|| ISSN(online): 2589-8698 || ISSN(print): 2589-868X ||

Available online on http://www.ijmbs.info

International Journal of Medical and Biomedical Studies; 2026; 10(3); 20-35

Association of Maternal Gestational Hypertensive Disorders with Retinopathy of Prematurity: Case Control Study

Sunehera Palo[1], Lucy Das[2], Sasmita Swain[3], Kumari Krishna Patro[4]

[1]MBBS, MS, DNB, Department of Obstetrics & Gynaecology, SCB MCH, Cuttack, Odisha, India
[2]Professor, Department of Obstetrics & Gynaecology, SCB MCH, Cuttack, Odisha, India
[3]Professor, Department of Obstetrics & Gynaecology, SCB MCH, Cuttack, Odisha, India
[4]Associate Professor, Department of Ophthalmology, Post Graduate Institute of Medical Education Research & Capital Hospital, Bhubaneswar, Odisha, India

Received: 22-02-2026 / Revised: 17-03-2026 / Accepted: 24-04-2026
DOI: https://doi.org/10.32553/ijmbs.v10i3.3273
Corresponding author: Kumari Krishna Patro
Conflict of interest: No conflict of interest

Abstract:

Background: Retinopathy of prematurity (ROP) is a multifactorial disease and a leading cause of preventable childhood blindness, particularly in preterm infants. Identification of maternal and neonatal risk factors is essential for early detection and management.

Aim: To evaluate the association of maternal and perinatal risk factors with the development of ROP in preterm infants.

Methods: A case-control study was conducted on 200 preterm infants (≤34 weeks gestation and/or birth weight <2000 g), including 100 cases with ROP and 100 controls without ROP. Maternal factors such as age, hypertensive disorders of pregnancy (HDP), and comorbidities were analyzed along with neonatal factors including gestational age, birth weight, gender, and oxygen therapy. Statistical analysis was performed using appropriate tests, with $p < 0.05$ considered significant.

Results: Maternal age and hypertensive disorders of pregnancy showed a statistically significant association with ROP ($p < 0.05$). Male gender, lower gestational age, and lower birth weight were significant neonatal risk factors. Oxygen therapy was also strongly associated with ROP development. Other maternal factors such as BMI, obstetric score, mode of delivery, and associated comorbidities did not show significant association.

Conclusion: ROP is influenced by multiple maternal and neonatal risk factors, with gestational age, birth weight, oxygen therapy, and hypertensive disorders of pregnancy being the most significant. Early identification of high-risk infants and strict monitoring of oxygen therapy can help reduce the incidence and severity of ROP.

Keywords: Maternal factors, BMI, obstetric score, gestational age, birth weight

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0) and the Budapest Open Access Initiative (http://www.budapestopenaccessinitiative.org/read), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

Hypertension is the most prevalent medical condition affecting pregnant women. Maternal prenatal hypertension can manifest as pre-eclampsia, eclampsia, or

HELLP syndrome (hemolysis, increased liver enzymes, and low platelets). It is a leading cause of maternal and neonatal morbidity and mortality, affecting up to 10% of pregnancies. Preeclampsia (PE) is defined as the "new onset of hypertension and proteinuria or the new onset of hypertension and significant end-organ dysfunction with or without proteinuria after 20 weeks of gestation or postpartum in a previously normotensive woman." high PE is diagnosed in preeclamptic women who have high hypertension and/or specific evidence of considerable end-organ failure, indicating the severe end of the PE continuum(1).

The global incidence of PE is 4.6%, with prevalence varying from 2% to 10%. In India, the incidence of PE is 5.4%. If not treated effectively, these problems can lead to maternal seizures, antepartum hemorrhage, placenta abruption, coma or death, and early fetal delivery and/or death. Furthermore, these diseases are connected with low child birth weight, and pre-eclampsia has been linked to growth limitation. According to recent research, mothers with pre-eclampsia have higher levels of circulating antiangiogenic factors like soluble fms-like tyrosine kinase 1 (s-flt1) and endoglin (a TGF1 co-receptor) and lower levels of bioactive proangiogenic factors like vascular endothelial growth factor (VEGF) and placental growth factor (PIGF). Furthermore, prospective investigations have shown that changed angiogenic factor concentrations are sensitive predictors of preeclampsia. Because the intrauterine environment is critical for the developing baby, uteroplacental insufficiency in diseases like pre-eclampsia can result in altered fetal vascular programming and short- and long-term problems(2).

Retinopathy of prematurity (ROP) is a retinal vascular disease that causes aberrant vascular development in the retinas of premature infants. Despite the rising survival rate of preterm infants, it remains a primary cause of childhood blindness despite modern surgical and laser treatments. Given its high prevalence and considerable morbidity, identifying risk factors, as well as effective prevention and quick treatment, is critical for maintaining these infants' lifetime vision. Several postnatal variables, such as low birth weight, low gestational age, male gender, and supplemental oxygen therapy, have been linked to the development of ROP(3).

However, the links between prenatal or maternal risk factors and ROP remain poorly understood. When PE is severe, it can result in considerable preterm, which has an impact on infant outcomes due to the severity of the condition. However, pre-eclampsia has been demonstrated to have varying impacts on ROP. Individual studies have demonstrated that PE protects against ROP, probably due to the oxidative stress placed on fetal development. On the other hand, some researchers discovered that PE is a risk factor for developing ROP due to the ischemia and angiogenic stress on retinal vascularization, whilst others found no significant connection(4).

Methods

Aim of the Study

To evaluate association of maternal gestational hypertensive disorders with retinopathy of prematurity (ROP).

Source of the Data

Study Design: hospital-based Case control study.

Study Period: 1.5 years (Jan 2023- Jun 2024)

Sample Size: 200

Place of Study: Department of obstetrics and gynecology, SCB MCH cuttack

Method of Data Collection

Inclusion Criteria of Cases:

1. Babies diagnosed with ROP at/before 34weeks of gestation and/or birth weight <2kg

Inclusion Criteria of Control:

- Babies without ROP at/before 34 weeks of gestation and/or birth weight <2kg

Exclusion Criteria:

- Babies born after 34 weeks and birth weight >=2kg.
- Babies with jaundice, respiratory dysfunction, congenital anomalies, haemolytic disorders, birth trauma, and other neonatal disorders.

Timing of Screening:

- Infants ≤27 weeks' gestation: first screening at 29–30 weeks' postmenstrual age.
- Infants >27 weeks' gestation: first screening at 4 weeks after birth.

Table 1: Maternal age distribution among cases and controls

Maternal age group	Cases (N =100) n (%)	Controls (N=100) n (%)
<20 yrs	0(0)	4(4)
20-24yrs	15(15)	47(47)
25-29yrs	58(58)	44(44)
>=30yrs	27(27)	5(5)

In the study, the maximum percentage of mothers belonged to the age range of 25 to 29 years in case group (58%) & 20 to 24 years in control group (47%). [table 1 & figure 1].

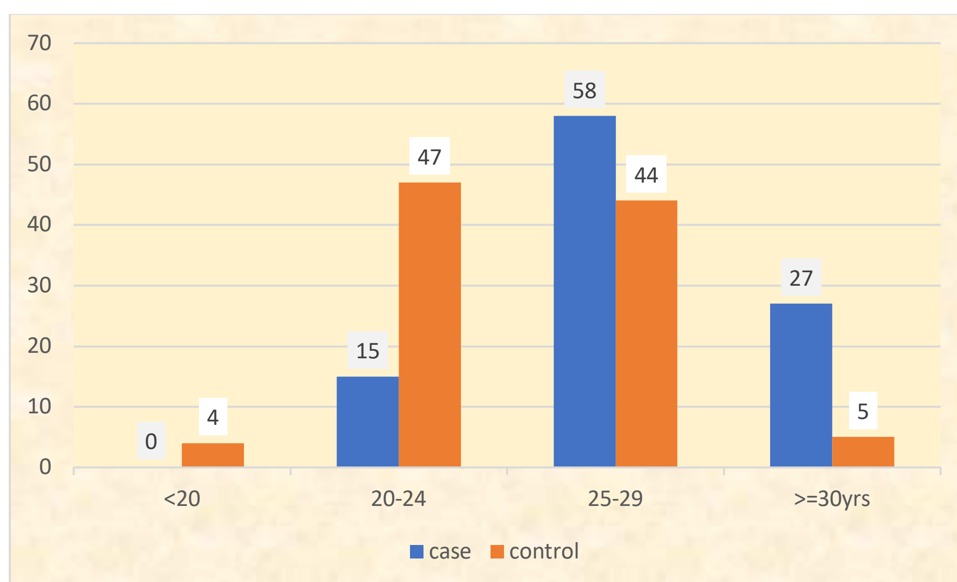

Figure 1: Maternal age distribution among cases and controls

Table 2: Median maternal age among case and control groups

Group	Maternal age in years		P value
	Median	IQR	
Cases (N=100)	27	4	<0.0001
Controls (N=100)	24	4	

Mann Whitney U test

The median age of mothers in the case group was 27years, the age of youngest mother was 20 and of the oldest mother was 35years. [table 2 & figure 2]

The median age of the mothers in the control group was 24years, the age of youngest mother was 18 and that of oldest mother was 31years. [table 2 & figure 2]

Maternal age was statistically significantly higher ($p<0.05$) in case group.

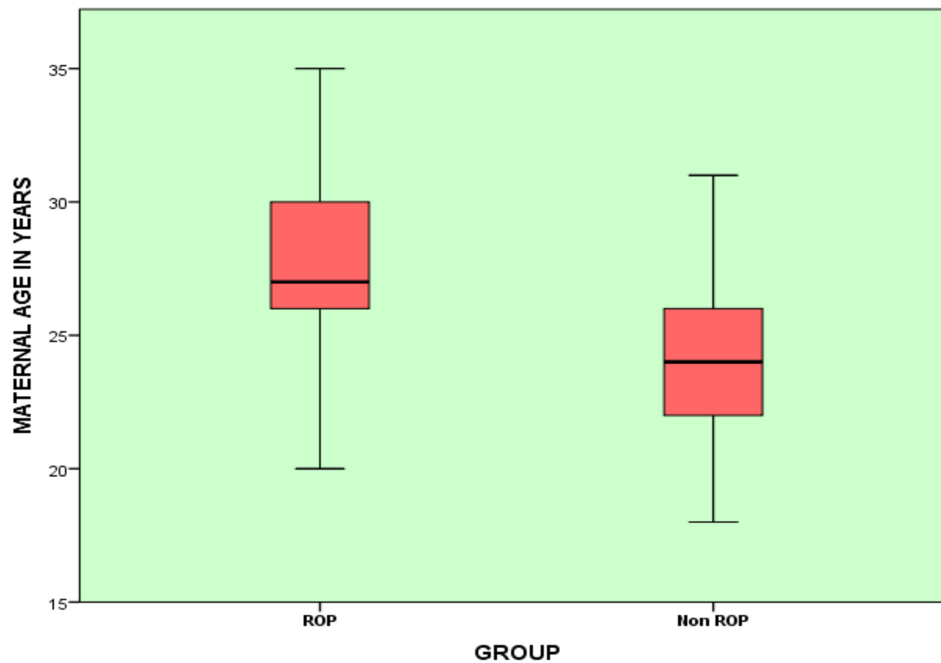

Figure 2: Median maternal age among case and control group

Table 3: Median pregestational BMI among case and control groups

Group	Pregestational BMI		P value
	Median	**IQR**	
Cases (N=100)	23	2.9	**0.025**
Controls (N=100)	24	2	

Mann Whitney U test

The median pregestational BMI of mothers in the case group was 23 & in the control group was 24. [table 3 & figure 3]

Table 4: Gravidity among cases and controls

Gravida	Cases (N=100) n(%)	Controls (N=100) n(%)	P value
G1	60 (60)	68 (68)	**0.157**
G2	26 (26)	26 (26)	
G3	14 (14)	6 (6)	

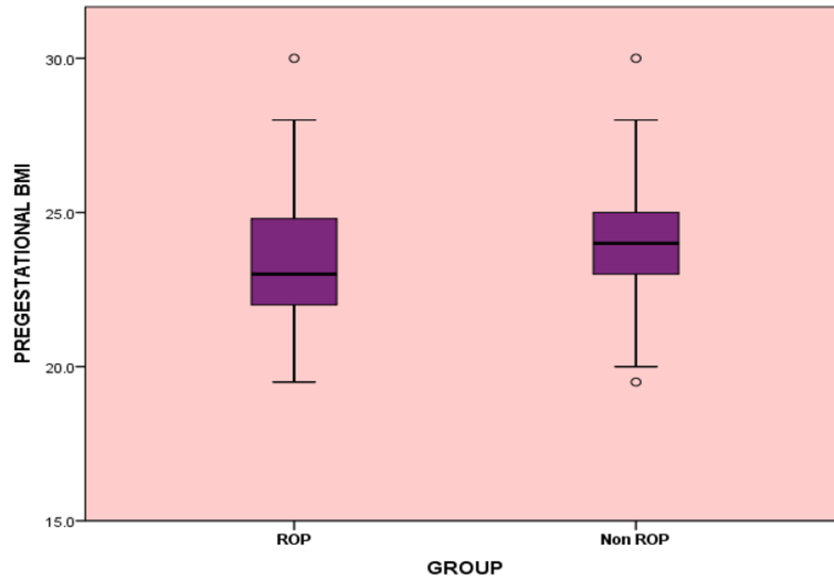

Figure 3: Median pregestational BMI among case and control groups

Chi square test

In our study, in case group 60% (60 cases) were primigravida, 40%(40cases) were multigravida whereas in control group 68% (68 cases) were primigravida and 32%(32 cases) were multi gravida. In both groups maximum mothers are primigravida. [table 4 & figure 4].

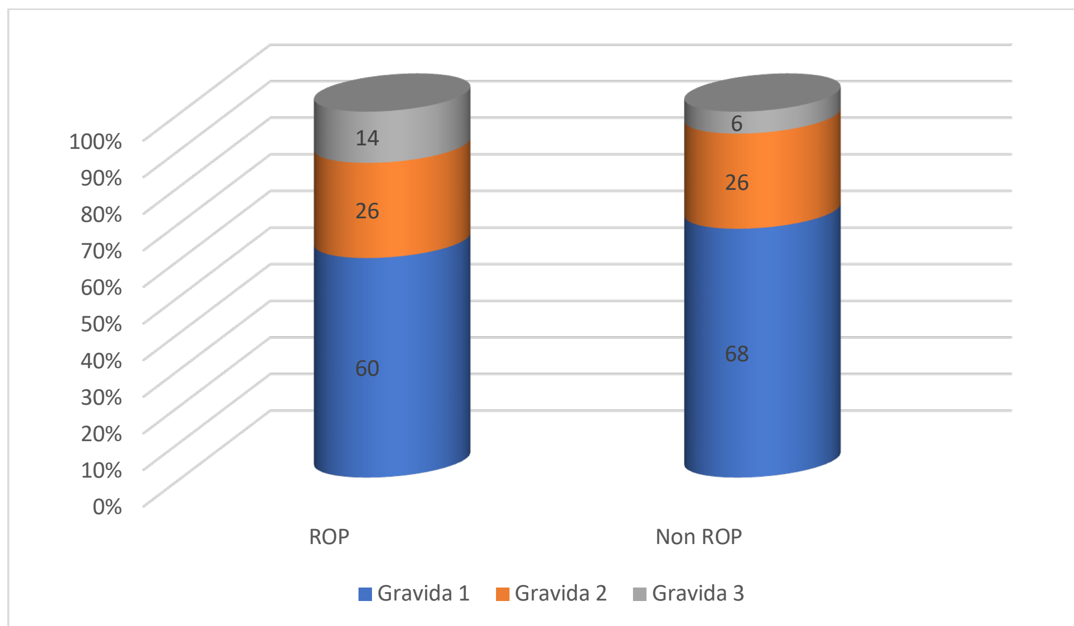

Figure 4: Gravidity among cases and controls

Table 5: Parity among cases and controls

Parity	Cases (N=100) n(%)	Controls (N=100) n(%)	P value
P0	72 (72)	71 (71)	**0.073**
P1	18 (18)	26 (26)	
P2	10 (10)	3 (3)	

Chi square test

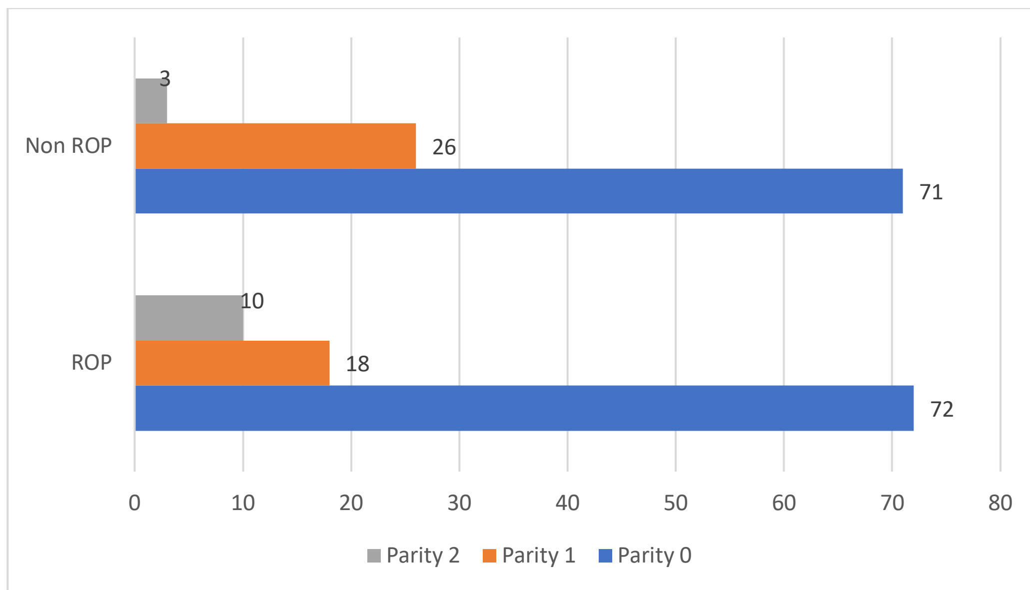

Figure 4: Parity among cases and controls

Table 6: Distribution of no of fetus among cases and controls

No. of fetus	Cases (N=100) n(%)	Controls (N=100) n(%)	P value
Singleton	95 (95)	95 (95)	**0.574**
Twin	4 (4)	5 (5)	
Triplet	1 (1)	0 (0)	

Chi square test

In our study, in both groups 90% (95 cases) were singleton pregnancy. 4%(4 cases) were twin & 1% (1 case) was triplet among case group whereas in control group 5% (5 cases) were twin without any statistical significance.[table 6 & figure 6]

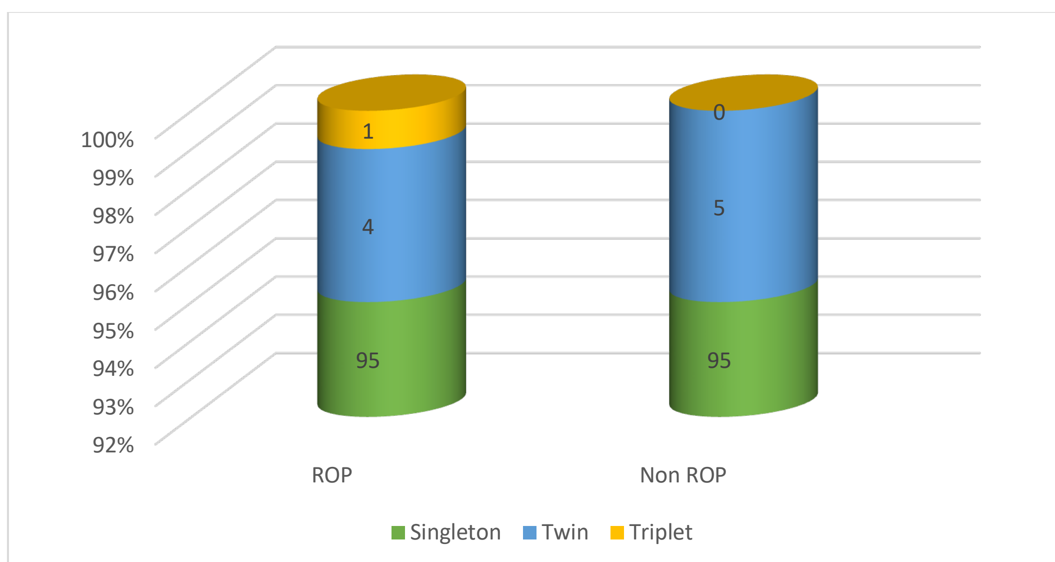

Figure 6: Distribution of no of fetus among cases and controls

Table 7: Mode of delivery among cases and controls

Mode of delivery	Cases (N=100) n(%)	Controls (N=100) n(%)	P value
VD	66 (66)	62 (62)	
C section	34 (34)	38 (38)	**0.556**

Chi square test

Out of 100 cases, 66% were delivered by vaginal delivery & 34% were delivered by c-section; Out of 100 controls, 66% were delivered by vaginal delivery & 34% were delivered by c-section in our study. There was no statistical significance difference. [table 7 & figure 7]

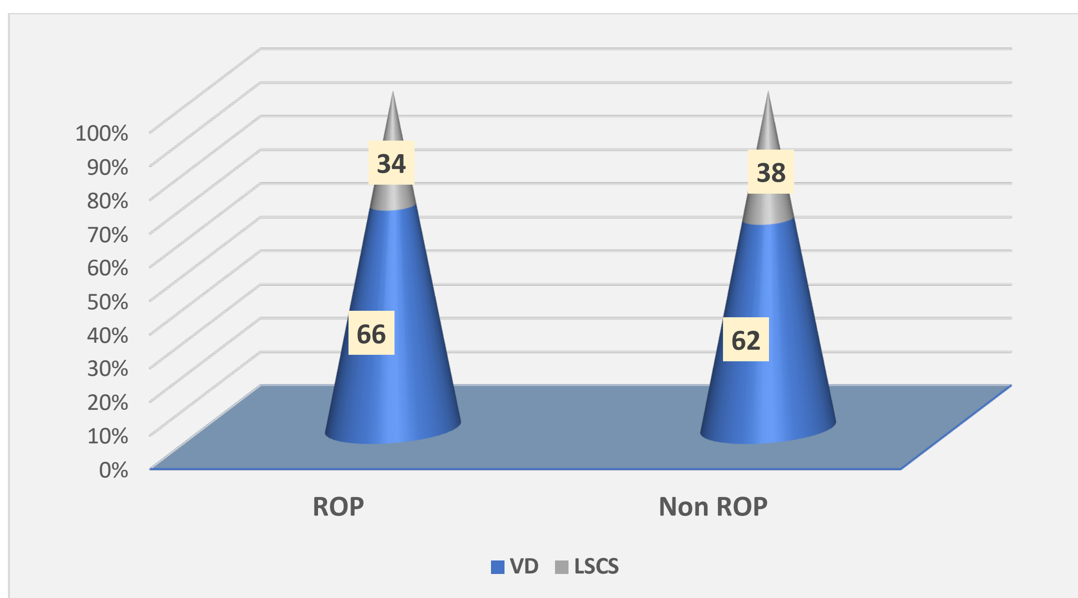

Figure 7: Mode of delivery among cases and controls

Table 8: maternal gestational hypertensive disorders (HDP) among cases and controls

HDP	Cases (N=100) n(%)	Controls (N=100) n(%)	P value
Present	52 (52)	31 (31)	
Absent	48 (48)	69 (69)	**0.003**

Chi square test

Maternal gestational hypertensive disorders were statistically significantly (p value <0.05) higher among ROP group (52%) compare to control group (31%). [table 8 & figure8]

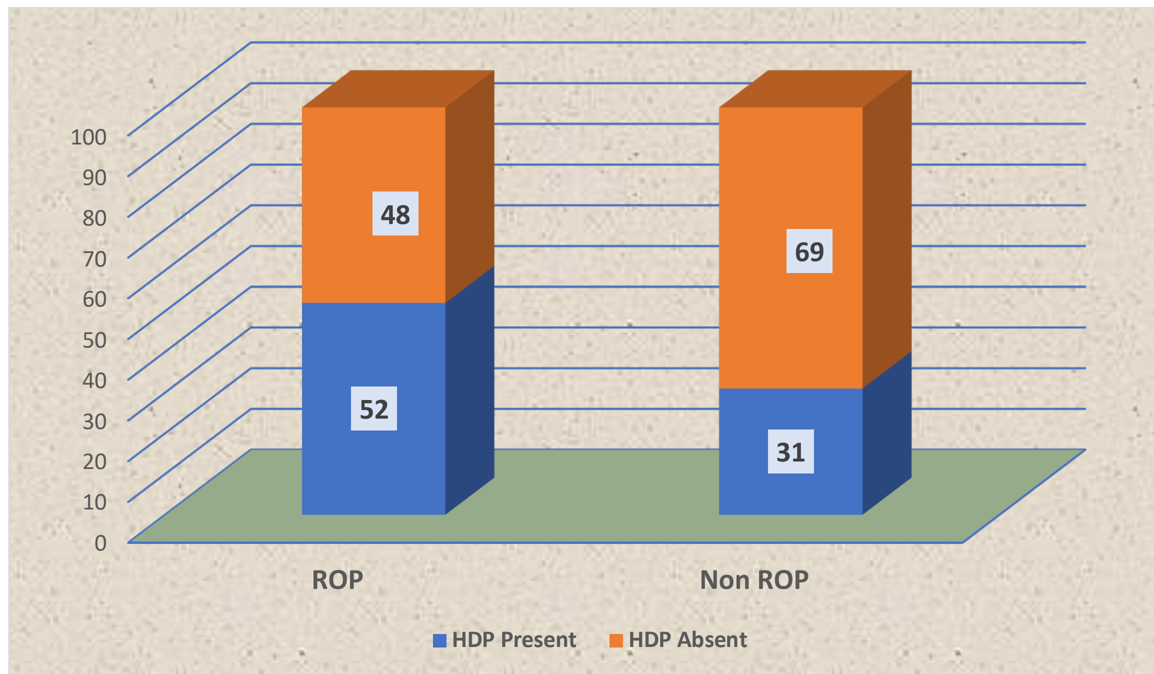

Figure 8: maternal gestational hypertensive disorders (HDP) among cases and controls

Table 9: Distribution of type of HDP among cases and controls

Type of HDP	Cases (N=100) n(%)	Controls (N=100) n(%)	P value
GHTN	2 (2)	1 (1)	**0.025**
Pre eclampsia	47 (47)	29 (29)	
Eclampsia	3 (3)	1 (1)	
Without HDP	48 (48)	69 (69)	

Chi square test

In our study 52% of preterm infants with ROP had maternal gestational hypertension distributed over spectrum of HDP as 47% preeclampsia,3% eclampsia,2% gestational hypertension & 31% of preterm infants without ROP had maternal gestational hypertension distributed over spectrum of HDP as 29% preeclampsia, 1% eclampsia, 1% gestational hypertension. [table 9 & figure 9]

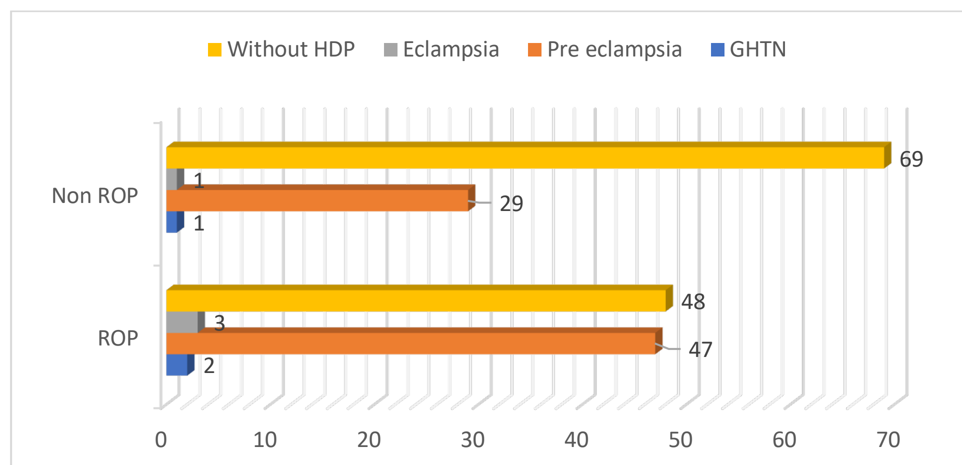

Figure 9: Distribution of type of HDP among cases and controls

Table 10: Distribution of other maternal disorders among cases and controls

		Cases (N=100) n(%)	Controls (N=100) n(%)	P value
GDM	Present	4 (4)	3 (3)	**1.0**
	Absent	96 (96)	97 (97)	
Pregestational DM	Present	1 (1)	2 (2)	**1.0**
	Absent	99 (99)	98 (98)	
Heart disease	Present	1 (1)	2 (2)	**1.0**
	Absent	99 (99)	98 (98)	
Seizure disorders	Present	1 (1)	2 (2)	**1.0**
	Absent	99 (99)	98 (98)	
Asthma	Present	4 (4)	6 (6)	**0.51**
	Absent	96 (96)	94 (94)	
Thyroid disorders	Present	8 (8)	9 (9)	**0.8**
	Absent	92 (92)	91 (91)	

Fisher's exact test

In our study out of 100 preterm infants with ROP; 4% had GDM, 1% had pregestational DM, 1% had maternal heart disease, 1% had maternal seizure disorder, 4% had maternal asthma, 8% had maternal thyroid disorders. In control group proportion of maternal medical disorders were 3%, 2%, 2%, 2%, 6%, 9% respectively without any statistical significance. [table 10 & figure10]

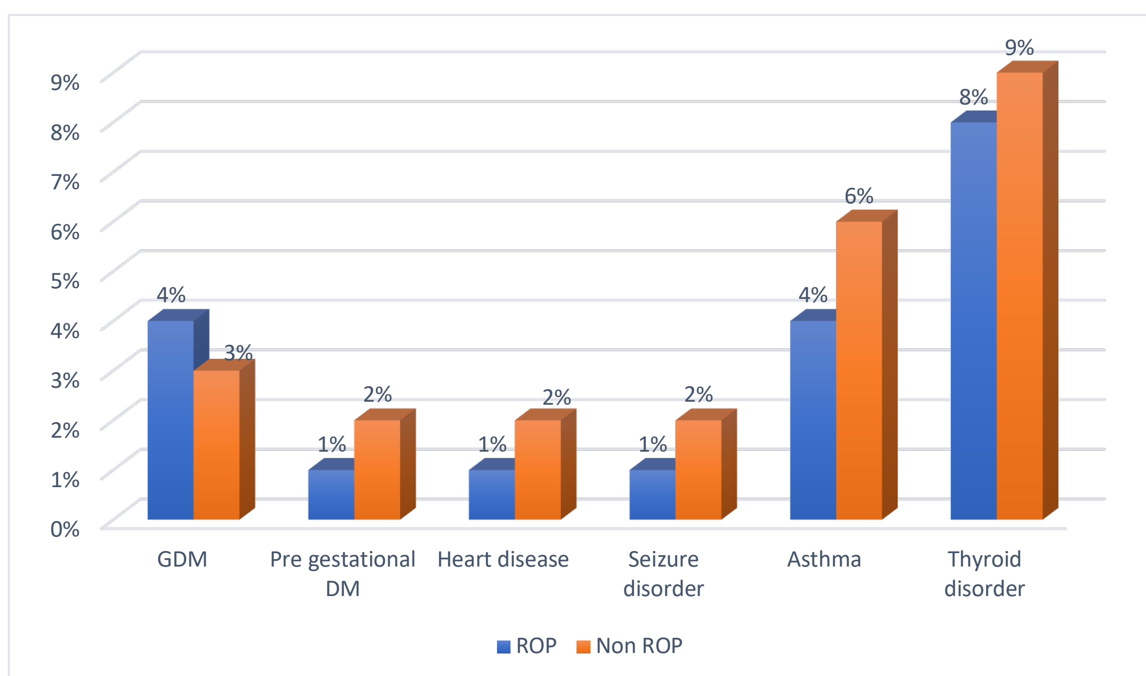

Figure 10: Distribution of other maternal disorders among cases and controls

Table 11: Gender distribution among cases and controls

Gender of the baby	Cases (N=100) n(%)	Controls (N=100) n(%)	P value
Male	64 (64)	40 (40)	
Female	36 (36)	60 (60)	**0.001**

Chi square test

According to gender 64% were male & 36% were female in the ROP group; 40% were male & 60% were female in non-ROP group. Male infants were being more affected with statistically significant difference ($p<0.05$). [table 11 & figure 11]

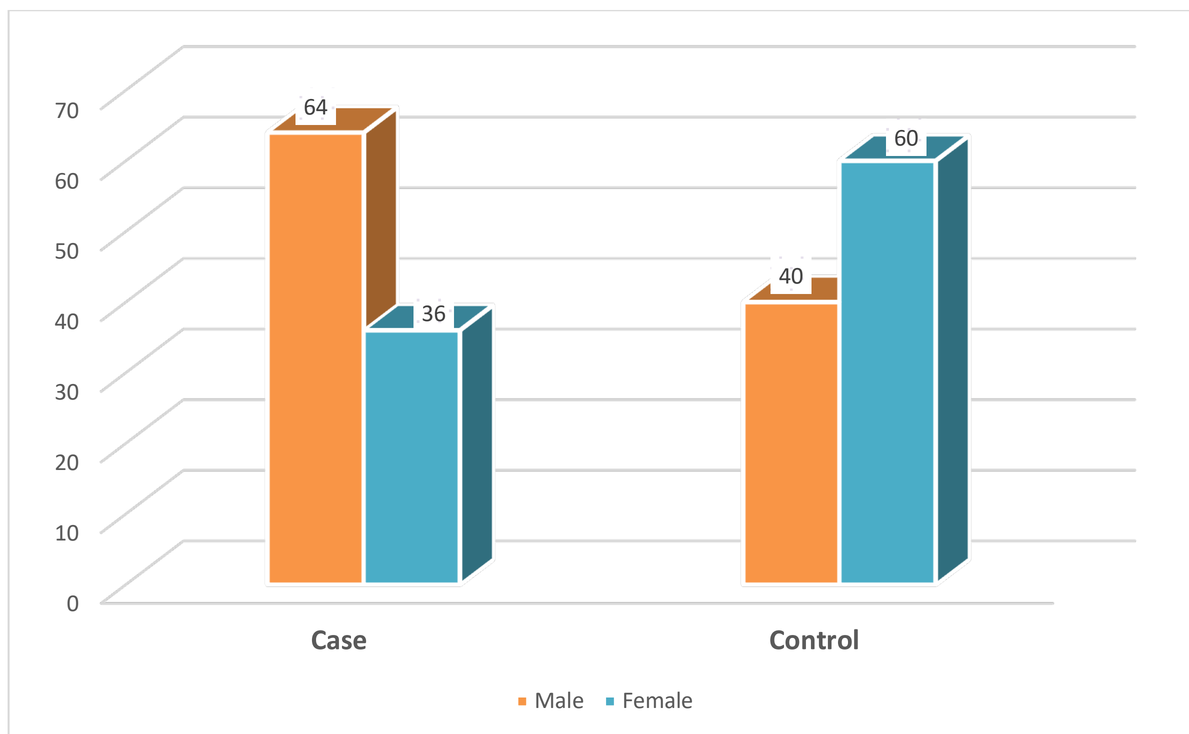

Figure 11: Gender distribution among cases and controls

Table 12: Gestational age distribution among cases and controls

Gestational age	Cases (N =100)	Controls (N=100)
< 30wks	3	1
30-34wks	80	58
>34wks	17	41

In our study maximum number of infants were delivered between 30 to 34 weeks in both groups; 80% in case group & 58% in control group. [table 12& figure 12]

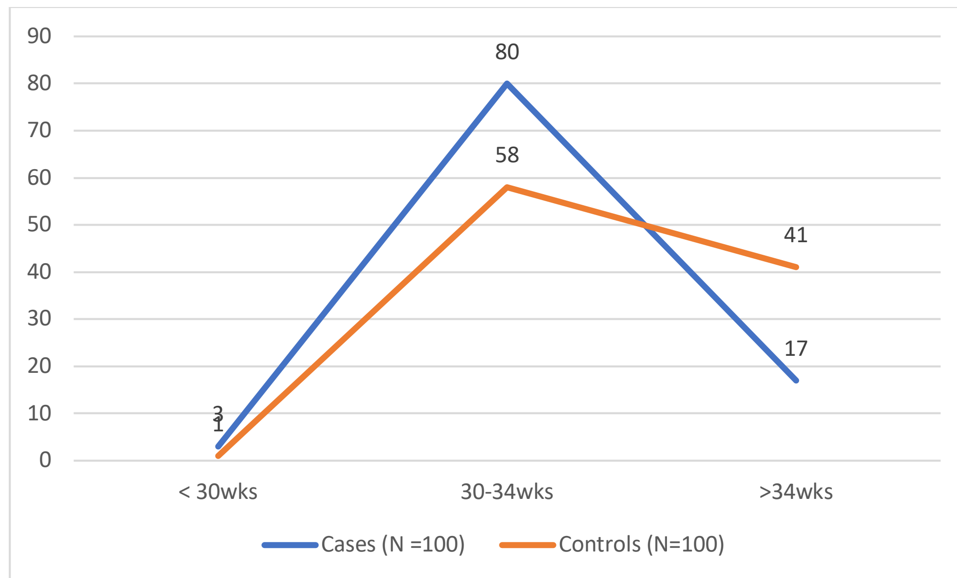

Figure 12: Gestational age distribution among cases and controls

Table 13: Median Gestational age at delivery of cases and controls

Group	Gestational age in weeks		P value
	Median	**IQR**	
Cases (N=100)	32.35	1.9	**<0.0001**
Controls (N=100)	33.4	1.8	

Mann Whitney U test

Analysis of gestational age indicates that patients who developed ROP were statistically significantly (P<0.05) born earlier with median GA of 32.35±1.9weeks compared to those who did not develop ROP–33.4±1.8 week. [table 13& figure 13]

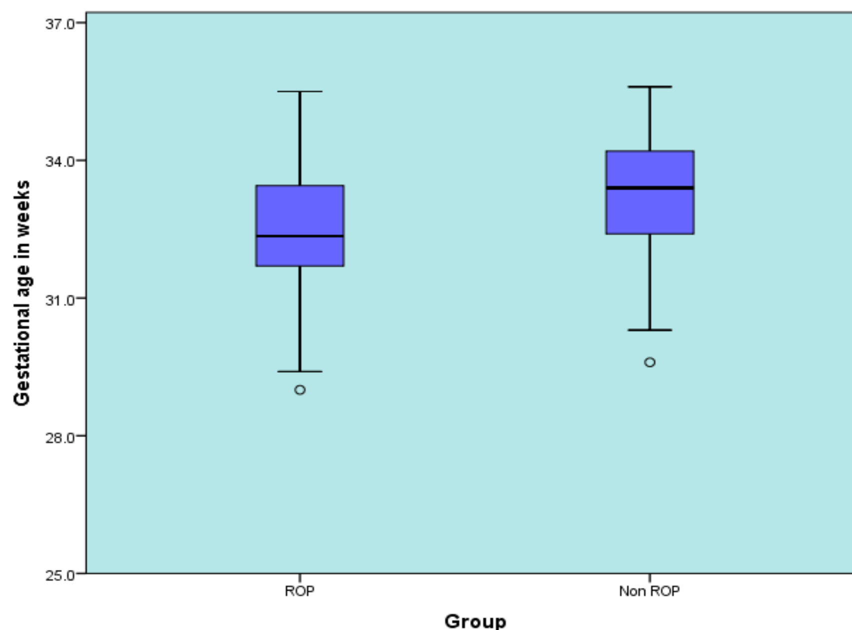

Figure 13: Median Gestational age at delivery of cases and controls

Table 14: Birth weight distribution among cases and controls

Birth weight	Cases (N =100)	Controls (N=100)
< 1.3kgs	5	1
1.3-1.5kgs	37	31
1.5-1.7kgs	45	30
>1.7kgs	13	38

In our study maximum number of infants in case group were delivered with birth weight between 1.5-1.7 kgs (45%) & in control group >1.7kgs (38%). [table 14& figure 14]

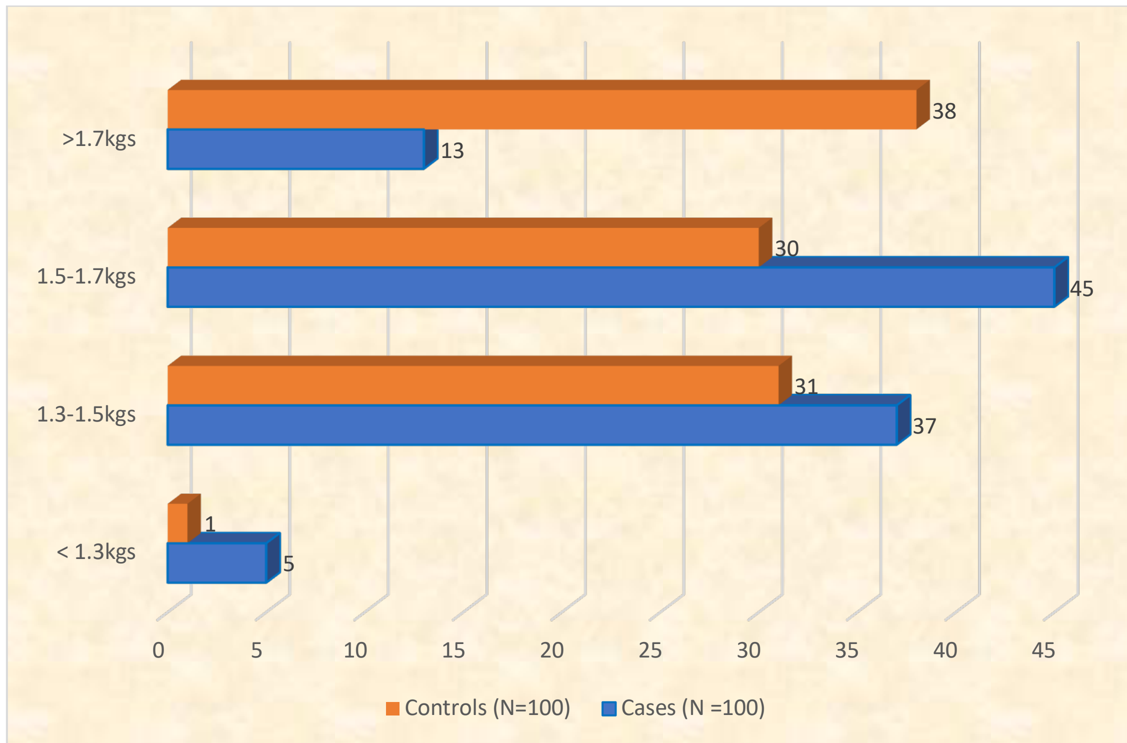

Table 14: Birth weight distribution among cases and controls

Table 15: Median Birth weight of cases and controls

Group	**Birth weight**		**P value**
	Median	**IQR**	
Cases (N=100)	1.5	0.2	**<0.0001**
Controls (N=100)	1.6	0.3	

Mann Whitney U test

Birth weight was statistically significantly lower in patients who developed ROP with median birth weight 1500±200 grams compared to patients who did not develop ROP 1600±300 grams. [table 15 & figure15]

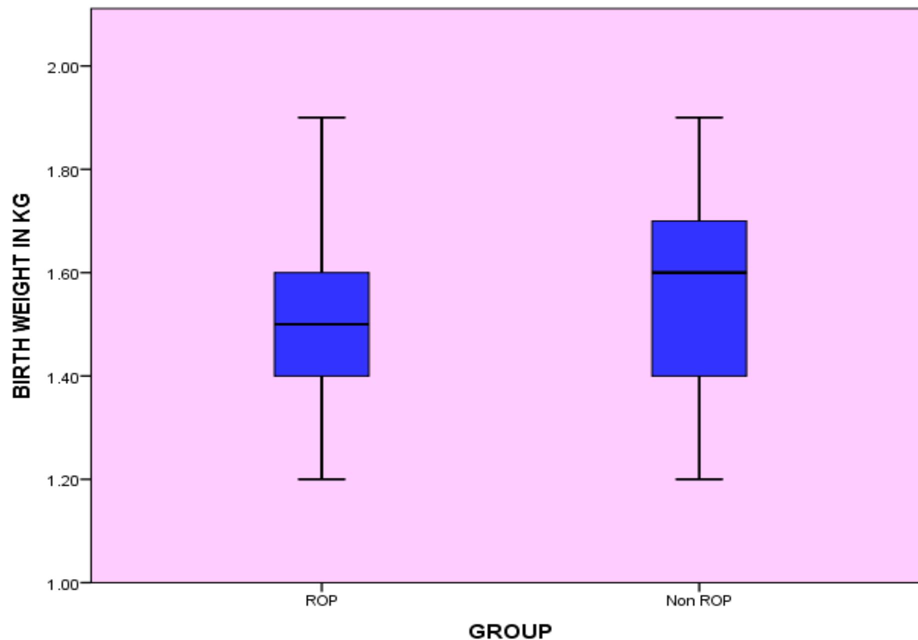

Figure 15: Median Birth weight of cases and controls

Table 16: Distribution of type of resuscitative measures among cases and controls

Resuscitative measures	Cases (N=100) n(%)	Controls (N=100) n(%)	P value
Oxygen only	12 (12)	37 (37)	**<0.0001**
BMV	24 (24)	23 (23)	
Intubation	64 (64)	40 (40)	

Chi square test

In our study in the case group 12% of premature infants received oxygen only, 24% received BMV & 64% were intubated and in the control group 37% of premature infants without ROP received oxygen only, 23% received BMV & 40% were intubated. There was statistical significant difference between 2 groups ($p<0.05$). [table 16 & figure 16]

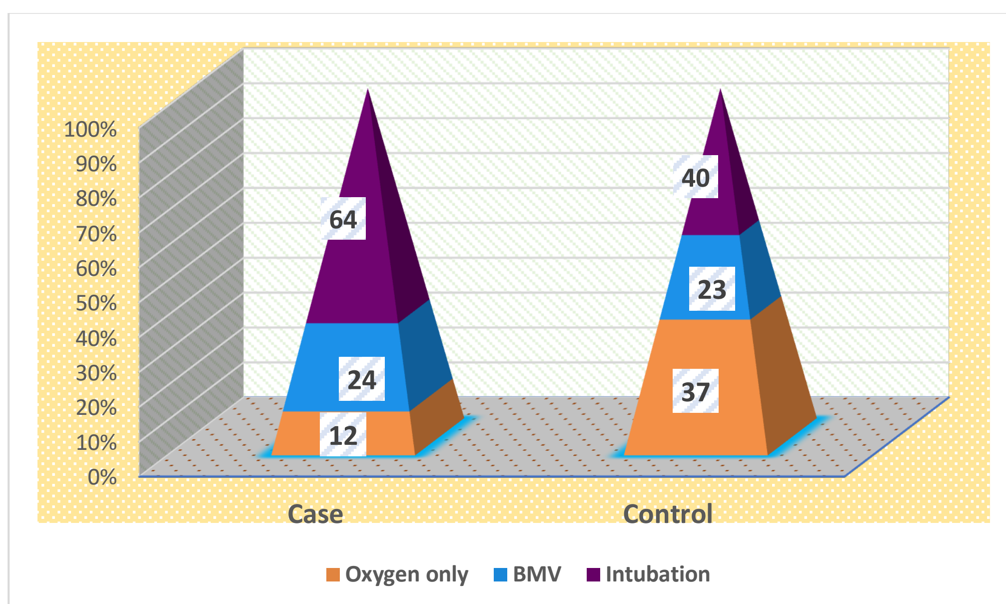

Figure 16: Distribution of type of resuscitative measures among cases and controls

Table 17: Multivariable Logistic regression

Risk factors	ROP n(%)	aOR	95% CI	P value
HDP				
Present	52 (52)	2.275	1.102 – 4.699	0.026
Absent	48 (48)	Ref		
Maternal age (in years)	…..	1.448	1.262 – 1.662	<0.0001
Gestational age (in Week)	…..	0.618	0.461 – 0.828	0.001
Birth weight (in Kg)	…..	0.116	0.008 – 1.612	0.109
Gender of baby				
Male	64 (64)	3.262	1.565 – 6.799	0.002
Female	36 (36)	Ref		
Resuscitative measures				
	24 (24)	2.839	0.916 – 8.797	0.070
BMV	64 (64)	1.555	0.506 – 4.782	0.441
Intubation	12 (12)	Ref		
Oxygen only				

Table 17 shows the associations between HDP and risk of ROP after adjusting for maternal age, gestational age at delivery, birth weight, gender, resuscitative measures at birth. HDP had a significantly increased risk of ROP. The overall relative risk was 2.275 (95% confidence interval [CI], 1.102–4.699) for HDP. Also maternal age, gestational age at delivery, gender associated with increased risk of ROP.

Discussion

The current case-control study examined various maternal and neonatal risk factors for the development of retinopathy of prematurity (ROP) in 200 preterm newborns. 100 newborns got ROP, and 100 acted as controls. The findings emphasise the complex nature of ROP and the importance of both maternal and postnatal factors(5).

Maternal age was found to be a statistically significant predictor of ROP, with the case group having a greater maternal age. This finding is consistent with prior research, such as Wu et al., which identified higher maternal age as a risk factor. However, contrary evidence from other studies suggests that lower maternal age may also contribute, implying that maternal age may interact with other confounding factors(4).

STUDY	YEAR	STUDY DESIGN	SAMPLE SIZE	PHENOTYPE OF HDP	ADJUSTED OR	CONFIDENCE INTERVAL
Shah	2005	Case control study	564	preeclampsia	2.51	1.32-4.7
Yang	2011	Case control study	216	preeclampsia	2.52	1.32-4.7
Forte filho	2011	Prospective cohort	324	preeclampsia	0.41	0.2-0.82
Gebsce	2016	Case control study	219	preeclampsia	3.2	1-11.5
Shulman	2017	Retrospective cohort	290992	preeclampsia	6.07	4.72-7.79
Lu	2018	Prospective cohort	773	HDP	1.43	0.3-5.2
MY STUDY	2024	Case control study	200	HDP		

Maternal pregestational BMI and obstetric score were not shown to be significantly associated with ROP, implying that these factors may not influence disease development independently. Similarly, in this study, mode of delivery and gestation type (single vs multiple) were not substantially related with ROP, despite earlier research indicating inconsistent results(6).
This study's major conclusion was a significant relationship between hypertensive disorders of pregnancy (HDP) and ROP ($p = 0.003$). A larger proportion of infants with ROP were born to moms with HDP, namely preeclampsia. This is consistent with other studies identifying HDP as a risk factor for placental insufficiency and fetal development restriction. However, several research have revealed a protective function for preeclampsia, emphasizing the complexities of its interaction with ROP(7).

Other maternal comorbidities, such as diabetes, thyroid problems, asthma, and heart disease, had no significant association with ROP in this study. These diseases may contribute indirectly, raising the likelihood of preterm birth, rather than directly altering retinal pathology. Among neonatal variables, male gender was substantially related with ROP, validating prior research that identified male sex as a risk factor. Furthermore, shorter gestational age and birth weight were identified as the most important factors of ROP, consistent with global findings. Preterm newborns' retinal vascularization is immature, making them more susceptible to oxidative stress and aberrant vascular proliferation(8).

Oxygen therapy has identified as an important independent risk factor for ROP. A greater proportion of newborns with ROP needed urgent respiratory care, including intubation. This study complements previous research linking high or unregulated oxygen exposure to retinal impairment. Finally, our study confirms that ROP is influenced by a combination of maternal and neonatal variables, specifically gestational age, birth weight, oxygen therapy, and hypertensive diseases of pregnancy. Early detection and close monitoring of these risk variables are critical for prompt screening and illness progression prevention(9).

Conclusion

In conclusion, the findings of this study show that hypertensive disorders of pregnancy, short gestational age, advanced maternal age, and male gender are all related with a considerably higher risk of ROP in preterm birth. Because our study was time-limited and had a small sample size, future investigations with larger databases are needed to gain a better understanding of the links between these maternal diseases and newborn ROP. Future research explaining the mechanisms underlying these findings may lead to a better knowledge of retinal angiogenesis in health and illness.

References

1. Hitachi M, Miyamichi K, Honda S, Wanjihia V, Nzou SM. The association between 2017 American College of Cardiology / American Heart Association guideline for hypertension and neonatal outcomes in Kenya : a retrospective study. Trop Med Health [Internet]. 2025;53(41):1–9.
2. Chan PYL, Tang S, Au SCL, Rong S, Lau HHW, Ko STC, et al. Association of Gestational Hypertensive Disorders with Retinopathy of prematurity : A Systematic Review and Meta- analysis. Sci Rep [Internet]. 2016;6(August):1–9.
3. Zayed MA, Uppal A, Hartnett ME. New-Onset Maternal Gestational Hypertension and Risk of Retinopathy of Prematurity. IOVS. 2010;51(10):4983–8.
4. Zhu T, Zhang L, Zhao F, Qu Y, Mu D. Association of maternal hypertensive disorders with retinopathy of prematurity : A systematic review and

meta-analysis. PLoS One. 2017;12(4):1–11.
5. Ge Ge YZ and MZ. Pregnancy-induced hypertension and retinopathy of prematurity a meta-analysis. Acta Ophthalmol. 2021;99:1263–73.
6. Jacob N, Kasturi N, Deb AK, Maurya DK. Correlation between hypertensive retinopathy and fetal outcomes in patients with preeclampsia in a tertiary care hospital : A prospective cohort study. Indian J Ophthalmol. 2023;71(March):910–5.
7. Palmrich P, Haase N, Sugulle M, Kalafat E, Khalil A, Binder J. Maternal haemodynamics in Hypertensive Disorders of Pregnancy under antihypertensive therapy (HyperDiP): study protocol for a prospective observational case – control study. BMJ Open. 2023;13(e065444):1–6.
8. Shen L, Zheng R, Sun X, Chen S. Development and validation of a multivariate nomogram for predicting retinopathy of prematurity in infants with gestational age ≤ 34 weeks. Front Pediatr. 2025;13(May):1–9.
9. Sharma JC, Choudhary B, Maru L, Mathur P. The retina in hypertensive disorders of pregnancy : a study of the prevalence and association with severity of disease in a tertiary referral centre in India. Int J Reprod Contraception, Obstet Gynecol. 2020;9(1):375–82.