



# Maternal ABO Blood Group and the Risk of Preeclampsia and Pregnancy Outcomes in a Nigerian Tertiary Care Hospital

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## Summary

### BACKGROUND

Preeclampsia is a multisystemic disorder that contributes significantly to maternal morbidity and mortality including adverse pregnancy outcomes. Though the aetiology is unknown, various risk factors including the ABO blood group have been linked with its occurrence. However, results from studies that assess the association between the ABO blood group and the risk of preeclampsia have been inconsistent. This study aimed to determine the association between maternal ABO blood group and the risk of preeclampsia as well as their pregnancy outcomes.

### MATERIALS AND METHODS

This was a prospective case-control study. A total of 198 consented participants consisting of 99 preeclamptic parturients (cases) and 99 normal parturients (controls) were consecutively recruited into the study from the ante-natal clinic for 6 months. Information including age, educational status, parity, ABO blood group, and pregnancy outcomes were obtained from participants' hospital records into a proforma designed for the study. Inferential statistics, Chi-square, and student t-test were used as appropriate, the p-value was set at 0.05.

### RESULTS

Blood group O was the most common among the study participants (75.8% and 76.8% for cases and controls respectively), while the B- blood type was the least represented (9.1% and 10.1% respectively). There was no association between the maternal ABO blood group and the risk of preeclampsia ( $p=0.904$ ). However, there was an association between maternal educational level and parity and the risk of preeclampsia ( $p = 0.014$  &  $0.001$  respectively). Furthermore, preeclamptic women were more likely to have adverse pregnancy outcomes ( $p=0.0001$ ).

### CONCLUSION

Like other similar studies, we found no association between maternal ABO blood and the risk of preeclampsia. However, maternal educational level and parity were associated with the risk of preeclampsia. Furthermore, preeclampsia harms pregnancy outcomes. Therefore, parity and educational level may be considered potential risk factors for preeclampsia during antenatal follow-up.

*Keywords:* ABO blood group, Preeclampsia, Pregnancy, Parity

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## Introduction

Preeclampsia is a pregnancy-specific multisystem disorder characterized by abrupt development of elevated blood pressure (hypertension) of 140/90 mmHg or more with associated proteinuria of  $\geq 300$ mg per 24 hours after the 20th week of gestation in a previously normotensive and non-proteinuric woman. [1]

The global burden is about 2-10% of pregnancies thus, contributing significantly to maternal morbidity and mortality. [2] For instance, in the United States, it affects about 5-8% of live births. [3] These figures are much higher in many developing countries. The World Health Organization (WHO) estimates the incidences to be 7-times higher in developing countries (2.8 of live births) than in developed countries (0.4% live births) of which as many as 10-25% of cases may result in maternal death. [4] In Nigeria, Osungbade *et al.* reported a prevalence rate of between 2% and 16%. [2]

The aetiology of preeclampsia remains largely unknown, however, some inherent risk factors have been associated with the pathogenesis of this condition including a previous history of preeclampsia, pre-existing diabetes, antiphospholipid syndrome, multiple pregnancies, nulliparity, pre-existing hypertension, and raised body mass index before pregnancy among others. [5] Musa J *et al.* [6] in their study identified a previous history of preeclampsia and BMI  $\geq 25$ mg/m<sup>2</sup> at booking as the most significant risk for developing preeclampsia among other risk factors [6].

The ABO blood group is the most important and most antigenic blood group system in transfusion practice. The gene locus for the ABO blood type is on chromosome-6 [7]. The ABO antigens are defined by the presence of oligosaccharides (carbohydrate moieties) expressed on the surface of the erythrocyte membrane including epithelial and endothelial cells in humans. [7, 8] Based on

the red cell antigens, 6-major genotypes and 4-phenotypes have been identified in the ABO blood group system with different degrees or frequencies of occurrence in various populations. [7, 9]

Various studies have shown a plausible link between the ABO blood group and the occurrence of specific disease conditions. [10, 11] Kaffenberger *et al.* [10] found that the ABO group was independently associated with the overall survival of patients undergoing surgery for renal cell carcinoma with the non-O blood group being an independent predictor of mortality. Iodice *et al.* [11] in their study among patients with haematological malignancy found that patients with chronic lymphocytic leukaemia (CLL) have an increased frequency of A2 blood phenotype. In a similar study, the authors found that the B-blood type was more prevalent in patients with Hodgkin lymphoma (HL) while those with acute lymphoblastic leukaemia (ALL) were of the O blood type. [12] Nevertheless, some other studies found no such relationship. [13]

Likewise, several studies have investigated the relationship between maternal ABO blood type and preeclampsia. [14, 15, 16] However, these results have been somewhat inconsistent. In Thailand, the authors found that the risk of preeclampsia was 1.7 fold higher in women with A and AB blood groups compared to those with the O-blood group. [14] Among Finish and Italian women, a 2.1-3.1 fold increase in the risk of preeclampsia was reported in those with AB-blood type compared to those with O-blood type. [15, 16] However in a similar study in Japan and Nigeria, the authors found no association between the maternal ABO blood group and the risk of preeclampsia. [17, 18]

Furthermore, preeclampsia has been associated with adverse pregnancy outcomes. In a prospective study by Bramham *et al.* [19], the authors found that women with previous preeclampsia are at a greater risk of adverse neonatal outcomes. In a similar study in



Ghana, the authors also found that women with preeclampsia/eclampsia have a higher risk of adverse pregnancy outcomes compared to those with chronic/gestational hypertension. [20] Also, in a retrospective study on the prevalence and maternofetal outcomes of preeclampsia/eclampsia amongst pregnant women in a tertiary hospital in the north-central region of Nigeria, the authors also concluded that preeclampsia/eclampsia is associated with high maternal and perinatal death. [21]

Whilst preeclampsia is a relatively common occurrence among pregnant women in our centre, there is a paucity of information regarding its association with maternal ABO blood group distribution. Therefore, this study aims to determine the association between maternal ABO blood group and the risk of preeclampsia and the pregnancy outcome among women in a tertiary healthcare facility in the South-south region of Nigeria.

## **Materials and Methods**

### ***Study site***

This study was conducted in the Department of Obstetrics and Gynaecology, University of Uyo Teaching Hospital (UUTH) a tertiary referral hospital with about 500-bed spaces in the South-south region of Nigeria.

### ***Study design /population***

This was a prospective case-control study designed to achieve the set objectives of the study. The study population was parturients receiving ante-natal care (ANC) in the above department in UUTH. Among the parturients, those diagnosed with preeclampsia in line with the definition and guidelines of the American College of Obstetrics and Gynaecology [1] were consecutively recruited into the study over 6 months. Parturients with normal pregnancy constituted the control arm of the study. A total of 198 participants consisting of ninety-nine preeclamptic

parturients (cases) and an equal number of parturients with normal pregnancy (controls) were recruited into the study. Both study groups were followed up till delivery.

### ***Data collection/analysis***

The sociodemographic data including age, parity, educational status, ABO blood group, and pregnancy outcomes were obtained from participants' case files. The data were presented in simple tables and descriptive statistics such as frequencies and mean were used as appropriate. Chi-square was used to determine the relationship between the outcome and the independent variable. A significant level was computed at  $p < 0.05\%$ .

### ***Ethical consideration***

Ethical approval was obtained from the University of Uyo/ University of Uyo Teaching Hospital, Uyo Akwa Ibom State institutional health research and ethics committee before the commencement of the study.

## **Results**

A total of 198 gravid women consisted of 99 with a confirmed diagnosis of preeclampsia (cases) and an equal number with normal pregnancy as controls. Their mean ages were  $33.4 \pm 6.4$  and  $31.1 \pm 6.5$  years respectively. A near-equal proportion of the women (64.6% and 66.7% for cases and controls respectively) had tertiary education and less than 10% had more than 4 children. (Table 1).

The predominant blood group among the cases and controls was the O-blood group (75% and 76% respectively), while the B-blood group was the least represented in both groups. Also, the O-blood group was more common than the non-O group (Table 2). There was no association between the ABO blood group and the risk of preeclampsia ( $p = 0.904$  and  $0.867$ ).

Adverse pregnancy was more prevalent among preeclamptic women with a higher rate of cesarean section compared to women with normal pregnancy section (70.7% vs 26.3) intrauterine fetal death (17.2% vs 6.1%) and fetal/maternal death (2% vs 0%) for cases and controls respectively. There was a strong association between preeclampsia and adverse pregnancy outcomes ( $p=0.0001$ ).

## Discussion

The aetiology of preeclampsia has been linked to several risk factors including age. It is more common at the extremes of maternal age; less than 18 years and greater

than 35 years. This later group of women was 1.5 times more likely to develop preeclampsia compared to those under 35 years of age. [22] Though the mean age of the preeclamptic parturients in this study was less than 35 years, it was however significantly higher than that of the controls ( $p=0.0137$ ). The increased comorbidity associated with older women including chronic hypertension may account for the increased frequency of preeclampsia among them. [22]

Several studies have reported a higher risk of preeclampsia among young nulliparous women.

**Table 1**  
*Demographic Characteristics of Participants*

Variables	N (%)		Total (n=198)	Statistical indices
	Preeclampsia (n=99)	Control (n=99)		
Age (years)				Df=2
15-24	9 (9.1)	19 (19.2)	28 (14.1)	$\chi^2=4.4333$
25-34	55 (55.6)	52 (52.5)	107 (54.0)	p-value=0.109
35-48	35 (35.4)	28 (28.3)	63 (31.8)	
Mean (SD)	<b>33.4 (6.4)</b>	<b>31.1 (6.5)</b>	<b>32.3 (6.5)</b>	Df=196 t-test=2.4886 p-value=0.0137+
Educational status				
Primary	10 (10.1)	1(1.0)	11(5.6)	Df=2
Secondary	25 (25.3)	32 (32.3)	57 (28.8)	p-value=0.014+*
Tertiary	(64.6)	66 (66.7)	130 (65.7)	
Parity				
0	24 (24.2)	6 (6.1)	30 (15.2)	Df=4
1	20 (20.2)	21 (21.2)	41 (20.7)	$\chi^2=18.3663$
2	23 (23.2)	45 (45.4)	68 (34.3)	p-value=0.001+
3	26 (26.3)	22 (22.2)	48 (24.2)	
> 3	6 (6.1)	5 (5.1)	11 (5.6)	

**Table 2**  
*ABO Blood Group Distribution of Participants and Controls*

Variables	N (%)		Total (n=198)	Statistical indices
	Preeclampsia (n=99)	Control (n=99)		
<b>Blood group</b>				
<b>A</b>	15 (15.2)	13 (13.1)	28 (14.1)	Df=1
<b>B</b>	9 (9.1)	10 (10.1)	19 (9.6)	$\chi^2=0.2021$
<b>O</b>	75 (75.8)	76 (76.8)	151 (76.3)	p-value=0.904
<b>Blood group</b>				
<b>O</b>	75 (75.8)	7	1	Df=1
		6 (76.8)	51 (76.3)	$\chi^2=0.0279$
<b>Non-O</b>	24 (24.2)	23 (23.2)	47 (23.7)	p-value=0.867

A study by Lee *et al.* [23] revealed that nulliparity increases the relative risk of developing preeclampsia by 1.3 while Luealon *et al.* [24], reported a higher risk of 3.8 in nulliparous women in Thailand.

The incidence of preeclampsia in multiparous women also varies but is lower than nulliparous. Findings from this study show that multiparous women were statistically more likely to develop preeclampsia ( $p = 0.001$ ). This contrasts with the studies above. Perhaps the differences in our study design and method of recruitment of participants relative to the studies above may have accounted for this disparity.

This study has also revealed that the less educated women were significantly more likely to develop preeclampsia ( $p = 0.014$ ) compared to the more educated ones. Our findings agree with those of other authors. Silva *et al.* [25] and Dinglas *et al.* [26] in their studies found that the less educated or uneducated women have a 5.1-fold and 7-fold increased risk of developing preeclampsia respectively. It has been reported that women with higher education are better able to understand and process health information, including better interaction with their healthcare providers and seek medical intervention early in the event of complications than the less educated women. [27].

The results from studies linking maternal ABO blood group to the risk of

developing preeclampsia have been rather inconsistent. Whilst some studies showed an association between maternal ABO blood group and risk of preeclampsia [28, 29, 30], other studies found no such association. [16, 31] This study was more in keeping with findings from the later studies which found no association between maternal ABO blood type and the risk of preeclampsia ( $p = 0.904$ ). In a study in Brazil, the authors found no association in the ABO/Rh blood groups between women with Preeclampsia and control. [31] Similarly, Okoye *et al.* [16] in their study found no increased risk of preeclampsia among women in the non-O blood group even though these women exhibited more symptoms of preeclampsia. In contrast to our study, other studies reported otherwise. Avci *et al.* [28] found that women with the AB blood group have a higher risk of preeclampsia while those with the O blood group who have preeclampsia have a high risk of developing hypertension. Furthermore, results from a population-based nested case-control study in Finland and a meta-analysis both demonstrated an increased risk of preeclampsia in women with the AB blood group. [29, 30]

Adverse pregnancy outcomes have been associated with preeclampsia. Tolu *et al.* [32] conducted a study on maternal and perinatal outcomes of preeclampsia in a tertiary hospital in Ethiopia.

**Table 3**  
**Pregnancy Outcome between Participants and Controls**

Variables : Pregnancy Outcomes	N (%)		Total (n=198)	Statistical indices
	Preeclampsia (n=99)	Control (n=99)		
Normal delivery	10 (10.1)	63 (63.6)	73 (36.9)	
Cesarean section	70 (70.7)	26 (26.3)	96 (48.5)	Df=4
Intrauterine fetal death	17 (17.2)	6 (6.1)	23 (11.6)	p-value=0.0001+*
Maternal death	0 (0.0)	4 (4.0)	4 (2.0)	
Fetal and maternal death	2 (2.0)	0 (0.0)	2 (1.0)	

In this study, they found eclampsia, HELLP syndrome (hemolysis, elevated liver enzymes, low platelets), maternal death, stillbirth, intrauterine growth restriction (IUGR), preterm birth, and neonatal death among other complications were quite common.

Ndiwiga *et al.* [33] reported similar findings among women with early and late-onset preeclampsia with the former having a greater odds of adverse maternal and perinatal outcomes. These findings are consistent with that of our study ( $p=0.0001$ ) and corroborate the fact that preeclampsia when not properly managed often results in poor fetal and maternal outcomes.

A major limitation of this study is the relatively small sample sizes of the participants, hence findings may not fully reflect some of the causal relationships. We hereby recommend a large multicenter prospective study on this subject to validate our findings.

## Conclusion

This study found no association between maternal ABO and the risk of preeclampsia. Hence, the maternal blood group may not confer any significant risk of preeclampsia on the women. However, parity and educational level were associated with the risk of preeclampsia and perhaps may be considered as a potential risk for preeclampsia during antenatal screening. Furthermore, preeclampsia has unfavourable pregnancy outcomes.

## Conflict of Interest

The authors declare no conflict of interest

## Author's contributions

Timothy A. Ekwere: substantial contribution to conception and design, analysis and interpretation of data, drafting of the article, revising it critically for intellectual content, and approval of the version to be published.

Matthias G. Abah: Substantial contribution to concept and design, analysis and interpretation of data, revising the draft manuscript for intellectual content, and approval of the version to be published.

John E. Markson: Data acquisition, analysis and interpretation of data, revising of the draft for intellectual content, and approval of the version to be published.

Inibong Abah: Data acquisition, analysis, and interpretation of data, literature search, drafting of the article, revising for intellectual content, and approval of the version to be published.

## References

1. **American College of Obstetricians and Gynaecology.** Report of the task force on hypertension in pregnancy. *Obstet and Gynecol* 2013; 122(5): 1122-1131.
2. **Osungbade KO, Ige OK.** Public health perspective of preeclampsia in developing countries: Implication for health system strengthening. *J pregnancy* 2011; 2011: 481095.
3. **Pennington KA, Schlitt JM, Jackson DL, Schulz LC, Schust DJ.** Preeclampsia: Multiple approaches to a multifocal disease. *Dis Model Mech* 2012; 5 (1): 9-18.
4. **World Health Organization (WHO).** Make every mother and child count, in The world health report 2005, *World Health Organization, Geneva, Switzerland, 2005.*
5. **English FA, Kenny LC, McCarthy FP.** Risk factors and effective management of preeclampsia. *Integr Blood Press control* 2015; 8:7-12.
6. **Musa J, Mohammed C, Ocheke A, Kahansim M, Pam V, Daru P.** Incidence and risk factors for preeclampsia in Jos, Nigeria. *Afr Health Sci* 2018; 18(3): 584-595.
7. **Storry JR, Olsson ML.** ABO blood group system revisited: a review and update. *Immunohematology.* 2009; 25 (2):48-49.
8. **Chester MA, Olsson ML.** ABO blood group gene: a locus of considerable

- genetic diversity. *Transfusion Medicine Reviews* 2001; 15(3): 177-200.
9. **Ewald DR, Sumner SC.** Blood type biochemistry and human disease. *Wiley*
  10. **Kaffenberger SD, Morgan TM, Stratton KL, et al.** ABO blood group is a predictor of survival in patients undergoing surgery for renal cell carcinoma. *BJU Int.* 2012; 110: E641–646.
  11. **Iodice S, Maisonneuve P, Botteri E, Sandri MT, Lowenfels AB.** ABO blood group and cancer. *European Journal of Cancer.* 2010; 46(18):3345–3350
  12. **Vadivelu MK, Damodaran S, Solomon J, Rajaseharan A.** Distribution of ABO blood groups in Acute Leukaemias and Lymphomas. *Ann Hematol.* 2004; 83(9): 584-587
  13. **Sajan R, Lal S, Kazi S, et al.** (April 14, 2021) Frequency of ABO Blood Group in Pregnant Women and Its Correlation with Pregnancy-Related Complications. *Cureus* 13(4): e14487. doi:10.7759/cureus.14487
  14. **Phaloprakarn C, Tangjitgamol S.** Maternal ABO blood group and adverse pregnancy outcome. *J Perinatol* 2013; 33: 107-111
  15. **Spinillo A, Capuzzo E, Baltaro F, Piazzi G, Iasci A.** Case-control study of maternal blood group and severe pre-eclampsia. *J Hum Hypertens* 1995; 9: 623–625.
  16. **Hiltunen LM, Laivuori H, Rautanen A, Kaaja R, Kere J, Krusius T et al.** Blood group AB and factor V Leiden as risk factors for pre-eclampsia: a population-based nested case-control study. *Thromb Res* 2009; 124: 167–173.
  17. **Shibata-Hiraizumi Y, Suzuki S.** Maternal ABO blood group and adverse pregnancy outcomes in the Japanese population. *J Perinatol* 2013; 33: 743-744.
  18. **Okoye HC, Efobi CC, Ugwu, AO, Ugwu EO, Nwagha TU.** ABO blood group as a biomarker of preeclampsia among antenatal clinic attendees in Nigeria. *Niger J Clin Pract* 2020; 23: 729-733
  19. **Bramham K, Briley AL, Seed P, et al.** Adverse maternal and perinatal outcomes in women with previous preeclampsia: a prospective study. *Am J Obstet Gynecol* 2011; 204: .e1-9.
  20. **Dassah ET, Kusi-Mensah E, Morhe ESK, Odoi AT** (2019) Maternal and perinatal outcomes among women with hypertensive disorders in pregnancy in Kumasi, Ghana. *PLoS ONE* 14(10): e0223478. <https://doi.org/10.1371/journal.pone.0223478>
  21. **MMAkaba, G.O., Anyang, U.I. & Ekele, B.A.** Prevalence and materno-fetal outcomes of preeclampsia/eclampsia amongst pregnant women at a teaching hospital in north-central Nigeria: a retrospective cross-sectional study. *Clin Hypertens* 27, 20 (2021). <https://doi.org/10.1186/s40885-021-00178-y> MM
  22. **Lamminpää, R., Vehviläinen-Julkunen, K., Gissler, M. et al.** Preeclampsia complicated by advanced maternal age: a registry-based study on primiparous women in Finland 1997–2008. *BMC Pregnancy Childbirth* 2012; 12, 47. ). <https://doi.org/10.1186/1471-2393-12-47>
  23. **Lee CJ, Hsieh TT, Chiu TH, et al.** Risk factors for pre-eclampsia in an Asian population. *Int J Gynaecol Obstet.* 2000; 70:327-33. 12.
  24. **Luealon P, Phuong V.** Risk factors of preeclampsia in Thai women. *J Med Assoc Thai* 2010; 93: 661-6.
  25. **Silva LM, Coolman M, Steegers EA, et al.** Low Socioeconomic status is a risk factor for preeclampsia: The generation R Study. *J. Hypertens.* 2008; 26: 1200-8. 18.
  26. **Dinglas C, Lardner D, Homchaudhari A, et al.** Relationship of reported clinical features of preeclampsia and postpartum haemorrhage to demographic and other variables. *West Afr J Med.* 2011; 30: 84-8.
  27. **Karlsen S, Say L, Souza JP, et al.** The relationship between maternal education and mortality among women giving birth in health care institutions: analysis of the cross-sectional WHO global survey on maternal and perinatal health. *BMC Public Health.* 2011; 11: 606-15



28. **Avci D, Karagoz H, Ozer O, Esmeray K, Bulut K, Aykas F et al.** Are the blood groups of women with preeclampsia a risk factor for the development of hypertension postpartum? *Ther Clin Risk Manag.* 2016; 19 (12): 617-622.
29. **Hiltunen LM, Laivuori H, Rautanen A, Kaaja R, Kere J, Krusius T et al.** Blood group AB and factor V Leiden as risk factors for pre-eclampsia: a population-based nested case-control study. *Thromb Res* 2009; 124: 167–173.
30. **Alpoim PN, de Barros Pinheiro M, Junqueira DR, Freitas LG, das Graças Carvalho M, Fernandes AP et al.** Preeclampsia and ABO blood groups: a systematic review and meta-analysis. *Mol Biol Rep.* 2013; 40(3):2253-2261
31. **Hentschke MR, Caruso FB, Paula LG, Medeiros AK, Gadonski G, Antonello IC et al.** Is there any relationship between ABO/Rh blood group and patients with pre-eclampsia? *Pregnancy Hypertens* 2014; 4(2):170-173
32. **Tolu LB, Yigezu E, Urgie T, Feyissa GT.** Maternal and perinatal outcomes of preeclampsia without severe features among pregnant women managed in a tertiary referral hospital in urban Ethiopia. *PLoS One* 2020; 15(4): e0230638
33. **Ndwiga C, Odwe G, Pooja S, Ogutu O, Osofi A, Warren CE.** Clinical presentation and outcomes of preeclampsia and eclampsia at a national hospital, Kenya: A retrospective cohort study. *PLoS One* 2020; 15(6): e0233323. Doi: 10. 1371/journal.pone.0233323.