IMPACT OF EDUCATIONAL PROGRAM ON PREGNANCY OUTCOMES IN SEVERE PRE-ECLAMPSIA AT A TERTIARY HOSPITAL IN KENYA BETWEEN 2018 AND 2022: THE BEFORE AND AFTER ANALYSIS

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1.0 ABSTRACT

Background
Preeclampsia is a multisystem progressive disorder characterized by the new onset of hypertension and proteinuria or other significant end-organ dysfunction in the last half of pregnancy or postpartum. It complicates 4.6% of pregnancies worldwide. This study set out to describe change in pregnancy outcomes as a consequence of introduction of an educational program.

Objectives
To describe the impact of introducing maternal fetal medicine program to pregnancy outcomes in management of pre-eclampsia with severe features

Methods
The study was a retrospective cohort chart review of consecutive pregnant women with pre-eclampsia complicated by severe features, before and after the intervention; cared for at Moi Teaching and Referral Hospital - a tertiary referral hospital in Western Kenya, between Jan 2018 and December 2022.

Results
A total of 724 charts were reviewed. The two arms were confirmed to be homogenous based on age, parity, gestational age at diagnosis, marital status and risk assessment. Overall, there were better maternal and neonatal outcomes following the educational intervention; more so in improved birth weight, APGAR score at 5-minute, significantly more babies discharged alive from newborn unit. However, there were more caesarian section rates and deranged fetal doppler studies with this intervention.

Conclusion
Pregnancy outcomes in severe preeclampsia improved as a consequence of Maternal Fetal Medicine educational program intervention. Subsequently, we recommend support of the intervention for sustainability of favorable outcomes.

Keywords: pre-eclampsia, severe features, maternal fetal medicine, educational intervention, maternal outcomes, fetal outcomes

Educational Intervention: Maternal Fetal Medicine (MFM) Program at Moi University/Moi Teaching and Referral Hospital (MTRH) and Severe Pre-eclampsia Management

The program was established in September 2019 and it currently offers multidisciplinary care for high-risk pregnancies to optimize outcomes such as in pre-eclampsia. Specific to this study, biweekly assessment of maternal end organ damage together with individualized fetal growth monitoring and determination of optimal time to deliver.
Part of the intervention is to provide state-of-the-art quality level 2 ultrasound, using latest technology in both 2D and 3D/4D for early detection of fetal compromise coupled with intensive maternal surveillance. Lastly, guiding principles behind MFM at Moi University/MTRH clinical practice are based on several recommendation such as those by American College of Obstetrician & Gynecologists (ACOG), National Institute of Care in Excellence (NICE), Royal College of Obstetricians & Gynecology, International Society of Ultrasound in Obstetrics & Gynecology (ISUOG), Fetal Maternal Medicine Guidelines and Society of Maternal Fetal Medicine recommendations.

Objectives
First was to compare sociodemographic characteristics and risk factors of patients diagnosed with severe pre-eclampsia at MTRH in the pre-MFM era (2018-2019) and post-MFM era 2020- 2022; and secondly to determine impact of MFM Program on maternal and fetal outcomes on women being followed up for preeclampsia with severe features at MTRH in the same period.

2.0 METHODOLOGY

2.1 Aim, design, and setting
This retrospective study was designed in two arms, where the first comprised of participants who underwent care before the educational program, while the second was post intervention.
Moreso, the intervention in question involved risk assessment, institution of low dose aspirin as a pre-eclampsia prevention strategy, early dating and follow up growth scans upon diagnosis of pre-eclampsia with an aim to interrupt pregnancy as close as possible to 37 completed weeks.

Additionally, individualized end organ monitoring of renal, liver, hematological and neurologic was instituted. The pregnancy outcomes were compared between the two arms including length of time pregnancy was conserved, mode of delivery and gestational age at delivery, APGAR score at 5minutes, whether the neonate was admitted to new born unit and eventual outcome of both the baby and mother upon discharge.
All the patients' files diagnosed to have severe features of pre-eclampsia based on NICE 2019 guidelines on hypertensive disorders in pregnancy were retrieved between 2018 and 2022. In total, 874 patients' files were reviewed of which 724 patients were identified to have met the inclusion criteria.

The study setting was MTRH, which is the second national referral hospital in Kenya and is in the rural setting of western Kenya. It serves the entire population of western Kenya and has a catchment population of over seven million people. The hospital is in Uasin Gishu County, about 320km northwest of Nairobi – Kenya's capital city.

2.2 Characteristics of participants
The study population consisted of consecutive pregnant women with a confirmed diagnosis of severe features of pre-eclampsia, who were attended to at MTRH.
Those who were excluded consisted of: women with pregnancies less than 24 weeks (non-viable pregnancy), those that were lost to follow up and those with missing data.

Specific variables sought included:
Demographic variables, clinical and obstetrics history, preconception care including use of junior aspirin, documented risk assessment and gestational age at diagnosis.

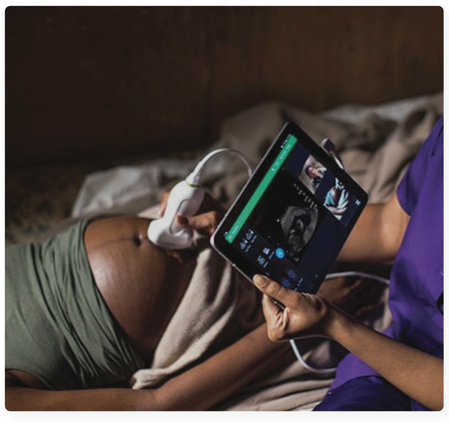
Pregnancy outcomes included length of time pregnancy was conserved, gestational age at delivery, reasons of pregnancy termination, documented maternal end organ derangement and mode of delivery
Fetal and neonatal outcomes included APGAR score, birth weight, admission to Neonatal Intensive Care Unit (NICU)/Newborn Unit (NBU), neonatal death, and stillbirth. Or whether the neonate was discharged home alive and well.

2.3 Study procedures: Data collection, Statistical analysis, and Limitations

2.3.1 Data collection and definitions
Data was collected using an abstraction sheet and later transferred into STATA software for analysis following data cleaning and verification process.
The primary outcome was optimized pregnancy outcome which comprised of the frequency of maternal end organ derangement, Gestational age at delivery, APGAR score at 5 minutes, and neonatal outcome at discharge.
Secondary outcomes included obstetric and perinatal complications/outcomes such as mode of delivery, length of hospital stay for both mother and neonate, number of investigations performed. Perinatal complications/outcomes included: admission to Neonatal Intensive Care Unit/New Born Unit (NICU/NBU), gestational age at delivery and birth weight.

2.3.2 Statistical analysis
The end of 2019 was used as the cut-off date to distinguish between the "before" and "after" periods. Exploratory data analysis was carried out to produce summaries of means, standard deviation, and frequencies. To test for homogeneity between the two-time points, Levene's test was employed to examine the homogeneity of variance centered at the mean for numeric variables, while the chi-square test was used for the categorical variables by period (before and after). For small cell samples, fishers exact p-value was read instead of the chi-square p-value. The significant level was taken to be 0.05. For the test of association, for continuous variables t-test was used and for categorical variable chi-square test was used. A sub-analysis of the second arm focusing on women progressing with expectant management beyond 34weeks was performed to ascertain improvement of maternal and neonatal outcomes without adversely affecting maternal end organs while optimizing neonatal results.

2.3.3 Limitations of the study
The study focuses on two stop points, disregarding events that may occur between diagnosis and delivery that may have an impact on timing of delivery such as trends in blood pressure control, maternal and fetal performance status in cases of conservative management prior to delivery.



3.0 RESULTS

Demographic characteristics of participants

The table below presents a summary of the demographic and characteristics and pre-eclampsia risk factors of patients who presented with pre-eclampsia within the period from 2018 to 2022.
Test for homogeneity was conducted to check if the two groups were homogeneous. The results shows that there was no difference in the two groups

Table 1: Summary of Demographic Characteristics and Pre-Eclampsia risk factors

Characteristics	Before	After	p-value
Continuous variables	Mean(sd)	Mean(sd)	
Age	27.0(8.00)	27.0(8.0)	0.719
Parity	1.3(1.6)	1.3(1.6)	0.290
Gestation at diagnosis (weeks)	35.0(5.9)	35.1(4.5)	0.378
Categorical variables	n(%)	n(%)	
Parity(cat)			
≤ 3	360(89.5)	286(88.8)	
> 3	42(10.5)	36(11.2)	0.752
Gestation at diagnosis (cat)			
Second Trimester	25(6.2)	26(8.2)	0.176[ɛ]
Third Trimester	369(92.3)	292(91.5)	
Marital status			
Married	310(77.5)	245(78.3)	
Single	90(22.5)	68(21.7)	0.805
Pre-Eclampsia History			
Yes	66(16.6)	70(21.9)	0.075
No	331(83.4)	250(78.1)	
History of Chronic Hypertension			
Yes	38(9.4)	34(10.6)	
No	364(90.6)	288(89.4)	0.621
Pregestational/ Gestational Diabetes			
Yes	1(0.3)	0(0.0)	
No	401(99.7)	322(100)	1.000[ɛ]
Autoimmune disease			
Yes	0(0.0)	1(0.3)	
No	400(100)	321(99.7)	0.446[ɛ]
Pregnancy interval > 10 years			
Yes	16(4.0)	5(1.6)	
No	386(96.0)	317(98.5)	0.053
Pre-conception care provided			
Yes	24(6.0)	21(6.6)	
No	378(94.0)	299(93.4)	0.759

fishers exact test

Test for association of selected covariates with the MFM program

Test for the association for the fetal and maternal outcomes before and after the MFM program. The results show that there were significantly more caesarian deliveries in the post-MFM era than before 38.3% vs 51.9% p < 0.001.
The mean number of days between diagnosis and delivery reduced significantly in post-MFM program 3.8 vs 2.5 p = 0.017 and there were significantly more deliveries in the second trimester in the after era.

Table 2:Association of maternal and fetal outcomes with the MFM program

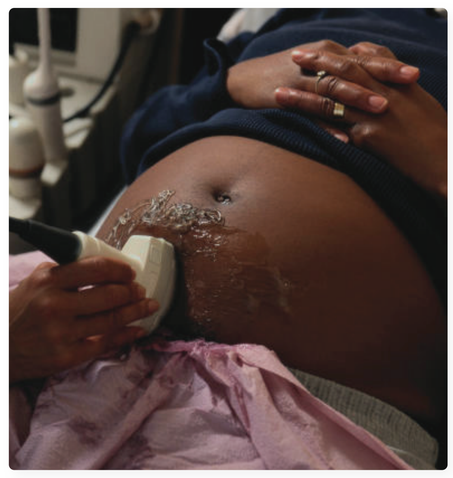
	Before	After	p-value
Maternal Outcomes			
Mode of delivery			
Vaginal	245(61.7)	153(48.1)	
Caesarian	152(38.3)	165(51.9)	<0.001
Kidney disease			
Acute/Chronic	2(0.5)	0(0.0)	
No	398(99.5)	319(100)	0.506[ɛ]
Neurological Deficit			
Yes	1(0.3)	2(0.8)	
No	308(99.7)	236(99.2)	0.583[ɛ]
Fetal Outcomes			
Mean and 95% CI of number of days between diagnosis and delivery in days	3.8[3.01-4.6]	2.5[2.0-3.2]	0.017
Gestational age at delivery			
First trimester	11(2.7)	3(1.0)	
Second trimester	14(3.5)	25(7.8)	
Third trimester	376(93.8)	291(91.2)	0.010[ɛ]
Apgar score			
Asphyxia	69(17.2)	69(21.4)	
Good	333(82.8)	253(78.6)	0.147
Admitted to NBU			
Yes	386(96.0)	317(98.5)	
No	16(4.0)	5(1.5)	0.073[ɛ]
Outcome upon discharge if admitted to			
NBU	54(13.5)	44(13.9)	
Alive	345(86.5)	273(86.1)	0.893
Dead			

Sub-analysis of fetal and maternal outcomes by the duration of conservation of pregnancy

This was recognized hospital clinical management protocol deviation where pregnancy interruption was recommended beyond 34weeks due to increased risks to maternal end organs regardless of fetal status. Preservation of pregnancy up to 36 or 37 weeks was associated with better birth weight, APGAR score at 5 minutes, Doppler and mortality outcomes. Up to 35 weeks was only associated with better mortality outcomes compared to delivery before 34 weeks

Table 3: Sub analysis of fetal and maternal outcomes by duration of conservation of pregnancy

	Delivery upto 34 weeks	Delivery after 34 weeks	p-value
Deliveries conserved upto 37+0 weeks			
Mean and 95% CI of actual birth weight	1656.7[1562.0-1751.5]	2423.5[2316.7-2530.4]	<0.001
Apgar score			
Asphyxia	80(32.1)	36(18.3)	
Good	169(67.9)	161(81.7)	0.001
Mode of delivery			
Vaginal	116(47.0)	102(53.1)	0.200
Caesarian	131(53.0)	90(46.9)	
Deranged Doppler			
Yes	78(34.7)	20(13.1)	
No	147(65.3)	133(86.9)	<0.00
Admitted to NBU			
Yes	244(98.0)	191(96.9)	
No	5(2.0)	3(3.1)	0.483
Outcome upon discharge if admitted to			
NBU	191(77.3)	176(90.3)	
Alive	56(33.7)	19(9.7)	<0.001[ɛ]
Dead			
Kidney disease			
Acute/Chronic	2(0.8)	0(0.0)	
No	245(99.2)	196(100)	0.506[ɛ]
Neurological Deficit			
Yes	0(0.0)	0(0.0)	
No	232(100)	180(100)	
Deliveries conserved upto to 36+0 weeks			
Mean and 95% CI of actual birth weight	1656.7[1562-175.5]	2237.0[2107.6-2366.4]	<0.001
Apgar score			
Asphyxia	80(32.1)	19(15.6)	
Good	169(67.9)	103(84.4)	0.001
Mode of delivery			
Vaginal	116(47.0)	50(42.7)	
Caesarian	131(53.0)	67(57.3)	0.449
Deranged Doppler			
Yes	78(34.7)	16(16.8)	
No	147(65.3)	79(83.2)	0.001
Admitted to NBU			
Yes	244(98.0)	117(95.9)	
No	5(2.0)	5(4.1)	2.43



4.0 DISCUSSION

The key findings were that MFM educational intervention was associated with less polytherapy of antihypertensives and higher birthweights and better maternal outcomes. Notably, with pregnancy prolongation beyond 34weeks for women with pregnancies complicated by severe features of pre-eclampsia there was no excess risk to the mothers.

However, there was a concurrent increase in caesarian rates and doppler derangements with this intervention. Comparatively, according to Norwitz et al, expectant management rather than expeditious delivery is reasonable for selected preterm pregnancies with preeclampsia with features of severe disease to reduce neonatal morbidity from preterm birth, even though the mother and fetus are at risk from disease progression.
Expectant management allows administration of a course of antenatal corticosteroids and may provide time for further fetal growth and maturation (Preeclampsia: Antepartum management and timing of delivery, UpToDate 2022)

In concurrence to this study as pertains benefits accrued as a result of pregnancy prolongations, two small randomized trials comparing delayed delivery with prompt delivery in pregnancies with preeclampsia with severe features (based on blood pressure criteria alone) at 28 to 32 [(9)] and 28 to 34 weeks of gestation (Aggressive or expectant management for patients with severe preeclampsia between 28-34 weeks' gestation: a randomized controlled trial,1990), both trials reported significant prolongation of pregnancy and improvement in neonatal outcome with expectant management, with no increase in the rate of maternal complications.
As regards educational interventions and improved outcomes, it is a well appreciated positive enhancement as demonstrated in similar studies such as one by Pankajkumar et al on utilization of educational session on women at risk of anemia as a prevention strategy.

They concluded that there was significant improvement in the knowledge regarding anemia and its preventive measures among pregnant women after a single educational session[(10)]Compared to this study, it echoes similar findings that educational intervention improves outcomes.

CONCLUSION
Following maternal-fetal medicine educational program, maternal and neonatal outcomes improved significantly over the 3-year period that followed. We recommend continued support and improvement of the same program for sustainability of results.

5.0 DECLARATIONS

Ethics approval and consent to participate
The study was approved by the Moi Teaching and Referral Hospital/ Moi University (MTRH/ MU) Institutional Research and Ethics Committee (IREC), Application approval number is FAN:0004278.
Permission to conduct the study was also sought from Hospital Management and was granted on 18th October 2022. Being a retrospective study with limited risk to the patients, where no contact with patients was required waiver of informed consent was sought and approved. There were no direct benefits to the participants of the study. However, the finding of the study will be used to improve the management (risk assessment and appropriate intervention) of patients in general. Data were de-identified at the entry to protect the privacy and ensure the confidentiality of patients

Availability of data and materials statement
The datasets generated and/or analyzed during the current study are available in the soft copy securely stored and are available from the corresponding author upon reasonable request.

Competing interests
None

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Authors' contributions
RC was a major contributor in development of manuscript including organization of data collection procedures and analysis and final compilation of report. PN and PM equally guided the protocol development especially at the initial stages culminating to ethical approval and eventually articulation of results findings. All authors read and approved the final manuscript."

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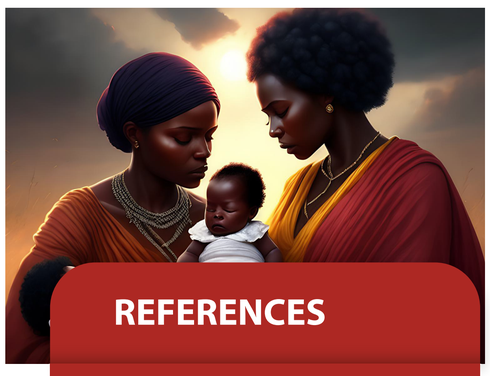
Authors' information
The author was a final year fellow in maternal fetal medicine program at the Moi University. Her background interest in optimization of maternal health through systemic approaches inspired this article



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