombosis; CCF, congestive cardiac failure; AVR, aortic valve replacement; EF, ejection fraction; PE, pulmonary embolism; LMWH, low-molecular-weight heparin; MVR, mitral valve replacement.

^a Warfarin was stopped by doctor in referral hospital when woman presented with pregnancy

^b Woman was started at 16 weeks of gestation due to previous DVT

^c Warfarin stopped by woman when she realized she was pregnant

^d Woman had defaulted all medication, she was restarted at presentation to our hospital

Table 3. Details of maternal deaths									
Diagnosis	Timing presentation	mWHO	NYHA	Age (yrs)	Parity	Attitude pregnancy	When	Cause of death	Fetal outcome
RHD, severe MS	First trimester	IV	IV	21	1	Undesired	16 days post abortion	Stroke	Medical abortion
RHD, bioMVR & AF on warfarin	First trimester	III	I	43	2	Desired & unplanned	56 days postpartum	Infective endocarditis	Small-for-gestational age, alive at 6 months
RHD, severe MS	Postpartum	IV	IV	35	4	Unknown	16 days postpartum	Newly diagnosed RHD, CCF, infective endocarditis and septic shock	Alive at 6 months
PPCM	Postpartum	IV	IV	17	0	Undesired	3 months postpartum	Multi-organ embolism due to left ventricular thrombus	Preterm birth, alive at 6 months
PPCM	Postpartum	IV	IV	18	0	Desired & planned	8 months postpartum	CCF	Alive at 6 months

mWHO, modified World Health Organization risk classification; NYHA, New York heart association classification; RHD, rheumatic heart disease; MS, mitral valve stenosis; MVR, mitral valve replacement; AF, atrial fibrillation; PPCM, peripartum cardiomyopathy; CCF, congestive cardiac failure

Obstetric outcomes

Antenatal care commenced in the first trimester for 16 (24.6%) women, in the second trimester for 38 (58.5%), in the third trimester for five (7.7%). Three (3.1%) women did not attend antenatal care and attendance was unknown for three women.

Of the 49 women with cardiac disease diagnosed before current pregnancy, only 30 (61.2%) women had received preconception counselling and only fifteen (30.6%) had a planned pregnancy. Regarding pregnancy outcome, three women had a spontaneous miscarriage. Four women had their pregnancy terminated as they were classified as high risk: their mWHO classification was III (2) or IV (2). Of the 58 women who gave birth, 28 (43.1%) had a spontaneous vaginal birth and two (3.3%) women had an assisted vaginal birth. Twenty-eight women gave birth by caesarean section (43.1%). Two women had a cardiac indication for caesarean section as they were haemodynamically unstable, and all other women had an obstetric indication.

Obstetric events occurred among 12 women: postpartum haemorrhage (6), eclampsia (2), pre-eclampsia (5), of which one woman also had postpartum haemorrhage.

Fetal outcomes

There were 57 live births of whom two were born with congenital abnormalities (clubfoot and hydrocephalus). There were four neonatal deaths of which three were due to complications of prematurity (all born before 28 weeks of gestation) and one, born at 34 weeks of gestation, died at home due to unclear cause 15 days after birth.

There were two twin pregnancies, one resulted in two macerated stillbirths. Born prematurely were 22 babies, six were born at less than 32 weeks' gestation due to pre-eclampsia (2), spontaneous preterm birth (2), placental abruption (1) and bleeding placenta praevia (1). Seven babies had a low birthweight.

Risk factors and mWHO risk prediction

Figure 2 presents the cardiac, obstetric, and fetal events according to mWHO classes. There were cardiac events in 71.4% of women in mWHO IV, 26.9% in mWHO III and none in mWHO I and II. There was a high rate of fetal and obstetric events in all classes.

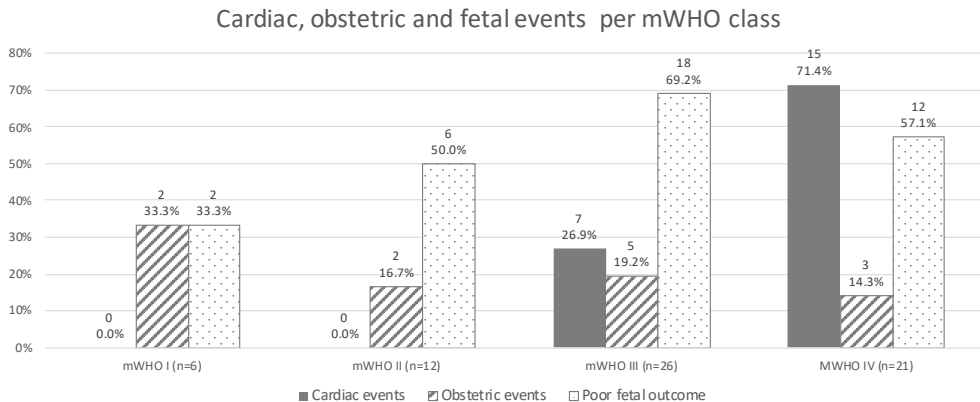


Figure 2. Events among mWHO classes.

Two women classified as mWHO III had a twin pregnancy, so for fetal outcome the denominator in mWHO III was 28.

Table 4. Associated factors for events					
Cardiac events					
Risk factor	Present (%)	Absent (%)	RR	95% CI	p Value
Prior cardiac event	6/26 (23.1)	16/35 (45.7)	0.5	0.2 - 1.1	0.07
Previous surgery	2/13 (15.4)	20/48 (41.7)	0.4	0.1 - 1.4	0.11
Pulmonary hypertension	9/11 (81.8)	13/50 (26.0)	3.1	1.8 - 5.4	0.001
Warfarin	3/8 (37.5)	19/53 (35.8)	1	0.4 - 2.7	1
NYHA III-IV at presentation	15/15 (100)	7/46 (15.2)	6.6	3.3 - 13.0	<0.001
mWHO III-IV	22/44 (50.0)	0/17 (0)			<0.001
Newly diagnosed	13/16 (81.3)	9/45 (20.0)	4.1	2.2 - 7.6	<0.001
Unplanned pregnancy	15/40 (37.5)	7/21 (33.3)	1.1	0.5 - 2.3	0.75
Fetal events					
Risk factor	Present (%)	Absent (%)	RR	95% CI	p Value
Prior cardiac event	18/27 (66.7)	18/38 (47.4)	1.4	0.9 - 2.2	0.12
Previous surgery	9/14 (64.3)	27/51 (52.9)	1.2	0.8 - 1.9	0.45
Pulmonary hypertension	4/11 (36.4)	32/54 (59.3)	0.6	0.3 - 1.4	0.2
Warfarin	5/8 (62.5)	31/57 (54.4)	1.1	0.6 - 2.1	0.72
NYHA III-IV at presentation	10/15 (66.7)	26/50 (52.0)	1.3	0.8 - 2.0	0.32
mWHO III-IV	28/47 (59.6)	8/18 (44.4)	1.3	0.8 - 2.4	0.27
Newly diagnosed	8/16 (50.0)	28/49 (57.1)	0.9	0.5 - 1.5	0.62
Unplanned pregnancy	24/42 (57.1)	12/23 (52.2)	1.1	0.7- 1.8	0.7
Obstetric events					
Risk factor	Present (%)	Absent (%)	RR	95% CI	p Value
Prior cardiac event	6/27 (22.2)	6/37 (16.2)	1.4	0.5 - 3.8	0.54
Previous surgery	3/14 (21.4)	9/50 (18.0)	1.2	0.4 - 3.8	0.72
Pulmonary hypertension	2/9 (18.2)	10/53 (18.9)	1	0.2 - 3.8	1
Warfarin	0/8 (0)	12/56 (21.4)			0.33
NYHA III-IV at presentation	5/14 (35.7)	7/50 (14.0)	2.6	1.0 - 6.8	0.12
mWHO III-IV	8/46 (17.4)	4/18 (22.2)	0.8	0.3 - 2.3	0.73
Newly diagnosed	4/15 (26.7)	8/49 (16.3)	1.6	0.6 - 4.7	0.45
Unplanned pregnancy	6/42 (14.3)	6/22 (27.3)	0.5	0.2 - 1.4	0.31

The incidence of cardiac, fetal and obstetric events presented as events/risk factor present or absent. Furthermore risk ratio and 95% confidence interval for each risk factor.

RR, risk ratio; CI, confidence interval; NYHA, New York heart association classification; mWHO, modified World Health Organization risk classification

Table 4 presents known potential risk factors for adverse events. NYHA III-IV at presentation, mWHO III-IV, pulmonary hypertension and newly diagnosed cardiac diseases were associated with cardiac events, but not with obstetric or fetal events.

Postpartum contraception

After pregnancy more than half of the women (35/65, 53.8%) were using long-acting reversible contraception, the majority were implants (26). After counselling, five women opted for sterilisation. All five had an obstetric indication for caesarean section. Eight women were not on contraceptives for the following reasons: opted for a long-acting reversible contraceptive method but did not have funds to return to the hospital (4), were not sexually active (3), or wanted another child soon (1).

Discussion

The HMH Service was introduced at Windhoek Central Hospital in Namibia to provide multidisciplinary care to women with cardiac disease referred to this tertiary centre. It was the first of its kind in the country and provided valuable insight into the spectrum and severity of cardiac disease in pregnant women in our setting, as well as the drivers of poor outcome. Several barriers to the provision of care were identified. In this section we discuss these insights and barriers.

RHD, cardiomyopathies and congenital heart disease were the most frequent cardiac diagnosis in this cohort, which is similar to findings from other LMICs.²⁶⁻²⁹ A high proportion of women had pre-existing cardiac disease that was only diagnosed in the current pregnancy, despite these women having been symptomatic in previous pregnancies. This indicates that cardiac disease is insufficiently recognised during antenatal care. This is a missed opportunity to intervene as nearly all these women presented in poor clinical condition having already developed cardiac complications. These complications may have been prevented by initiation of treatment or cardiac intervention at an earlier stage. Late diagnosis of cardiac disease is still a common problem in LMICs.^{13,14,26,30,31} Our findings suggest that women and health workers need to be made aware of symptoms and signs of cardiac disease and the importance of timely detection and management of cardiac illness. To improve diagnosis of cardiac disease and prevent complications, targeted screening programs should be implemented at healthcare service such as antenatal care or primary healthcare clinics, as recommended by the Pan-African Society of Cardiology.¹¹ This requires that health workers are trained and equipped to recognize, initiate management and refer women with suspected cardiac disease accordingly. In Uganda and Eritrea, countries with a similar high RHD prevalence as Namibia, screening with an echocardiogram of asymptomatic pregnant women revealed a prevalence of subclinical cardiac disease of 1.7% and 2.3% respectively, mainly RHD.^{28,29}

We identified a high mortality rate of 8.5% and over a third of the women had cardiac events. Similarly high rates were identified in other LMICs such as Kenya (9.3%) and South Africa (3.7%), and much lower mortality rates were identified in high-income settings (0.3-0.6%).^{7,10,26,32} More than two thirds of the women in our cohort had high-risk conditions (mWHO III/IV), which was also the case in the Kenyan and South African cohort.^{26,32} In two large cohorts, reporting on women from mainly high-income settings, only 15.0% and 17.4% of the cases were classified as high risk.^{7,10} The difference in outcome between high income countries and LMICs could be due to differences in availability of resources, but another explanation could be that more advanced disease is seen in middle-income settings, as diagnosis of mild cardiac disease is often missed.

Although the definition of maternal death only includes deaths within 42 days after the end of pregnancy, many women die from medical conditions, including cardiac disease, between six weeks and one year after the end of pregnancy.^{24,33} In this study three out of five maternal deaths occurred more than 42 days after birth. In a South African cohort nine of the ten maternal deaths were late maternal deaths and in a large Canadian cohort three out of six.^{7,32} These findings indicate that a longer follow-up period and monitoring and registration of late maternal deaths are essential to obtain more accurate data on outcome and further improve care after the end of pregnancy.

Fetal outcome in our cohort was poor, but more data is needed to identify pregnancies at risk for poor fetal outcome in the Namibian setting. Similar rates of poor fetal outcome were found in other LMICs such as Uganda, Kenya and Egypt among women with cardiac disease.²⁶⁻²⁸ Facilities that provided multidisciplinary care for pregnant women with cardiac disease, reported much lower rates, suggesting that joint care could improve fetal outcome.^{10,16} The overall poor fetal outcome in this cohort could also be explained by the high rate of obstetric events, such as placenta praevia and pre-eclampsia, which caused premature birth for several women. The high rates of obstetric events were not reported in the other cohorts.^{7,10,26,32} Considering our small cohort this finding might be due to chance.

The HMH Service quantified maternal risk using the mWHO risk classification and adopted the guidelines of the European Society of Cardiology. Several challenges with its use were encountered as neither consider barriers to the provision of care to pregnant women with cardiac disease that are specific to LMICs. For example, accurate risk classification requires access to comprehensive cardiac care and echocardiography as a bare minimum, which is not uniformly available at healthcare facilities in Namibia (Figure 1).⁶ As a result, several recommendations by mWHO and guidelines of the European Society of Cardiology on the level of care or frequency of

follow up visits appeared not to be appropriate or feasible in our setting. The mWHO classification has a heavy focus on congenital cardiac diseases, the most prevalent lesion in high-income settings. However some RHD lesions are not specifically mentioned, which may make it less fit for use by doctors with limited cardiac expertise.

The guidelines of the European Society of Cardiology did not recommend routine endocarditis prophylaxis during birth and was therefore not given to our study population.³⁴ However, in LMICs there are considerably higher rates of maternal infections and the Pan-African Society of Cardiology recently recommended antibiotic prophylaxis during birth for all women with RHD.^{11,35} We had two cases of infective endocarditis after birth in women with RHD and both women died.

Eight women had a thromboembolic event, of whom two died. Only less than half of these eight women had an indication for anticoagulation according to the adopted guidelines.¹⁷ Among the women using anticoagulation, there was a high rate of cardiac and fetal events. These results reiterate that for all women with cardiac disease the need for anticoagulation should be assessed, taking into account both the risks and benefits of this treatment, as well as the possibilities and challenges of our setting.

Given all these considerations, context-specific guidelines, a risk stratification tool and referral algorithms are needed, based on local evidence and available expertise and resources in Namibia. An adaptation of mWHO, incorporating other recognised risk factors, such as NYHA status, cardiac history or medication use, and taking into account the aforementioned local considerations, could form the base of a Namibian referral algorithm, such as the one implemented in a South African setting.¹⁶

Even though almost half of the women live far from our referral centre and despite limited resources, the HMH Service was able to increase access to care for women with cardiac disease in Namibia, including improved access to long term reliable contraception. The importance of access to preconception counselling and family planning for women with cardiac disease is recognized in many reports, as it can reduce high-risk pregnancies.^{6,36} Reported barriers are lack of integrated approach and misconceptions about side effects and contra-indications for contraceptive methods among women with cardiac disease and healthcare providers.³⁶⁻³⁹ The HMH Service sought to address some of these barriers through the integrated approach, training of health workers and counselling of women. Access to care still needs to improve as most women presented after the first trimester, two thirds of the pregnancies were unplanned and several women had to travel long distances (some greater than 700km) to receive long acting reversible contraception.

Due to staff shortages, the joint cardiac obstetric service was suspended after June 2017. Lack of staff is a common issue in LMICs and not easily solved.⁴⁰⁻⁴² Task shifting and sharing is a frequently used solution and could be considered.⁴³ In two studies performed in Uganda and Eritrea, echocardiograms were performed by nurses and medical students respectively and supervised by a cardiologist.^{28,29} The Namibian Ministry of Health and Social Services has an active programme of training health workers including specialists, nurses, technologists, pharmacists, and it is anticipated that the number of staff with special expertise will increase over the next few years. At last, findings of this study have been used for advocacy to ensure all stakeholders, including policy makers, prioritise cardiovascular health in women and commit to mobilise financial, technical and human resources.

Limitations

This study had several limitations. Firstly, we did not include women's perspectives in the evaluation of the HMM Service. Secondly, the severity of cardiac disease of this cohort may partially be a result of referral bias, as asymptomatic women or those with mild disease may have been undiagnosed or managed in district or regional hospitals. Thirdly, there was no Namibian data available/collected to compare the identified maternal and fetal outcomes, such as thromboembolic events or low birth weight. Considering Namibia's high maternal and neonatal mortality rates, these rates may be high in the general pregnant population as well.^{44,45} Fourthly, due to the small cohort it was not possible to perform a multivariable analysis identifying risk factors for poor outcome. Lastly, no data was collected to evaluate the impact of the provision of preconception counselling for women with cardiac disease at the cardiology outpatient department.

Conclusion

A collaborative approach is essential to ensure improved care of women with cardiac disease. Despite many barriers, it was possible to implement such an approach in a high burden setting like Namibia. A high rate of maternal and fetal events was identified. Important benefit of this service was insight into spectrum and severity of cardiac disease and local drivers of these poor outcomes such as late diagnosis of pre-existing cardiac disease. To improve outcomes, studies are needed to identify effective strategies for improved diagnosis of cardiac disease, as well as for the development of context-specific guidelines for a middle-income setting like Namibia. We encourage national and regional organisations to collaborate and initiate large prospective studies to collect high quality data that will inform these interventions.

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Appendix 1. Patient information leaflet

Birth control options

Remember



We strongly advise our heart patients to use birth control that works for several years. We advise the following options:

1. Hormonal loop

The loop is placed in your womb and prevents pregnancy for 5 years. Your period can become less heavy or stop altogether.



2. Implant

The implant is placed under the skin of your arm and prevents pregnancy for 3 years. The implant can cause irregular light periods and your periods may stop altogether.



Both options can be removed at any time when you want to become pregnant and there should be no delay in you getting pregnant.



*Neither the loop nor the implant protect against HIV/AIDS or other sexually transmitted diseases. Always use your birth control together with a condom.

- If you have **heart disease** pregnancy can be **dangerous** for you and your baby. Ask your doctor which risk group you are in (**green/orange/red**)
- **Plan your pregnancies with your doctor**
- If you do not want to become pregnant, we strongly recommend you use either the **hormonal loop** or the **implant**
- If you are pregnant, ask your doctor to refer you to the Heart and Maternal Health Service, in antenatal care (ANC) Windhoek Central Hospital



Heart & Maternal Health Service
Windhoek Central Hospital Maternity
Antenatal Care Clinic
Telephone: 061-203 3248

This flyer was made possible by support of:

- The Ministry of Health and Social Services (MOHSS)
- The Heart & Maternal Health (HMH) Service
- Illustrations by Margreet de Heer



Heart Disease and Womens' Health



Heart & Maternal Health
Namibia

What you need to know

We can help you

Plan your pregnancy

If you have heart disease, pregnancy can be dangerous for you and your baby as your heart has to work twice as hard.

Not all women with heart disease have the same chance of having problems during pregnancy. It depends which risk group you are in.



Ask your doctor which risk group you are in:

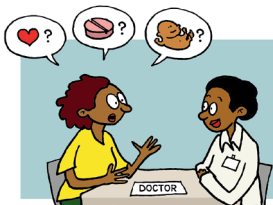
Green: you only have mild heart disease and there is no extra risk for you and your baby when you become pregnant (WHO I).

Orange: there is a risk of complications for you and your baby if you become pregnant (WHO II).

Red: it is very dangerous for you and your baby if you become pregnant (WHO III/IV).

If you become pregnant go and see your doctor as soon as possible. For a healthy baby, you and your heart need to be strong and healthy. Together with you, your doctor will decide which tablets are best for you and your baby.

Get an appointment at the Heart and Maternal Health (HMH) Service so we can look after you (antenatal care), your heart and your baby all in one visit. See contact details.



It is important to **plan your pregnancy**. The heart doctor is there to help you plan a safe pregnancy. This will lower the chance of having problems.

If you do not want to become pregnant now, you need to use reliable **family planning**. For heart patients we advise the hormonal loop or implant. You can read more about this on the next page.



Appendix 2. Details of all women with a prosthetic valve

mWHO, modified World Health Organization risk classification; RHD, rheumatic heart disease; IUGR, intra-uterine growth restriction; TOP, termination of pregnancy; GA, gestational age.

Appendix 2. Details of all women with a prosthetic valve							
Type of valve	Age	Parity	Diagnosis	mWHO	Details valve replacement	Cardiac outcome	
Bioprothesis	43	2	RHD	III	Mitral valve replacement	Death due to infective endocarditis	
Mechanical valve	40	4	RHD	III	Mitral valve replacement	Valvethrombosis needing thrombolysis	
Bioprothesis	27	1	RHD	III	Mitral valve replacement	No events	
Mechanical valve	21	0	RHD	III	Aortic valve replacement	No events	
Bioprothesis	19	0	RHD	III	Aortic valve replacement, mitral valve replacement	No events	
Bioprothesis	20	0	RHD	II	Mitral valve replacement	No events	
Mechanical valve	20	0	RHD	III	Aortic valve replacement, mitral valve repair	No events	
Mechanical valve	37	2	RHD	III	Aortic valve replacement	No events	
Bioprothesis	33	0	RHD	III	Mitral valve replacement	Unknown	

	Obstetric complications	Fetal outcome
	None	Alive, IUGR
	None	TOP
	Abruptio at GA 28 weeks	Neonatal death
	None	Miscarriage
	None	IUGR
	None	Spontaneous birth at 27 weeks, alive
	None	Alive
	None	Alive
	Bleeding placenta praevia, CS done at GA 31 weeks	Unknown

