Rwanda Medical Journal RMJ

ORIGINAL RESEARCH Open Access

Seasonal Variation in Preeclampsia and Eclampsia in Kigali

Authors: L. Mutabazi[1]; L. Bazzett-Matabele[1,2]; M. Small[1,2,3]; D. Ntasumbumuyange[1]; S. Rulisa[1]; U. Magriples[1,2,*]

Affiliations: *[1]Department of Obstetrics and Gynecology, College of Medicine and Health Sciences, University of Rwanda, Kigali, Rwanda; [2]Department of Obstetrics, Gynecology, and Reproductive Sciences, Yale University School of Medicine, New Haven, CT; [3]Department of Obstetrics and Gynecology, Duke University School of Medicine, Durham, NC*

ABSTRACT

BACKGROUND: Hypertensive disorders complicate up to 10% of all pregnancies. The World Health Organization estimates the incidence of preeclampsia and eclampsia to be higher in developing countries.
Aim: To document the prevalence of preeclampsia and eclampsia in Kigali and determine whether seasonality affects the rate.
METHODS: A combined retrospective and prospective study at 2 teaching hospitals in Kigali was performed over a 2-year period. Data was collected through an admission questionnaire for the prospective portion and the same data was collected for the retrospective portion.
RESULTS: There were 19,746 deliveries and 454 cases of preeclampsia and eclampsia giving an overall prevalence of 2.3% (2.0% and 0.3%, respectively). Most of the patients with preeclampsia (62.3%) presented with severe features. Half of the patients were admitted with blood pressure greater than 160/110 mmHg and 65.7% were preterm. Women with preeclampsia were more likely to have chronic hypertension than women with eclampsia (10.9% vs 0%, p=0.047). Two thirds of patients presenting with preeclampsia/eclampsia were admitted during the rainy season (OR 1.36, 1.11-1.65, p=0.002). Season at conception did not affect the prevalence of preeclampsia/eclampsia at admission. There was also no difference in the severity of the disease based on seasonality.
CONCLUSIONS: The overall prevalence of preeclampsia and eclampsia in Kigali is similar to other developing countries. Seasonal variation was found in Kigali with a higher prevalence in rainy season. Further studies need to be performed to examine whether other diseases are similarly affected by seasonal variation in such as malaria.

Keywords: Global Health, Preeclampsia, Eclampsia, Seasonal Variation

INTRODUCTION

Hypertensive disorders complicate 2 to 8% percent of all pregnancies [1]. The WHO estimates the incidence of preeclampsia (PEC) and eclampsia (EC) to be higher in developing countries (2.8% of live births) than in developed countries (0.4%) [2,3,4]. The reasons for the variations in rates are largely unknown though geographic, sociodemographic, racial and economic contributors have all been postulated [5,6,7]. PEC, either alone or superimposed on chronic hypertension, accounts for 10-15% of maternal deaths worldwide [8]. In countries where maternal mortality is lower, the relative proportion of deaths from preeclampsia/eclampsia and cardiovascular disease is higher likely due to reduction in mortality from hemorrhage and infection [9,10,11,12].

There has been debate in literature about whether there is seasonal variability in the occurrence of preeclampsia/eclampsia [13,14,15,16,17,18]. In Norway, Magnus et al. studied 1,869,388 births over a thirty-year period and found the prevalence of preeclampsia was highest in December and declined during spring and summer to its lowest level in August [13].

***Corresponding author:** Urania Magriples MD, Yale University School of Medicine/ Division of Maternal Fetal Medicine, urania.magriples@yale.edu; **Potential Conflicts of Interest (CoI):** All authors: no potential conflicts of interest disclosed; **Funding:** All authors: no funding was disclosed; **Academic Integrity.** All authors confirm that they have made substantial academic contributions to this manuscript as defined by the ICMJE; **Ethics of human subject participation:** The study was approved by the local Institutional Review Board. Informed consent was sought and gained where applicable;
Originality: All authors: this manuscript is original has not been published elsewhere; **Type-editor**: Hannah King (USA)
Review: This manuscript was peer-reviewed by three reviewers in a double-blind review process;
Received: 08th June 2019; **Initial decision given:** 08th June 2019; **Revised manuscript received:** 21st August 2019; **Accepted:** 24th August 2019

 Publisher: Rwanda Biomedical Centre (RBC)/Rwanda Health Communication Center, P.O.Box 4586, Kigali.
ISSN: 2079-097X (print); 2410-8626 (online)

Citation for this article: L. Mutabazi, L. Bazzett-Matabele, M. Small et al.; Seasonal variation in preeclampsia and eclampsia in kigali. Rwanda Medical Journal, Vol. 77, no. 1, pp. 11-15, 2020.

A study from India examining 29,562 deliveries did not show a difference in preeclampsia between the monsoon and dry seasons, though the incidence of eclampsia was significantly higher during the monsoon season (0.2% vs. 0.08%, p = 0.01) [14]. This may have been secondary to delays in access to medical care during the monsoon. There is also debate on whether the season of conception or delivery affects the disease [18].

The rate of PEC and EC in Rwanda is unknown, though anecdotally it is felt to be a common pregnancy complication. There is no available data describing seasonal variability in the incidence of preeclampsia and eclampsia in Rwanda. Though Rwanda is located within the equatorial belt, its climate is not typically equatorial. It has a modified humid climate typical of a tropical Savannah type secondary to its landscape that contains many rainy forests. Two rainy seasons are generally distinguishable, one centered around March-May and the other around October-December. The maximum rainfall occurs between March to May and September to December [19]. The specific aims of the study were to examine the incidence of PEC and EC in Kigali, Rwanda, the risk factors associated with these and whether seasonality at delivery affects the incidence rate.

METHODS

Study design: The current study is a combined retrospective and prospective study.

Study sites: The study was performed on pregnant women admitted for delivery at Kigali University Teaching Hospital (KUTH) and Muhima District Hospital, both located in Kigali, Rwanda, over a 2-year period. They represent the 2 largest maternity hospitals in Kigali. Kigali University Teaching Hospital (KUTH) is a public referral hospital with a maternity unit that performs 2500 deliveries per year. Muhima District Hospital conducts over 10,000 annual deliveries.

Procedures: A retrospective chart review of all women with a confirmed diagnosis of preeclampsia or eclampsia was performed from December 2015 to August 2017. Prospective data was collected through the use of a questionnaire on admission, by trained midwives, from September to December 2017. All patients included in the prospective part of the study gave written informed consent.

Variables: Preeclampsia was defined as proteinuria and a systolic blood pressure of 140 mm Hg or more and/or a diastolic blood pressure of 90 mm Hg or more on two separate occasions, at least 4 hours apart after 20 weeks of gestation in a woman with previously normal blood pressure profile. Severe preeclampsia was defined by the presence of at least one of the following findings: systolic BP>160 (repeated for confirmation), diastolic BP > 110 (repeated for confirmation), headache, blurred vision, neurologic symptoms, epigastric pain, pulmonary edema, oliguria, Cr > 1.1 mg/dl, elevated liver function tests (twice the normal reference value) and thrombocytopenia (platelets less than 100 thousand) [20]. Season (rainy vs. dry) on admission and conception was recorded. Two rainy seasons are generally distinguishable, one centered around March-May and the other from October-December and patients were stratified by season at conception and delivery [19]. Demographic data as well as the hospital course were recorded for all patients with preeclampsia and eclampsia.

Data collection, management and analysis: Descriptive statistics such as frequency, mean and standard deviation were used to describe the study variables. Chi-square test was used to analyze quantitative variables between different groups. Data analysis was done using Microsoft Excel and SPSS v23.0 .A p value <0.05 was taken as to be statistically significance.

Ethical clearance: The study received ethics approval from each of the hospitals and from the Institutional Research Board of the College of Medicine and Health Sciences/University of Rwanda (No. 328 /CMHS IRB/2017).

RESULTS

Over a 2-year period, 19,746 deliveries were conducted, and 454 cases of PEC/EC were identified for an overall prevalence of 2.3% (2.0% PEC; 0.3% EC). Patient demographics and clinical presentation are shown in Table 1.

The majority of the patients (66.1%) were from Kigali. Most patients were admitted with severe preeclampsia (62.3%). Half of the patients were admitted with elevated blood pressure greater than 160/110 mmHg and 65.7 % were admitted preterm (prior to 36 weeks and 6 days of gestation age). Proteinuria was present in 95.8%. Anemia on admission (Hemoglobin < 11 g/dl) was present in 17% of the cohort with no significant difference in

Table 1: Socio-demographic and clinical characteristics of the study participants

Age (years)	n	%
<20	23	5.1
20-35	352	77.5
>35	79	17.4
Province of origin		
Eastern	63	13.9
Southern	38	8.4
Northern	39	8.6
Western	14	3.1
City of Kigali	300	66.1
Blood pressure (mm Hg)		
<140/90	42	9.3
140/90 to 160/110	182	40.1
>160/110	230	50.7
Hemoglobin (g/dl)		
<11	77	17.0
>11	377	83.0
Gestational age at admission (weeks)		
<28	48	10.6
≥28 to < 37	250	55.1
≥37	156	34.1

EC (15.5%) and PEC (17.2%). Two third of patients (66.5%) presenting with PEC/EC were admitted during rainy season. The rainy season was significantly associated with higher risk of preeclampsia/eclampsia (OR 1.36, 95% CI 1.11-1.65, p=0.002). Season at conception did not affect the prevalence of PEC/EC at admission with 50.4% of women conceiving during rainy season. The proportion of PEC to EC did not vary by season or by the patient's residence (Figure 1).

Women with PEC were more likely to be overweight (OR 8.9, 95% CI 1.20-66.8, p=0.032) and have a history of hypertension (OR 8.4, 95% CI 1.01-70.7, p=0.047) when compared to women with EC. The majority of patients (90.5%) were normotensive

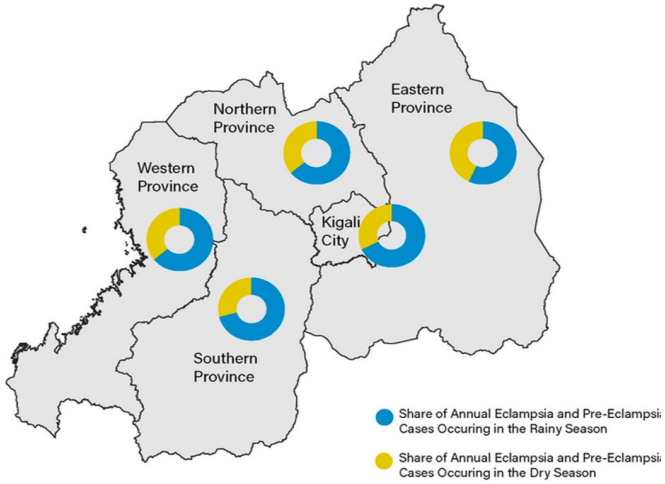

Figure 1: Proportion of Preeclampsia and Eclampsia by province and season

before getting pregnant. Only 1.3% of patients presenting with preeclampsia had preexisting diabetes and only one patient had gestational diabetes. Only 7% of the cohort had a multifetal gestation, therefore no significant association was found. Smoking was also not common with less than 1% of the entire cohort reporting smoking during pregnancy.

DISCUSSION

The overall prevalence of preeclampsia and eclampsia in our study was 2.3% (2.0% PEC; 0.3% EC) which is similar to WHO statistics which estimate the prevalence of preeclampsia in developing countries to be 2.8% [2]. The prevalence of preeclampsia varies worldwide and in African countries varies from 1.8% to 7.1 %. Variation between countries likely reflects variation in socioeconomic status, access to care and timeliness of diagnosis as well as background prevalence of hypertension and PEC. Our study noted differences in risk factors between preeclampsia and eclampsia with a significantly higher risk of chronic hypertension noted in women with preeclampsia.

In our study, two thirds of patients presenting with PEC/EC were admitted during the rainy season, and the rainy season was significantly associated with a higher risk of PEC/EC. The proportion of PEC/EC did not seem to change by season or location. Seasonality of preeclampsia has been demonstrated in several studies [13,14,15,16,17,18]. Our results differ from a study conducted in the Democratic Republic of Congo (DRC) which demonstrated in 17,592 pregnancies, 6% had PEC in the rainy season as compared to 13% in dry season [17]. The authors postulated that this may be secondary to nutritional deficiencies caused by the effects of low rate of precipitation on food security rather than meteorological factors. A study from Mumbai, India, demonstrated seasonal variation of EC with monsoon compared to dry seasons but not of PEC [14]. In our study, the season at conception did not affect the prevalence of PEC/EC at admission. Our results differ from a study conducted by Phillips, et al. that revealed a significant association of month of conception (p=0.003) with risk of preeclampsia [18]. Conception during the summer months had the highest risk (incidence 2.3%; OR: 1.7) compared with spring (incidence 1.4%).

Table 2. Association of risk factors with preeclampsia (PEC) compared to eclampsia (EC) among the study participants

	PEC	EC	OR (95% CI)	p
N	396	58		
Age (years)				
<20	11 (2.8%)	12 (20.7%)		
20-35	312 (78.8%)	40 (69.0%)	13.2 (4.13-42.6)	<0.001
>35	73 (18.4%)	6 (10.3%)	1.6 (0.63-3.81)	0.33
BMI				
18.5-24.9	215 (54.2%)	52 (89.7%)		
25-30	142 (35.8%)	6 (10.3%)	8.9 (1.20-66.8)	0.032
>30	39 (10.0%)	0	1.6 (0.19-13.7)	0.666
Gravidity				
Primigravida	155 (39.1%)	32 (55.2%)		
Multigravida	241 (60.9%)	26 (44.8%)	0.6 (0.35-1.08)	0.087
History of hypertension				
Yes	43 (10.9%)	0	8.4 (1.01-70.7)	0.047
No	353 (89.1%)	58 (100%)		

A review examining the associations of anemia, preeclampsia and eclampsia and seasonality highlighted the difficulties in comparing different areas even within Africa, given that baseline risks of anemia and malaria vary by country and season, food security and even antenatal care attendance likely also vary [21].

The main limitation in our study is that most of the participants are from Kigali and may not reflect variations in risk factors and prevalence of disease across Rwanda. Women in Kigali likely have better access to antenatal care and may not reflect the demographics and prevalence of the entire country. Demographic data collection was limited to the women who developed preeclampsia and eclampsia and did not assess other possible confounding factors such as nutritional variation or malaria as a factor in the development in disease. Despite these limitations, this study represents a large cohort of Rwandan women and establishes both the background rates of preeclampsia and eclampsia as well as the seasonality of the disease which may stimulate further research in this field.

CONCLUSIONS

Preeclampsia and eclampsia have significant impacts on maternal morbidity and mortality in Rwanda. Hypertensive disease was found to be the second leading cause of severe maternal morbidity [22,23]. Eclampsia is the fourth leading cause of death in Rwanda, accounting for 9.4% of all maternal deaths from 2009 to 2013 [24]. Our study demonstrated an increased risk of PEC/EC in rainy season. Further studies need to be performed to examine whether PEC and EC are affected by seasonal variation of other diseases such as malaria and whether prophylactic treatment affects the prevalence of disease and maternal outcomes.

REFERENCES

1. L. Duley. The global impact of preeclampsia and eclampsia. Semin Perinatol. vol. 33, no.3, p.130-137, June 2009.
2. World Health Organization. WHO recommendations for prevention and treatment of pre-eclampsia and eclampsia. Geneva: WHO, 2011. Available at http://apps.who.int/iris/bitstream/10665/44703/1/9789241548335_eng.pdf. [Accessed May 30, 2019].
3. K.S. Khan, D. Wjdyla, L. Say, et al. WHO analysis of causes of maternal death: a systematic review. Lancet. vol.367, no. 9516, p. 1066-74, April 2006.
4. L. Say, D. Chou, A. Gemmill, et al. Global causes of maternal death: a WHO systematic analysis. Lancet Glob Health, vol. 2, no. 6, p. e323-33, June 2014.
5. K.O. Osungbade, O.K. Ige. Public health perspectives of preeclampsia in developing countries: Implication for health system strengthening. J Pregnancy. Article ID 481095, Jan. 2011. Available at http://dx.doi.org/10.1155/2011/481095. [Accessed May 30, 2019].
6. V.L. Bilano, E. Ota, T. Ganchimeg, et al. Risk factors of preeclampsia/eclampsia and its adverse outcomes in low- and middle-income countries: a WHO secondary analysis. PLoS One. vol. 9, no. 3, p. e91198, Mar. 2014.
7. B. Sibai, M. Ewell, R.J. Levine, et al. Risk factors associated with preeclampsia in healthy nulliparous women. The Calcium for Preeclampsia Prevention (CPEP) Study Group. Am J Obstet Gynecol. vol. 177, no. 5, p.1003-10, Nov.1997.
8. L. Ghulmiyyah, B. Sibai B. Maternal mortality from preeclampsia/eclampsia. Semin Perinatol. vol. 36, no. 1, p.56-9, Feb. 2012.
9. J.A. Ozimek, S.J. Kilpatrick. Maternal mortality in the twenty-first century. Obstet Gynecol Clin N Am. vol.45, no. 2, p.175–86, June 2018.
10. Duley L. Maternal mortality associated with hypertensive disorders of pregnancy in Africa, Asia, Latin America and the Caribbean. Br J Obstet Gynaecol. vol.99, no. 7, p. 547-53, July 1992.
11. Kassebaum NJ, Barber RM, Bhutta ZA, Dandona L, Gething PW, Hay SI, et al. Global, regional, and national levels of maternal mortality, 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet. 2016 Oct 8;388(10053):1775–812.
12. S.E. Geller, A.R. Koch, C.E. Garland, et al. A global view of severe maternal morbidity: moving beyond maternal mortality. Reprod Health. vol. 15 (Suppl 1), no.98, June 2018.
13. P. Magnus, A. Eskild. Seasonal variation in the occurrence of pre-eclampsia. BJOG. vol. 108, no. 11, p.1116–9, Nov. 2001.
14. V. Subramaniam. Seasonal variation in the incidence of preeclampsia and eclampsia in tropical climatic conditions, BMC Womens Health. vol. 15, no. 7, p. 18. Oct 2007.
15. A.A. Ali, G.K. Adam, T.M. Abdallah. Seasonal variation and hypertensive disorders of pregnancy in eastern Sudan. J Obstet Gynaecol. vol. 35, no. 2, p. 153-4, Feb. 2015.
16. M. Morikawa, T. Yamada, T. Yamada, et al. Seasonal variation in the prevalence of pregnancy-induced hypertension in Japanese women. J Obstet Gynaecol Res. vol.40, no.4, p. 926-31, Apr. 2014.
17. J.P. Elongi, B. Tandu, B. Spitz , et al. Influence of the seasonal variation on the prevalence of pre-eclampsia in Kinshasa. Gynecol Obstet Fertil. vol. 39, no. 3, p. 132-5, Mar. 2011.
18. J.K. Phillips, I.M. Bernstein, J.A. Mongeon, et al. Seasonal Variation in Preeclampsia Based on Timing of Conception. Obstet Gynecol. vol. 104, no. 5 (pt 1), p. 1015-20, Nov.2004.
19. Rwanda Meteorology Agency, Climatology of Rwanda. Available: https://www.meteorwanda.gov.rw/index.php?id=30. [Accessed: May 30, 2019].
20. America College of Obstetricians and Gynecologists. ACOG practice bulletin No. 202. Gestational hypertension and preeclampsia. Obstet Gynecol. vol. 133, no. 1, p. e1-25, Jan. 2019.
21. T. Hlimi. Association of anemia, pre-eclampsia and eclampsia with seasonality: a realist systematic review. Health Place, vol. 31, p.180-92, Jan. 2015.
22. S. Rulisa, I. Umuziranenge, M. Small, et al. Maternal near miss and mortality in a tertiary care hospital in Rwanda: A case series from the University Teaching Hospital of Kigali (CHUK). BMC Pregnancy Childbirth. vol.15, p. 203. Sept. 2015.
23. F. Sayinzoga, L. Bijlmakers, J. van Dillen, et al. Maternal death audit in Rwanda 2009–2013: a nationwide facility-based retrospective cohort study. BMJ Open. Vol. 6, no. 1, p. e009734, Jan. 2016.

24. C. Benimana, M. Small, S. Rulisa. Preventability of maternal near miss and mortality in Rwanda: A case series from the University Teaching Hospital of Kigali (CHUK). PLoS ONE. vol. 13, no. 6, p. e0195711. June 2018.