

FREQUENCY OF NEUROLOGICAL OUTCOME IN ECLAMPTIC PATIENTS VISITING CIVIL HOSPITAL

KARACHI

Asma Safdar Syed¹and Zakia Bano²

¹Department of Obstetrics and Gynecology, Chiniot General Hospital

²Department of Obstetrics and Gynecology, Darulsehat hospital, Liaquat College of Medicine and Dentistry, Karachi.

ABSTRACT

Objective: Pregnancy-induced hypertension (PIH), a leading cause of maternal morbidity and death, may be a significant predictor of pregnancy-associated intra-cerebral hemorrhage (ICH). Therefore, this study was planned to determining the neurological outcomes associated with eclamptic women during pregnancy.

Methodology: This was a cross-sectional study, which was conducted in the Department of Obstetrics and Gynecology at Civil Hospital Karachi, using non-probability sampling technique. The study duration was about six months, from October 2021 to March 2022. The study included 94 patients aged 16 to 40 years who were diagnosed with eclampsia during a pregnancy of more than 20 weeks, whether booked or not, and of any parity. Parity and maternal age were presented as Mean and Standard Deviation. For the presentation of qualitative variables including prenatal booking status, signs and symptoms, and intra cerebral hemorrhage, frequencies and percentages were computed.

Results: The study results showed that out of 94 patients, 37 (39.4%), were between the ages of 16 and 20; 23 (24.5%) were between the ages of 21 and 25; 24 (25.5%) were between the ages of 26 and 30. Most of the patients 70 (74.5%) were unscheduled to have none or no more than three antenatal visits. Parity status revealed that 47 (50.0%) patients were nulliparous. Headache was the most common signs or symptoms of intra-cerebral hemorrhage in 39(41.5%) women, followed by seizures 23(24.5%). Intra-cerebral hemorrhage was observed in

only 2 (2.9%) patients in un-booked antenatal cases. While most of the patients 68 (99.1%) did not report intra-cerebral hemorrhage.

Conclusion: This study concluded that neurological symptoms such as seizures and headache were more common in patients with eclampsia. Un-booked cases accounted for the majority of intra cerebral hemorrhages. Only a few patients reported maternal death as a result of intra-cerebral hemorrhage, which was most common in nulliparous and multigravida women.

Keywords: Intra-cerebral hemorrhage, eclampsia, pregnancy, seizures, headache

INTRODUCTION

The top three major causes of maternal death worldwide are the hypertensive diseases of pregnancy (HDP), notably pre-eclampsia and eclampsia [1,2]. Pre-eclampsia is typically described as occurring during pregnancy when there is considerable proteinuria and new hypertension [3, 4]. In the absence of early detection and adequate therapy, the disease's course can place women at a high risk of developing eclampsia, a dangerous illness clinically characterized by seizures [3]. In low- and middle-income countries, the World Health Organization Global Survey on Maternal and Perinatal Health's secondary analysis identified socio-demographic factors (such as maternal age above 30 years and lower educational status) along with clinical factors (such as chronic hypertension, overweight, and severe anemia) as the main causes of pre-eclampsia [5]. Pregnancy hypertensive disease (including eclampsia), obstetric bleeding, and puerperal sepsis account for more than half of all maternal fatalities worldwide [6, 7].

The Case Fatality Rate (CFR) of eclampsia in developed nations ranges from 0% (no case fatality) up to 1.8% [10], which is extremely low compared to underdeveloped countries (the CFR of Nigeria [8] and Ethiopia [9] was 22.3 and 13.3%, correspondingly). The sixth-most populated nation in the world is Pakistan. Pakistan is the nation with the third-highest burden of maternal, fetal, and child death, according to a recent comprehensive review of worldwide mortality [11]. Maternal mortality ratio (MMR) in Pakistan was 279 per 100,000 live births in 2006-07,

according to Pakistan Demographic and Health Survey [12]. Rural and urban populations differ significantly; for Sindh province, which is predominately rural, the MMR was as high as 345–350 per 100,000 live births [13].

Disseminated intravascular coagulation (DIC), maternal shock, hemolysis, acute kidney injury (AKI), respiratory distress, elevated liver enzymes and low platelets syndrome (HELLP), neurologic complications, postpartum hemorrhage (PPH), need for blood transfusions, intensive care unit (ICU) admission, and maternal deaths are common adverse maternal outcomes in eclamptic patients [14–17]. Other factors, gestational age, platelet count, the frequency of convulsions, birth weight, place of residency, mother age, gravidity, and the occurrence of stillbirths are the parameters substantially linked to severe maternal outcomes of eclampsia [18–20].

Intra-cerebral hemorrhage (ICH) linked with pregnancy is a rare but serious condition that significantly raises maternal mortality. One of the risk factors for pregnancy-related ICH is preeclampsia. [21–22] Compared to other etiologies, patients with pregnancy-associated ICH have worse prognoses for both the mother and baby. [21,23] Endothelial dysfunction, microangiopathy, and vasospasm are potential consequences of preeclampsia on systemic vasculature. Additionally, chronically high blood pressure weakens the walls of blood vessels, causing them to burst and hemorrhage. [21] A research by Bateman et al. found that GH and preeclampsia/eclampsia were major independent risk factors for ICH during pregnancy, accounting for 30.5% of such cases. [24] In a research by Oudghiri et al., a pre-eclamptic patient at 31 weeks of pregnancy experienced a spontaneous rupture of the membranes [25].

Neuroimaging is a crucial part of the prompt diagnosis of ICH, which is essential for subsequent management and treatment. Pregnancy is safe for either conventional computed tomography or magnetic resonance imaging [26,27]. Venous or arterial vessels can also be further visualized using computed tomography angiography or venography, time-of-flight magnetic resonance imaging, or phase-contrast methods. If ICH develops, seeking neurosurgical advice is advised in addition to putting the afflicted women in a facility with high-acuity monitoring.

Essentially, the provision of prompt and efficient medical care can avert the morbidities and deaths of eclamptic women. Mothers are more susceptible to eclampsia and associated consequences when they receive less prenatal care because of a weak health system, a lack of qualified medical personnel, poor service quality, a lack of intensive care units, and poverty [28,29]. As a result, eclampsia is challenging to diagnose and treat, presumably as a result of our ignorance of its underlying etiology. Therefore, this study was planned to determine the neurological outcomes associated with eclamptic women during pregnancy in order to manage timely.

METHODOLOGY

This was a cross-sectional study, which was conducted in the Department of Obstetrics and Gynecology at Civil Hospital Karachi, using non-probability sampling technique. The study duration was about six months, from October 2021 to March 2022 after approval of synopsis. The ethical approval was obtained from the Ethical Review Board of concerned Hospital. The study included 94 patients aged 16 to 40 years who were diagnosed with eclampsia during a pregnancy of more than 20 weeks, whether booked or not, and of any parity. Whereas patients with a past history of epilepsy and hysteria, tetany, metabolic disorders, and patients with prolonged hypertension, with identified cardiac or respiratory or renal diseases were excluded from the study.

The patient fulfilling the criteria were admitted to Department of Obstetrics and Gynecology. An informed consent was taken after explanation of the procedure. A detailed history was taken, which included age, parity, booking status (either booked or un-booked), number of fits, history of fits in previous pregnancies and other signs and symptoms preceding the fits, including headache, blurred vision, altered mental status, and cranial nerve deficits. Pulse, blood pressure, temperature, pallor edema, reflexes, the chest and cardiovascular system, abdominal examination including height of fundus, lie of the fetus, presentation, and fetal heart sounds were all thoroughly examined. Pelvic examination, which include pelvic

assessment, bishop scoring, condition of membranes, color of liquor were also assessed. A thorough neurological examination including motor power of the muscles, tone and reflexes was carried out to evaluate the intra-cerebral hemorrhage, cranial nerve deficits, fundoscopy to see the retinal hemorrhages, papilledema etc. The patient was closely monitored until after delivery to assess her neurological outcomes. If it was discovered during the neurological evaluation that she had developed some neurological complications, neuroimaging such as an MRI or CT scan of the brain was performed.

All patients were followed in intensive care unit or high dependency unit until they fully recovered and were ambulatory. Once the patients were ambulatory, they were properly counselled for future pregnancies, the importance of antenatal checkups and queries regarding the disease were discussed, and they were advised to follow up.

Data analysis was performed by statistical package for social sciences (SPSS version-10.0). Parity and maternal age were presented as Mean and Standard Deviation. For the presentation of qualitative variables including prenatal booking status, signs and symptoms, and intra cerebral hemorrhage, frequencies and percentages were computed. Stratification was done according to antenatal booking and parity status in order to evaluate the effect of these variables on neurological outcome.

RESULTS

The study included 94 eclamptic patients, with a mean age of 24.48 ± 5.48 (range = 16-40) years. The majority of the women, 37 (39.4%), were between the ages of 16 and 20; 23 (24.5%) were between the ages of 21 and 25; 24 (25.5%) were between the ages of 26 and 30; 6.4% were between the ages of 31 and 35; and 4.3% were between the ages of 36 and 40. Only 24 (25.5%) were scheduled to have 3 or more antenatal visits during the pregnancy, while 70 (74.5%) were unscheduled to have none or no more than three antenatal visits. Parity status revealed that 47 (50.0%) patients were nulliparous, 18 (19.1%) were primigravida, 24 (25.5%) were multigravida (2-5), and 5 (5.3%) women were grand multigravida (para > 5). The mean of parity was 1.4 ± 1.9 , as shown in Table I.

Headache was the most common sign or symptom of intra-cerebral hemorrhage in 39(41.5%)women, followed by seizures 23(24.5%), altered mental status 18 (19.14%), blurred vision 8(8.51%), and cranial nerve deficit in 6 (6.4%) women, as shown in Table II.

Intra-cerebral hemorrhage was observed in only 2 (2.9%) patients in un-booked antenatal cases. While most of the patients 68 (99.1%) did not report intra-cerebral hemorrhage. Additionally, there were no cases of hemorrhage in booked antenatal cases, as shown in Table III.

A frequency analysis of intra-cerebral hemorrhage with respect to parity status revealed that only 1 (2.1%) nulliparous woman reported intra-cerebral hemorrhage, and 1 (2.1%) woman had paras 2–5 that reported intra-cerebral hemorrhage, as shown in Table IV.

Table I: Baseline characteristic of eclamptic patients (n=94).

Variables		Mean±SD n(%)
Patient's mean age (n=468)		24.48 ± 5.48
Age group	16-20 years	37(39.4%)
	21-25 years	23(24.5%)
	26-30 years	24(25.5%),
	31-35 years	6(6.4%),
	36-40 years	4(4.3%)
Antenatal Booking Status	Booked (at least 3 antenatal visits)	24 (25.5%)
	Un-booked (no or less than 3 antenatal visits)	70 (74.5%)
Parity status	Nulliparous	47(50.0%)
	Para 1	18 (19.1%)
	Para 2-5	24(25.5%)
	Para >5	5 (5.3%)
Mean parity		1.4 ± 1.9

Tab-II. Signs and Symptoms of Intra-cerebral Hemorrhage.

Variables	n (%)
Seizures	23(24.5%)
Altered mental status	18(19.14%)
Headache	39(41.5%)
Blurred vision	8(8.51%)
Cranial nerve deficit	6(6.4%)

Tab III. Frequency of Intra-cerebral Hemorrhage according to Antenatal Booking Status.

Intra-cerebral hemorrhage	Antenatal booking status	
	Booked	Un-booked
Yes	0 (0)	2 (2.9%)
No	24 (100%)	68 (97.1%)
Total	24	70

Tab IV. Frequency of Intra-cerebral Hemorrhage according to Parity Status

Intra-cerebral hemorrhage	Parity status			
	Nulliparous	Para 1	Para 2-5	Para >5
Yes	1 (2.1%)	0 (0%)	1 (2.1%)	0 (0%)
No	46 (97.9%)	18 (100%)	23(95.8%)	5 (100%)
Total	47	18	24	5

DISCUSSION

Eclampsia is a potentially fatal seizure illness that affects pregnant women and new mothers; in order to make a differential diagnosis, it is important to exclude out conditions including known epilepsy, cerebral infections, and brain tumors [30-32]. Therefore, eclampsia is regarded as an obstetric emergency. Therefore, this study demonstrated the neurological manifestation related to eclampsia during pregnancy.

Both preeclampsia and eclampsia are associated with high rates of maternal morbidity and death, as well as a variety of neurological problems. One study examined at 741 pre-eclamptic women out of the 5564 women with Caesarean delivery (CDs). 32 of the 63 women in whom eclampsia developed needed to be admitted to the ICU. The prevalence of eclampsia-related neurological problems was 20.63% overall, and it was 40.62% among patients hospitalized to the intensive care unit. [33] The present study was inconsistent with the above mentioned

research and reported that only 2(2.9%) patients had intra-cerebral hemorrhage in eclamptic women.

Headache, nausea, and vomiting are typical ICH signs and symptoms. Patients with big hematomas are more likely to get headaches, which are linked to increased intracranial pressure, traction on meningeal pain fibers, or blood in the cerebrospinal fluid. Rarely are headaches linked to small, deep hematomas [34]. Another study found that vomiting was more frequent in individuals with cerebellar hemorrhages and was seen in roughly 50% of patients with hemisphere ICH. It frequently occurs in conjunction with elevated intracranial pressure [34]. Since the thalamus and brainstem are compressed and there is a rise in intracranial pressure, patients with big ICH frequently have a reduced state of consciousness. Large ICHs involving the brainstem reticular activating system are indicative of stupor or coma [35]. Moreover, another research reported about 10% of patients with ICH and 50% of patients with lobar hemorrhage having seizures. In the first 24 hours or at the start of bleeding, seizures frequently happen [36]. Before and after hospitalization, neurological impairment is frequent and may be an early sign of hematoma growth or increasing edema. [37]. The present study was in contrast with the above mentioned researches and showed that headache was observed in 39(41.5%)patients, seizures were reported in 23(24.5%)patients. Altered mental status was observed in 18(19.14%)patients, and is caused by the raised intra-cranial pressure.

In another prospective cohort research from the China National Stroke Registry examined consecutive patients with ICH. Patients with and without seizures present at ICH start and throughout hospitalization were compared for in-hospital complications, functional outcomes, and death at 3, 6, and 12 months. 3216 individuals with ICH were included in the research, and 139 (4.3%) of them had seizures. When compared to individuals who did not have seizures, the presence of seizures was related with higher rates of hospital complications. Seizures are a sign of poor outcomes at 3-, 6-, and 12-month follow-up and are linked to significant in-hospital complications in ICH patients [21]. The present study did not agree with the previously referenced research in that only 2 (2.6%) eclamptic patients had ICH, despite the fact that 23(24.5%)of the patients had seizures.

Similarly, one study based on age and parity distribution, found that 76.57% of eclamptic mothers were under 24 years old. Additionally, it can be assumed from their study that eclampsia-related fatalities affected primarily younger age groups and primigravidae (61.26%). Early marriage and pregnancy are to blame for this [15]. This research and one from India are comparable [38]. Teenage pregnancies are a highly widespread occurrence in rural India as a result of social traditions. Early marriage and childbirth are also significantly influenced by low socioeconomic level and illiteracy [38]. The present study, which was consistent with the previously mentioned research, showed that the majority of the patients 37(39.4%) who had eclampsia were between the ages of 16 and 20. However, it was not consistent in the finding that maternal mortality happened more frequently in nulliparous and grand multiparous patients.

Similarly, another research revealed that showed that the majority of deaths in their investigation occurred in the late third trimester (ante partum). Maximum fatalities occurred in un-booked patients (90.09%) and within 12 hours of admission (73.87%). This is mostly caused by inadequate prenatal care, late referral, and transfers of patients who are near death to tertiary hospitals [15]. These findings were similarly supported by a research conducted by Berhan et al [39]. The current study found that maternal mortality from intra-cerebral hemorrhage occurred in 2 (2.9%) of un-booked cases, contradicting the findings of the previously mentioned studies.

Consequently, providing a woman with good antenatal care will help her avoid developing neurological complications, which will result in a good neurological outcome. These measures include early detection of neurological complications by these signs and symptoms and confirmation by neuro-imaging techniques (CT / MRI). Prospective studies are required to assess the various neurological outcomes in eclamptic patients and their prompt therapy to achieve better results in the future because eclampsia is thought to be a disease of emerging nations.

CONCLUSION

This study concluded that neurological symptoms such as headache and seizures were more common in patients with eclampsia. Un-booked cases accounted for the majority of intra cerebral hemorrhages. Only a few patients reported maternal death as a result of intra-cerebral hemorrhage, which was most common in nulliparous and multigravida women. The primary focus should be on establishing basic and comprehensive emergency obstetrics care in order to minimize maternal mortality and morbidity. The majority of fatalities may be prevented by raising socioeconomic standing, education level, and nutritional quality of patients, good prenatal, intra-partum, and postpartum treatment, early referral, and providing swift and well-equipped transportation facilities.

Conflict of Interest: None

Ethical Approval: The ethical approval was taken from the university ERC.

REFERENCES

1. Sibai B, Dekker G, Kupferminc M. Pre-eclampsia. *Lancet*. 2005 Feb 26-Mar 4;365(9461):785-99. doi: 10.1016/S0140-6736(05)17987-2.
2. Mol BWJ, Roberts CT, Thangaratinam S, Magee LA, de Groot CJM, Hofmeyr GJ. Pre-eclampsia. *Lancet*. 2016 Mar 5;387(10022):999-1011. doi: 10.1016/S0140-6736(15)00070-7.
3. The American College of Obstetrician and Gynecologists. Hypertension in pregnancy. 2013. <http://www.acog.org/~media/Districts/District%20VIII/HypertensionPregnancy.pdf?dmc=1&ts=20140527T0350044350>. Accessed 18 March 2015.
4. The World Health Organization. WHO recommendations for prevention and treatment of pre-eclampsia and eclampsia. 2011. http://apps.who.int/iris/bitstream/10665/44703/1/9789241548335_eng.pdf. Accessed 18 March 2015.
5. Bilano VL, Ota E, Ganchimeg T, Mori R, Souza JP. Risk factors of pre-eclampsia/eclampsia and its adverse outcomes in low- and middle-income countries:

- a WHO secondary analysis. Young RC, ed. PLoS One. 2014;9(3):e91198. doi:[10.1371/journal.pone.0091198](https://doi.org/10.1371/journal.pone.0091198).
6. Wagnew M, Dessalegn M, Worku A, Nyagero J. Trends of preeclampsia/eclampsia and maternal and neonatal outcomes among women delivering in Addis Ababa selected government hospitals, Ethiopia: a retrospective cross-sectional study. Pan Afr Med J. 2016;25(2):12. <https://doi.org/10.11604/pamj.supp.2016.25.2.9716>.
 7. Say L, Chou D, Gemmill A, Tunçalp Ö, Moller AB, Daniels J, et al. Global causes of maternal death: a WHO systematic analysis. Lancet Glob Health. 2014 Jun;2(6):e323-33. doi: 10.1016/S2214-109X(14)70227-X.
 8. El-Nafaty AU, Melah GS, Massa AA, Audu BM, Nelda M. The analysis of eclamptic morbidity and mortality in the Specialist Hospital Gombe, Nigeria. J ObstetGynaecol. 2004 Feb;24(2):142-7. doi: 10.1080/01443610410001645415.
 9. Abate M, Lakew Z. Eclampsia a 5 years retrospective review of 216 cases managed in two teaching hospitals in Addis Ababa. Ethiop Med J. 2006 Jan;44(1):27-31.
 10. Mahran A, Fares H, Elkhateeb R, Ibrahim M, Bahaa H, Sadad A, et al. Risk factors and outcome of patients with eclampsia at a tertiary hospital in Egypt. BMC Pregnancy Childbirth. 2017;17(1):435. <https://doi.org/10.1186/s12884-017-1619-7>.
 11. Bhutta ZA, Hafeez A, Rizvi A, Ali N, Khan A, Ahmad F, et al. Reproductive, maternal, newborn, and child health in Pakistan: challenges and opportunities. Lancet. 2013 Jun 22;381(9884):2207-18. doi: 10.1016/S0140-6736(12)61999-0.
 12. Pakistan Demographic and Health Survey 2006–07. <http://dhsprogram.com/pubs/pdf/FR200/FR200.pdf>. Accessed 18 September 2015.
 13. United Nations Development Programme Pakistan & Government of Sindh. Report on the status of millennium development goals Sindh. 2012. <http://www.pg.undp.org/content/dam/pakistan/docs/MDGs/UNDP-PK-MDG-SindhReport-2012.pdf>. Accessed 18 March 2015.
-

14. [GetanehY](#), [FekaduE](#), [JemereAT](#), [MengistuZ](#), [TarekegnGE](#), [Oumer](#) M. Incidence and determinants of adverse outcomes among women who were managed for eclampsia in the University of Gondar Comprehensive Specialized Hospital, Northwest Ethiopia. [BMC Pregnancy Childbirth](#). 2021; 21: 734. doi: [10.1186/s12884-021-04199-1](https://doi.org/10.1186/s12884-021-04199-1)
15. Das R, Biswas S. Eclampsia: the major cause of maternal mortality in eastern India. *Ethiop J Health Sci*. 2015;25(2):111–6. doi: [10.4314/ejhs.v25i2.2](https://doi.org/10.4314/ejhs.v25i2.2).
16. Wassie AY, Anmut W. Prevalence of Eclampsia and its Maternal-fetal outcomes at Ghandi Memorial Hospital, Addis Ababa Ethiopia, 2019. Retrospective study. *Int J Womens Health*. 2021 Feb 22;13:231-237. doi: [10.2147/IJWH.S298463](https://doi.org/10.2147/IJWH.S298463).
17. Chibber R, Al-Hijji J, Amen A, Fouda M, Kaleemullah ZM, El-Saleh E, et al. Maternal and perinatal outcome of eclampsia over a decade at a tertiary hospital in Kuwait. *J Matern Fetal Neonatal Med*. 2016 Oct;29(19):3132-7. doi: [10.3109/14767058.2015.1114095](https://doi.org/10.3109/14767058.2015.1114095).
18. Onoh RC, Mamah JE, Umeokonkwo CD, Onwe EO, Ezeonu PO, Okafor L. Severe preeclampsia and eclampsia: a 6-year review at the Federal Teaching Hospital, Abakaliki, Southeast Nigeria. *Trop J ObstetGynaecol*. 2019;36(3):418-423. DOI: [10.4103/TJOG.TJOG_45_19](https://doi.org/10.4103/TJOG.TJOG_45_19).
19. Ngwenya S, Jones B, Mwembe D. Determinants of adverse maternal and perinatal outcomes in severe preeclampsia and eclampsia in a low-resource setting, Mpilo Central Hospital, Bulawayo, Zimbabwe. *BMC Res Notes*. 2019 May 28;12(1):298. doi: [10.1186/s13104-019-4334-9](https://doi.org/10.1186/s13104-019-4334-9).
20. Melese MF, Badi MB, Aynalem GL. Perinatal outcomes of severe preeclampsia/eclampsia and associated factors among mothers admitted in Amhara Region referral hospitals, North West Ethiopia, 2018. *BMC Res Notes*. 2019;12:147. <https://doi.org/10.1186/s13104-019-4161-z>.
21. Li Z, Zhao X, Wang Y, Wang C, Liu L, Shao X, et al. Association between seizures and outcomes among intracerebral hemorrhage patients: the China National Stroke Registry. *J Stroke Cerebrovasc Dis*. 2015 Feb;24(2):455-64. doi: [10.1016/j.jstrokecerebrovasdis.2014.09.021](https://doi.org/10.1016/j.jstrokecerebrovasdis.2014.09.021).

22. Cantu-Brito C, Arauz A, Aburto Y, Barinagarrementeria F, Ruiz-Sandoval JL, Baizabal-Carvallo JF. Cerebrovascular complications during pregnancy and postpartum: clinical and prognosis observations in 240 Hispanic women. *Eur J Neurol*. 2011 Jun;18(6):819-25. doi: 10.1111/j.1468-1331.2010.03259.x.
23. Yoshimatsu J, Ikeda T, Katsuragi S, Minematsu K, Toyoda K, Nagatsuka K, et al. Factors contributing to mortality and morbidity in pregnancy-associated intracerebral hemorrhage in Japan. *J ObstetGynaecol Res*. 2014 May;40(5):1267-73. doi: 10.1111/jog.12336.
24. Bateman BT, Schumacher HC, Bushnell CD, Pile-Spellman J, Simpson LL, Sacco RL, et al. Intracerebral hemorrhage in pregnancy: frequency, risk factors, and outcome. *Neurology*. 2006 Aug 8;67(3):424-9. doi: 10.1212/01.wnl.0000228277.84760.a2.
25. Oudghiri N, Behat M, Elchhab N, Doumiri M, Tazi AS. Spontaneous subdural hematoma associated with preeclampsia: a case report and literature review. *Pan Afr Med J*. 2014 Oct 28;19:213. doi: 10.11604/pamj.2014.19.213.5451.
26. Ray JG, Vermeulen MJ, Bharatha A, Montanera WJ, Park AL. Association between MRI exposure during pregnancy and fetal and childhood outcomes. *JAMA*. 2016;316(9):952-961. doi:10.1001/jama.2016.12126
27. Ladhani NNN, Swartz RH, Foley N, Nerenberg K, Smith EE, Gubitzi G, et al. Canadian Stroke Best Practice Consensus Statement: Acute Stroke Management during pregnancy. *Int J Stroke*. 2018 Oct;13(7):743-758. doi: 10.1177/1747493018786617.
28. Rebahi H, Elizabeth-Still M, Faouzi Y, Rhassane El Adib A. Risk factors for eclampsia in pregnant women with preeclampsia and positive neurosensory signs. *Turk J Obstet Gynecol*. 2018;15(4):227–234. doi: [10.4274/tjod.22308](https://doi.org/10.4274/tjod.22308).
29. Ajah LO, Ozonu NC, Ezeonu PO, Lawani LO, Obuna JA, Onwe EO. The Feto-Maternal Outcome of Preeclampsia with Severe Features and Eclampsia in Abakaliki, South-East Nigeria. *J ClinDiagn Res*. 2016 Sep;10(9):QC18-QC21. doi: 10.7860/JCDR/2016/21078.8499.

30. Phipps E, Prasanna D, Brima W, Jim B. Preeclampsia: updates in pathogenesis, definitions, and guidelines. *Clin J Am Soc Nephrol*. 2016 Jun 6;11(6): 1102–1113.
31. American College of Obstetricians and Gynecologists, Task Force on Hypertension in Pregnancy. Hypertension in pregnancy. Report of the American College of Obstetricians and Gynecologists' Task Force on Hypertension in Pregnancy. *Obstet Gynecol*. 2013 Nov;122(5):1122–1131.
32. Liu S, Joseph KS, Liston RM, Bartholomew S, Walker M, León JA, et al. Incidence, risk factors, and associated complications of eclampsia. *Obstet Gynecol*. 2011 Nov;118(5):987–994.
33. Singh R, Hayaran N, Nagar D, Jain A. Spectrum of Neurological Complications in Eclampsia in a Tertiary Care Hospital in India. *Maternal Fetal Medicine*. 2018; |40(7):876-882. DOI: <https://doi.org/10.1016/j.jogc.2017.08.038>.
34. [An SJ](#), [Kim TJ](#), [Yoon BW](#). Epidemiology, Risk Factors, and Clinical Features of Intracerebral Hemorrhage: An Update. *J Stroke*. 2017 Jan; 19(1): 3–10. doi: [10.5853/jos.2016.00864](https://doi.org/10.5853/jos.2016.00864).
35. Steiner T, Kaste M, Forsting M, Mendelow D, Kwicinski H, Szikora I, et al. Recommendations for the management of intracranial haemorrhage - part I: spontaneous intracerebral haemorrhage. The European Stroke Initiative Writing Committee and the Writing Committee for the EUSI Executive Committee. *Cerebrovasc Dis*. 2006;22(4):294-316. doi: 10.1159/000094831.
36. Vespa PM, O'Phelan K, Shah M, Mirabelli J, Starkman S, Kidwell C, et al. Acute seizures after intracerebral hemorrhage: a factor in progressive midline shift and outcome. *Neurology*. 2003 May 13;60(9):1441-6. doi: 10.1212/01.wnl.0000063316.47591.b4.
37. Qureshi AI, Mendelow AD, Hanley DF. Intracerebral haemorrhage. *Lancet*. 2009 May 9;373(9675):1632-44. doi: 10.1016/S0140-6736(09)60371-8.
38. Dutta MR, Pant L, Kabiraj M, Basu SB. Magnesium sulphate in eclampsia: A safe, efficient and cost effective approach. *J Obstet Gynecol Ind*. 2002;52(3):65–68.

39. Berhan Y, Berhan A. Reasons for persistently high maternal and perinatal mortalities in Ethiopia: Part III — Perspective of the “Three delays” model Health system factors. *Ethiop J Health Sci.* 2014 Sep; 24(0 Suppl): 137–148.