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Research Article

"Refractive Error Type In Preterm Infants With And Without ROP"

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ABSTRACT

Retinopathy of prematurity (ROP) is a devastating eye disorder that occurs in premature infants due to abnormal retinal vascularization. ROP's consequences go beyond the immediate risk of retinal detachment; in severe situations, it can cause a kid to suffer with visual issues for the rest of their life. It can also make it difficult for a toddler to focus and see well at different distances. A refractive defect is an imperfection in the eye's normal shape that causes vision to blur. Refractive errors are one of the most common types of vision problems. The goal of this research is to see if there is a link between refractive morbidity and preterm delivery, retinopathy of prematurity (ROP), or both. The research used an observational retrospective design. Data will be collected from babies who match the inclusion criteria born between July 2018 and July 2023. **SPSS**software will be used to conduct statistical investigations. To summarize the data, we shall employ descriptive statistics. Comparative statistics will be used to assess the relationships between variables. A 95% confidence interval will be utilized for all statistical investigations. A p-value of less than 0.05 is regarded as statistically significant.

Key-word: Refractive error, spontaneous regressed, retinopathy of prematurity (ROP), Child

Introduction

Retinal vascular ischemia, hypoxia, and hypoplasia brought on by premature delivery can cause retinopathy of prematurity (ROP). Premature babies are very susceptible to ROP, birth before term the retina remain undeveloped and abnormal vessel development known as ROP. While ROP usually resolves or regresses in its early stages known as spontaneous regressed ROP, more advanced stages required early treatment, if not done can result blindness or severe visual impairment, it is important to necessitating proper medical attention.Recent advances in neonatology, on the other hand, have resulted in dramatic increases in survival rates. A child's visual health could be seriously jeopardized by this issue, which can result in retinal detachment and permanent vision impairment. A child's visual health could be seriously jeopardized by this issue, which can result in retinal detachment and permanent vision impairment.(1)
The anterior chamber, cornea, and lens are the main structures in the front of the eye that are affected by myopia in preterm infants. Myopia is characterized by difficulties focusing on distant objects, which can be caused by anatomical changes in the eye. Low birth weight, the severity of ROP, and possible adverse effects from ROP management therapies are all linked to the development of myopia in preterm newborns.(2)
Furthermore, myopia and other refractive abnormalities are common in ex-premature infants, and they are more common in severe ROP cases. In these cases, myopia is noted in more than 65 percent of treated eyes, emphasizing its close relationship to this serious retinal disease. Furthermore, more than 23% of treated eyes have astigmatism, which can result in distorted or impaired vision from unevenly shaped corneas or lenses. Furthermore, about 5% of newborns with ROP exhibit hypermetropia, sometimes referred to as farsightedness.(3)

The effects of ROP go beyond the immediate risk of retinal detachment; in extreme cases, it can cause a kid to battle with vision abnormalities for the rest of their life. It can also damage a child's ability to focus and see properly at different distances. Giving these kids the greatest opportunity possible for a functioning and healthy visual future requires acknowledging and treating the visual effects of ROP. Thus, treating the wide range of vision-related issues linked to ROP requires early intervention and thorough eye care.

Retinopathy of Prematurity (ROP)

Retinal vascular disease known as ROP in premature infants can cause significant visual impairment If not detected and treated in a timely manner. (4)Preterm baby survival has grown dramatically over the past 20 years worldwide, particularly in nations like India, where over 3.5 million preterm babies are born and survive each year. (5) ROP in India and other developing nations is also known as the "third epidemic" and is caused by a combination of two epidemic patterns: uncontrolled supplemental oxygen (first epidemic pattern) and evolving but inconsistent care of very preterm children (second epidemic pattern). (6),(7) Early-life blindness is regarded as a developmental emergency since it can result in a significant loss of life years with a disability .

Thirty years ago, residual paralysis from wild poliovirus was the most common kind of disability in developing countries. It was endemic in 125 countries and produced over 350,000 cases of paralysis annually, most of which were children. With the intention of eradicating polio by the year 2000, “the World Health Assembly responded by establishing the Global Polio Eradication Initiative (GPEI), the largest partnership between the public and commercial health sectors.”**(Aylward& Tangermann, 2011)**, (9)The eradication of polio is almost complete today**.** (10)In the post-polio phase, there is a significant danger of severe, irreversible visual damage from untreated ROP. A child's whole development and quality of life are negatively impacted by blindness, which is a serious disability. Childhood blindness can have significant long-term impacts on a child's and family's social, educational, and employment chances. Childhood-onset blindness can have greater detrimental impacts than blindness that develops later in life.(11),(12)

ROP was associated with 32,200 cases of blindness and visual impairment worldwide in 2010, with middle-income nations being the primary victims of the illness. About 10% of the global estimate is accounted for by India alone, where 2900 children survive with vision impairment and 5000 children are projected to have severe ROP**.** (13)**.** There are few epidemiological data on ROP-related blindness in India. It's crucial to take note of the current rise in research from different parts of India detailing surgical techniques and results for stage 4 and 5 ROP. The advanced stages of the disease are attributed to inadequate follow-up protocols and delayed referrals. (15)**,**(16)**,**(17)**.** These are among the key lessons that may be drawn from GPEI**.(Aylward& Tangermann, 2011)**

Refractive error

Refractive error (RE), a condition in which the eye is unable to concentrate light rays from objects onto the retinal plane, is the cause of fuzzy visuals. The three types of refractive errors are astigmatism (“no single point of focus in the eye”), hyperopia (long sightedness), and myopia (short sightedness). When two eyes have different refraction powers, it is called anisometry. (18)

Refractive error is one of the most common and important causes of visual impairment; in high-income nations, it accounts for a considerable 47% of cases. RE has a significant effect in emerging nations, perhaps leading to lower economic output.

RE has an impact on people's life at all ages, making it harder for them to do daily chores, reducing their vision, and ultimately leading to blindness. Although it affects people of all ages, it is believed that children are more affected than adults because of the longer delay. The main source of refractive error in adults is nuclear sclerosis, which exhibits a rising tendency as sclerosis increases but then decreases following correction.(19)**,** (20)

Vision 2020, a visionary project started in 1999, has concentrated its efforts on treating particular primary causes of “visual impairment and blindness” in an effort to end avoidable blindness. Prevalence, social impact, treatability, and cost-effectiveness are some of the factors that go into determining these priorities. One of the main areas of concern among these concerns is refractive error. Worldwide, an estimated 12.8 million children between the ages of 9 and 15 have refractive abnormalities, which affect their vision.(21)

According to reports, children are the most susceptible group in the population, with many experiencing vision impairment for the rest of their life. Over the past 20 years, refractive error has garnered significant attention, with school-age children being more susceptible than the general population (21). Rather, they pinch their eyes, sit close to the board, and even skip tasks that call for good eyesight in an attempt to make up for their vision issues.(22)

Data on the prevalence of visual impairment were obtained from an extensive nationwide blindness survey carried out in Ethiopia in 2006. Following cataract (42.3%) as the most common cause of vision impairment, refractive error came in second place among the causes at 33.4%. As a percentage of blindness, refractive

error was in third place at 11.5%; the top two conditions were trachomatous corneal opacity (7.8%) and cataract (49.9%).
Further disclosing a gender gap, the poll indicated that women were more likely than men to become blind or have impaired eyesight. Specific interventions in eye health care are necessary, as evidenced by the much higher incidence of blindness (1.9% for women versus 1.2% for males) and impaired vision (4.1% against 3.1%) for women.(23)
Many children and adults are experiencing difficulties with their schooling and employment, even though correcting refractive defects is an easy and affordable task that can be completed with the use of corrective eyeglasses. Studies carried out in Nigerian businesses and healthcare institutions have repeatedly shown that refractive error is one of the most common eye disorders and is associated with lower productivity and frequent absenteeism.(22)

Methodology:

Study Design:
This investigation seeks to determine the relationship between refractive morbidity and preterm birth, retinopathy of prematurity (ROP), or both. The study is designed as an observational retrospective study.

Data Collection:
This study collected data from infants born between July 2018 and July 2023 who fulfill the inclusion criteria mentioned below:
- Infants born at less than 37 weeks of Gestational Age (GA).
- Infants with birth weights up to 2000 grams (BW).
- Infants without any congenital eye disorders other than ROP.

Clinical Examination:
All infants enrolled in the study were undergo a thorough clinical examination to ascertain the type and severity of refractive errors, such as myopia, hyperopia, and astigmatism. The examination were administered between 3 and 6 months of age according to the calendar.

Refractive Error Assessment:
Refractive error assessment will be conducted using a streak Retinoscope, which has been demonstrated to be a reliable and accurate method for measuring refractive errors in children. Using tropicamide drops, cycloplegic refractions will be carried out.

Data Collection Variables:
The following data will be collected for each infant:
- Gestational Age (GA) at birth.
- Birth Weight (BW).
- Type and severity of refractive error (myopia, hyperopia, astigmatism).
- Presence or absence of ROP.

Statistical Analysis:
SPSS (Statistical Package for the Social Sciences) software utilized to conduct statistical analyses. We were summarize the data with descriptive statistics. Comparative statistics were used to evaluate the associations between variables.

Data Analysis:
- The prevalence of different refractive errors in preterm infants were determined.
- The association between preterm birth and refractive errors were assessed.
- The relationship between the presence of ROP and the type of refractive error were investigated.
- Chi-squared tests and logistic regression used for these analyses.

Statistical Significance:
A confidence interval level of 95% will be employed for all statistical analyses. A p-value below the threshold of 0.05 will be deemed to have statistical significance.

Objectives:

- To find correlation between gestational age and refractive error in right and left eye.
- To find correlation between birth weight and refractive error in right and left eye.
- To find correlation between treated ROP cases and refractive error in both eyes.
- To distribute type of refractive error with ICROP classification.

Result:

The data analysis reveals several crucial findings. To begin, the strong relationship identified between Gestational Age (GA) and DRR in both the right and left eyes, as well as the significant association between Birth Weight and DRR, suggests that GA and Birth Weight play important roles in the development or regression of DRR. These findings have important implications for understanding the course of DRR and its potential causes. Moving on to subgroup comparisons, it is obvious that not all differences between groups are statistically significant.

Gender		
	Frequency	Percent
Male	136	64.8
Female	74	35.2
Total	210	100.0

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
GA (in weeks)	210	26.00	36.00	31.6333	2.39893
Birth_weight(BW)_gm	210	780.00	2000.00	1506.7048	293.75013
Valid N (listwise)	210				

Table 1.1: Relationship between GA and DRR

Correlations				
		GA (in weeks)	DRR-RE	DRR- LE
GA (in weeks)	Pearson Correlation	1	.241**	.231**
	Sig. (2-tailed)		.000	.001
	N	210	210	210
DRR-RE	Pearson Correlation	.241**	1	.970**
	Sig. (2-tailed)	.000		.000
	N	210	210	210
DRR- LE	Pearson Correlation	.231**	.970**	1
	Sig. (2-tailed)	.001	.000	
	N	210	210	210
**. Correlation is significant at the 0.01 level (2-tailed).				

The above table discusses relation between GA and DRR in which sig. value is 0.00 (with right and left eye) which is significant shows correlation between GA and DRR.

Table 1.2: Relationship between Birth weight and DRR

Correlations				
		Birth_weight(BW)_gm	DRR-RE	DRR- LE
Birth_weight(BW)_gm	Pearson Correlation	1	.137*	.159*
	Sig. (2-tailed)		.048	.021
	N	210	210	210
DRR-RE	Pearson Correlation	.137*	1	.970**
	Sig. (2-tailed)	.048		.000
	N	210	210	210
DRR- LE	Pearson Correlation	.159*	.970**	1
	Sig. (2-tailed)	.021	.000	
	N	210	210	210
*. Correlation is significant at the 0.05 level (2-tailed).				
**. Correlation is significant at the 0.01 level (2-tailed).				

The above table discusses relation between Birth weight and DRR in which sig. value is 0.00 (with right and left eye) which is significant shows correlation between Birth weight and DRR.

Correlations				
		Treatment done_Regressed ROP	DRR-RE	DRR- LE
Treatment done_Regressed ROP	Pearson Correlation	1	-.303**	-.283**
	Sig. (2-tailed)		.000	.000
	N	210	210	210

DRR-RE	Pearson Correlation	-.303**	1	.970**
	Sig. (2-tailed)	.000		.000
	N	210	210	210
DRR- LE	Pearson Correlation	-.283**	.970**	1
	Sig. (2-tailed)	.000	.000	
	N	210	210	210
**. Correlation is significant at the 0.01 level (2-tailed).				

The above table discusses relation between Birth weight and DRR in which sig. value is 0.00 (with right and left eye) which is significant shows correlation between Birth-weight and DRR.

Group Statistics					
	ICROP-RE_FINAL visit	N	Mean	Std. Deviation	Std. Error Mean
DRR-RE	13.00	55	4.2545	1.35015	.18205
	14.00	90	4.2333	1.30728	.13780
DRR- LE	13.00	55	4.2545	1.33636	.18019
	14.00	90	4.2222	1.33894	.14114

Independent Samples Test								
		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
DRR-RE	Equal variances assumed	.005	.941	.094	143	.926	.02121	.22654
	Equal variances not assumed			.093	111.412	.926	.02121	.22833
DRR- LE	Equal variances assumed	.000	.994	.141	143	.888	.03232	.22900
	Equal variances not assumed			.141	114.445	.888	.03232	.22889

The above table discusses Comparison between spontaneous regresses ROP and Fully vascularized retina, In DRR-RE, F value is 0.00 and Sig. value is 0.94 and In DRR- LE, F value is 0.00 and Sig. value is 0.99.

Group Statistics					
	ICROP-RE_FINAL visit	N	Mean	Std. Deviation	Std. Error Mean
DRR-RE	14.00	90	4.2333	1.30728	.13780
	15.00	65	3.3077	1.77591	.22027
DRR- LE	14.00	90	4.2222	1.33894	.14114
	15.00	65	3.3692	1.70082	.21096

Independent Samples Test								
		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
DRR-RE	Equal variances assumed	26.573	.000	3.739	153	.000	.92564	.24758
	Equal variances not assumed			3.563	111.604	.001	.92564	.25983
DRR-LE	Equal variances assumed	19.658	.000	3.491	153	.001	.85299	.24432
	Equal variances not assumed			3.361	117.225	.001	.85299	.25382

The above table discusses Comparison between Fully vascularized retina and Regressing ROP with treatment, In DRR-RE, F value is 26.57 and Sig. value is 0.00 and In DRR- LE,, F value is 19.65 and Sig. value is 0.00.

Group Statistics					
	ICROP-RE_FINAL visit	N	Mean	Std. Deviation	Std. Error Mean
DRR-RE	15.00	65	3.3077	1.77591	.22027
	13.00	55	4.2545	1.35015	.18205

DRR- LE	15.00	65	3.3692	1.70082	.21096
	13.00	55	4.2545	1.33636	.18019

Independent Samples Test								
		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
DRR-RE	Equal variances assumed	20.412	.000	-3.240	118	.002	-.94685	.29226
	Equal variances not assumed			-3.313	116.739	.001	-.94685	.28577
DRR-LE	Equal variances assumed	16.941	.000	-3.128	118	.002	-.88531	.28301
	Equal variances not assumed			-3.191	117.394	.002	-.88531	.27744

The above table discusses the Comparison between Fully vascularized retina and Regressing ROP with treatment, In DRR-RE, F value is 26.57 and Sig. value is 0.00 and In DRR- LE,, F value is 19.65 and Sig. value is 0.00.

ICROP-RE_FINAL visit * DRR-RECrosstabulation									
Count									
		DRR-RE							Total
		.00	1.00	2.00	3.00	4.00	5.00	6.00	
ICROP-RE_FINAL visit	13.00	2	2	3	0	17	28	3	55
	14.00	1	5	6	0	36	32	10	90
	15.00	3	8	18	3	7	22	4	65
Total		6	15	27	3	60	82	17	210

The above table discusses the Distribution between ICROP-RE_FINAL visit *DRR-RE, in spontaneous regresses ROP, Emmetropia is 2, Myomia is 2, Myopic Astigmatism is 3, Myomia>3ds is 0, Hypermetropia is 17, Hypropic astigmatism is 28, and Hypermetropia>3DS is 3. In Fully vascularized retina, Emmetropia is 1, Myomia is 5, Myopic Astigmatism is 6, Myomia>3ds is 0, Hypermetropia is 36, Hypropic astigmatism is 32, and Hypermetropia>3DS is 10. In Regressing ROP with treatment, Emmetropia is 3, Myomia is 8, Myopic Astigmatism is 18, Myomia>3ds is 3, Hypermetropia is 7, Hypropic astigmatism is 22, and Hypermetropia>3DS is 4.

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	44.248[a]	12	.000
Likelihood Ratio	44.656	12	.000
Linear-by-Linear Association	12.185	1	.000
N of Valid Cases	210		
a. 9 cells (42.9%) have expected count less than 5. The minimum expected count is .79.			

ICROP-RE_FINAL visit * DRR- LE Crosstabulation									
Count									
		DRR- LE							Total
		.00	1.00	2.00	3.00	4.00	5.00	6.00	
ICROP-RE_FINAL visit	13.00	1	4	2	0	17	28	3	55
	14.00	2	4	6	0	36	32	10	90
	15.00	2	7	19	3	9	21	4	65
Total		5	15	27	3	62	81	17	210

The above table discusses the Distribution between ICROP-RE_FINAL visit * DRR- LE Cross tabulation, in spontaneous regresses ROP, Emmetropia is 1, Myomia is 4, Myopic Astigmatism is 2, Myomia>3ds is 0, Hypermetropia is 17, Hypropic astigmatism is 28, and Hypermetropia>3DS is 3. In Fully vascularized retina, Emmetropia is 2, Myomia is 4, Myopic Astigmatism is 6, Myomia>3ds is 0, Hypermetropia is 36, Hypropic astigmatism is 32, and Hypermetropia>3DS is 10. In Regressing ROP with treatment, Emmetropia is 2,

Myomia is 7, Myopic Astigmatism is 19, Myomia>3ds is 3, Hypermetropia is 9, Hypropic astigmatism is 21, and Hypermetropia>3DS is 4.

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	42.520[a]	12	.000
Likelihood Ratio	42.075	12	.000
Linear-by-Linear Association	11.007	1	.001
N of Valid Cases	210		
a. 9 cells (42.9%) have expected count less than 5. The minimum expected count is .79.			

Group Statistics					
	Gender	N	Mean	Std. Deviation	Std. Error Mean
DRR-RE	Male	136	3.8897	1.60404	.13754
	Female	74	4.0676	1.39795	.16251
DRR- LE	Male	136	3.9191	1.54946	.13286
	Female	74	4.0541	1.43242	.16652

Independent Samples Test								
		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
DRR-RE	Equal variances assumed	1.081	.300	-.802	208	.423	-.17786	.22171
	Equal variances not assumed			-.835	168.338	.405	-.17786	.21290
DRR-LE	Equal variances assumed	.275	.600	-.619	208	.537	-.13494	.21804
	Equal variances not assumed			-.633	160.388	.527	-.13494	.21303

The above table discusses the Comparison Between male and female, In DRR-RE, F value is 1.08 and Sig. value is 0.30. In DRR-LE, F value is 0.27 and Sig. Value is 0.60.

Table: Abbreviations used:-

ROP	“Retinopathy of prematurity”
A-ROP	“Aggressive retinopathy of prematurity”
NICU	“Neonatal intensive care unit”
GA	“Gestational age”
CA	“Chronological age”
PT	“Preterm”
PMA	“Postmenstrual age”
BW	“Birth Weight”
RJN	“Ratan Jyoti Netralaya”
RF	“Risk factor”
DRR	“Dilated Retinoscopic Refraction”
RE	“Right Eye”
LE	“Left Eye”

Discussion

The p-value indicates a strong relationship between these two variables. This is an important observation because it suggests that GA may play a role in the development or regression of refractive error. It could have significant consequences for understanding the course of the disease.we find a comparable strong association between Birth Weight and DRR, which is consistent with our findings for GA. The low p-value of 0.00 indicates that there is a robust association between Birth Weight and DRR in both the right and left eyes. GA and birth weight appear to be substantially related to DRR. Following that, we'll look at some comparisons between different groupings. The Sig. value of 0.94 in the comparison between "Spontaneously Regresses ROP" and "Fully Vascularized Retina" in the "DRR-RE" category suggests that the difference may not be statistically significant, and the Sig. value of 0.99 in DRR- LE suggests that the difference may not be statistically significant. So, while there is some variation, it may not be significant enough to make important conclusions. However, when "Fully Vascularized Retina" and "Regressing ROP with Treatment" are compared in the same category, we get substantially higher F-values and Sig. values of 0.00, and in DRR- LE, the Sig. value is 0.00. This indicates a considerable difference between both groups. The distribution of

various eye diseases in different subgroups is shown in the cross-tabulation analysis. It's fascinating to see the differences between "Spontaneously Regresses ROP," "Fully Vascularized Retina," and "Regressing ROP with Treatment." These distinctions shed light on the nature of these disorders. Finally, F-values for "DRR-RE" and "DRR-LE" for males and females are 1.08 and 0.27, respectively. The Sig. values are 0.30 and 0.60, both of which are quite high. It shows that in certain circumstances, gender may not have a substantial impact on the outcomes.

In our study we found 27 children had myopia in which 3 children from spontaneous regresses ROP group , 6 children from Fully vascularized retina and 18 children from Regressing ROP with treatment while in other study done by (Wang et al., 2022)(24) There was a 5.08 percent prevalence of myopia in our study's youngest age group (ages 3-5), but it was seen only in children with ROP. In our study, 82 children found in Hypropic astigmatism while in study of (Ozdemir et al., 2009)(25) In premature children aged 5-7 years old who did not have ROP, the incidence of hyperopia was observed to be 21%. (Küçükevcilioğlu et al., 2015) (26)hyperopia was shown to occur at a rate of 28.8% in infants who acquired intermediate-level ROP, compared to a rate of 22.3% in infants who did not develop ROP. In our study Gestational age, birthweight is significantly correlated with refractive errors. While in other study done by (Bulut et al., 2023) (27) found Factors like birth weight in premature newborns and gestational week have a major impact on the incidence of myopia. Another study (Joong et al., 2023) (28)shown a connection between retinal structural alterations and visual result. Macular dragging was seen in 37 eyes (33.6%), and it was significantly linked to poor visual results. As measured by the DM/DD ratio, the severity of macular dragging was also correlated with VA. Our study founds ROP groups are significantly distributed with refractive errors. While in other study done by (Larsson et al., 2003) (29) demonstrated an increased risk for aberrant refractive errors, such as myopia, hypermetropia, astigmatism, anisometropia, and strabismus, in premature infants.

Conclusion

The comparisons between "Spontaneously Regresses ROP" and "Fully Vascularized Retina" in the "DRR-RE" category, as well as the comparisons in DRR-LE, do not produce statistically significant findings. In contrast, when comparing "Fully Vascularized Retina" and "Regressing ROP with Treatment" in the same category, we discover extremely significant differences, highlighting the major impact of treatment techniques on the advancement of refractive error severity like myopia. Early correction of refractive error can prevent to develop squint and amblyopic eye. Finally, the comparison of males and females suggests that gender may not have a significant impact on outcomes in certain cases.

Future recommendation:

- Repeat dilated refraction in every 6 month is very important in all treated ROP cases.
- To aware parents about refractive error and its impact in future if remain uncorrected, can cause Amblyopia (poor vision in one or both eye).
- Early detection of refractive error can help in future refractive status prediction.
- Child must do more outdoor activities than indoor in daily routine to prevent myopia.

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