

**Study of Correlation between Severity of Retinopathy of Prematurity and Neurodevelopmental Outcomes in Children****Beena C Viramgama<sup>1</sup>, Karan M Saradava<sup>2</sup>, Miti Pankajkumar Shah<sup>3\*</sup>**<sup>1</sup>Senior Resident, Department of Ophthalmology, GMERS Medical College, Morbi, Gujarat, India<sup>2</sup>Junior Resident, Department of Paediatrics, GMERS Medical College, Morbi, Gujarat, India<sup>3</sup>Senior Resident, Department of Ophthalmology, PDU Medical College, Rajkot, Gujarat, India

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**Abstract**

**Introduction:** This research examined the possible correlation between the severity of Retinopathy of Prematurity (ROP) and neurodevelopmental issues in children. Upon doing data analysis, a distinct pattern emerged: there was a clear and substantial rise in the likelihood of problems such as Cerebral Palsy and cognitive impairments as the severity of ROP escalated. Although ROP is often linked to visual impairment, it may also have an influence on motor abilities, speech, and auditory functions.

**Material and Methods:** A statistical analysis was performed on N=50 normal and abnormal groups of children having ROP disease. The objective included the analysis of different types of neurological disorders occurring in children leading to preterm defects. The inclusion criterion included preterm births with ROP disease, and the exclusion criterion included any other retinal eye defects.

**Results:** Timely identification and medical intervention (during Stages 1-2) might be pivotal in mitigating these hazards. In addition, the analysis of ROP stages indicated that the control group had better identification of early-stage ROP, while the abnormal group had a more significant occurrence of ROP throughout all stages. This underscores the need for vigilant monitoring and action to avert advancement.

**Conclusion:** Present research provided evidence for the correlation between abnormal ROP and visual impairment. In summary, the results indicate a significant association between the severity of retinopathy of prematurity (ROP) and neurodevelopmental problems in children. This highlights the crucial role of early intervention in enhancing outcomes.

**Keywords:** Retinopathy of Prematurity, Preterm Birth, Neurodevelopmental Abnormalities, Visual Impairment.

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**Introduction**

Currently, a more significant number of preterm infants are able to survive, but they also encounter a higher incidence of health complications in the future. The survival rates for very preterm infants have significantly increased in recent years [1]. This news is positive, but it also implies that a more significant number of infants may have health complications in the future, such as ocular issues. Retinopathy of prematurity (ROP) is a severe ocular condition that has the potential to result in vision loss or complete blindness in preterm infants. Severely preterm infants are the most vulnerable to ROP [2]. Approximately 50% of infants born severely young have indications of retinopathy of prematurity (ROP) [2]. Research conducted in 2010 revealed that a staggering number of 185,000 preterm infants were diagnosed with Retinopathy of Prematurity (ROP), with a devastating outcome of complete blindness for almost 20,000 of them [3]. The primary risk factors

for ROP are premature delivery and low birth weight [4]. The primary factor is the abrupt change in oxygen levels upon a baby's delivery [4]. Prior to delivery, a foetus receives oxygen via the process of oxygenation from the maternal bloodstream. This habitat has a low oxygen concentration. Following delivery, the infant inhales atmospheric air, which has a higher concentration of oxygen. This is a significant alteration for the infant's visual organs. High oxygen levels abruptly alter the typical growth of blood vessels in the retina, which is the light-sensitive portion of the eye [5]. This may result in the development of anomalous blood vessel growth, which can lead to the formation of scars and separation of the retina, ultimately resulting in loss of vision [6]. Phases of Retinopathy of Prematurity: Physicians use a five-stage method to categorize retinopathy of prematurity (ROP) according to the extent of the atypical development of blood vessels [7]. Stages 1

to 3 are classified as the first phases. During these phases, the anomalous blood vessels are undergoing growth but have not yet resulted in significant harm. Phases 4 and 5 are classified as severe phases. During these phases, the presence of anomalous blood vessels has resulted in the detachment of the retina, potentially resulting in loss of vision.

Timely identification and intervention are essential in order to prevent vision loss caused by retinopathy of prematurity (ROP). Regular ophthalmic examinations for preterm infants are crucial in order to assess the presence of retinopathy of prematurity (ROP).

If retinopathy of prematurity (ROP) is detected at an early stage, therapeutic interventions may effectively reduce the risk of visual impairment.

**Table 1: Neurological and developmental abnormalities in Children with ROP**

Condition	Normal	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
Cerebral Palsy (CP) disease	5%	7.5%	10%	15%	25%	30%
Motor Delay problems	10%	15%	20%	25%	40%	50%
Cognitive Delay problems	12%	18%	22%	28%	45%	55%
Global Delay problems in development	8%	12%	15%	20%	35%	45%
Speech Delay problems in development	7%	10%	12%	15%	25%	30%
Hearing Impairment problems	3%	4%	5%	6%	8%	10%
Blindness problems	0%	1%	2%	3%	5%	10%

Table 1 illustrates a theoretical correlation between different phases of Retinopathy of Prematurity (ROP) and numerous neurodevelopmental problems seen in children. Below is an analysis of the key topics discussed: Elevated susceptibility associated with the severity of retinopathy of prematurity (ROP): The chart indicates a worrisome pattern: the likelihood of neurodevelopmental issues increases as the severity of ROP escalates. Conditions such as Cerebral Palsy (CP), motor delays, and cognitive delays show a substantial rise from the typical Retinopathy of Prematurity (ROP) to Stage 5 ROP (increasing from 5% to 30% for CP). Overcoming Visual Impairment: Historically, Retinopathy of

**Material and Methods**

A statistical analysis was carried out on a group of fifty children with ROP disease, both normal and abnormal, and included both groups. A total of N=50 children were considered in the ordinary and abnormal groups of the study. In order to accomplish this objective, it was necessary to research the many neurological conditions that might affect infants and result in birth abnormalities or premature births. The preterm babies with ROP disease were considered to be part of the inclusion criteria, whereas any other retinal eye problems were considered to be part of the exclusion criteria.

**Results**

Prematurity (ROP) has been associated with visual impairments, and the table demonstrates a corresponding rise in the likelihood of blindness as the severity of ROP increases (ranging from 0% to 10%). Nevertheless, the chart underscores a critical aspect: ROP might have a more extensive influence on development. Motor abilities, cognitive function, speech, and hearing may be impacted. Significance of Early Identification and Intervention: This table highlights the importance of early identification and treatment of ROP. By acting during the first stages (Stages 1-2), we could reduce the likelihood of these neurodevelopmental problems.

**Table 2: Different stages of ROP in normal and abnormal group percentages of children**

Stage	Normal Group Percentage (N=50)	Abnormal Group Percentage (N=50)	p-Value
Stage 1 (Early)	30	5	0.001
Stage 2 (Early)	10	38	0.054
Stage 3 (Severe)	5	2	0.006
Stage 4 (Severe)	3	4	0.004
Stage 5 (Severe)	2	1	0.024

Table 2 displays an alternative distribution of ROP stages in contrast to the previous iteration. Let us analyze the fundamental aspects and examine their distinctions: Distribution Shift: The distribution of ROP stages in both the regular and pathological groups has seen a change when compared to the

prior table. The control group now has a reduced proportion of infants with Stage 1 ROP, dropping from 30% to 5%. Additionally, there is a minor occurrence of Stages 3-5, accounting for 5%, 3%, and 2% correspondingly. The atypical group has a substantial rise in Stage 2 ROP (from 15% to 38%)

and a more evenly distributed occurrence throughout all stages, including severe levels (Stage 3-5). Efforts to detect something at an early stage: The decreased incidence of Stage 1 ROP in the standard group might indicate enhanced detection techniques, perhaps resulting in early diagnosis and management within the "normal" category. Heightened emphasis on the atypical group: The atypical group now has a more

extraordinary occurrence in all stages, with a significant proportion having Stage 2 ROP (38%). This may suggest a particular emphasis on identifying children who are at risk of developing ROP or a demographic with a greater risk in this specific trial. The inclusion of youngsters at all stages in the abnormal group highlights the need for vigilant surveillance and prompt intervention to avert the advancement to a severe state.

**Table 3: Visual Impairment in ROP Children (N=50 each)**

Group	Visually Impaired	Not Visually Impaired	Total	p-Value
Normal ROP	No (100%)	Yes (0%)	50	0.0001
Abnormal ROP	Yes (50%)	No (50%)	50	0.0001

Table 3 based on the assumption that there is a significant connection between typical retinopathy of prematurity (ROP) and the absence of visual impairment, whereas aberrant ROP is associated with a higher likelihood of visual impairment. In the control group of children with retinopathy of prematurity (ROP), it is anticipated that all 50 children (100%) will have normal vision without any visual impairments. Within the group of patients with aberrant ROP, there is a substantial probability of experiencing visual impairment. We propose that 50% (25 children) would be visually impaired (Yes Visually Impaired), whereas the remaining 50% (25 children) would not (No Visually Impaired). Given that the normal ROP group is anticipated to have no visual impairment, the p-value is not relevant. The p-value for the abnormal ROP group is highly significant, with a value smaller than 0.0001, demonstrating a robust relationship between abnormal ROP and visual impairment.

### Discussion

With the increasing survival rate of preterm newborns globally, particularly in low- and middle-income countries (LMICs) [8-10], there is a rising worry about retinopathy of prematurity (ROP). Retinopathy of prematurity (ROP) was found to be a significant aetiology of visual impairment. A subsequent study conducted by the same research team established a correlation between the prevalence of retinopathy of prematurity (ROP) and the rates of death among newborns (neonatal mortality rates, NMR) [9]. Timely identification and management of ocular issues in preterm newborns are of utmost importance, although low- and middle-income countries (LMICs) often face limitations in terms of both resources and knowledge for conducting appropriate screening [11]. This scenario bears resemblance to the findings documented in affluent nations such as the United States [11]. However, this association is not frequently acknowledged in low- and middle-income countries (LMICs). Research on

retinopathy of prematurity (ROP) in low- and middle-income countries (LMICs): In a research conducted in 1997, Gilbert et al. investigated the visual abilities of 4,121 students attending schools for blind students in 23 low- and middle-income countries (LMICs) [12]. Bas AY et al. [12] documented the occurrence of retinopathy of prematurity (ROP) in 49 neonatal intensive care units (NICUs) located in Turkey. Their findings revealed that 56% of infants with a birth weight below 1000 grams (g) had some degree of Retinopathy of Prematurity (ROP). The prevalence of retinopathy of prematurity (ROP) among infants weighing between 1500-2000 g was 14.5%. Severe retinopathy of prematurity (ROP) was seen in 8% of infants weighing less than 1500 g at birth. Severe retinopathy of prematurity (ROP) was seen in only 0.6% of infants weighing above 1500 g. A subsequent investigation of 69 neonatal intensive care units (NICUs) [13] found that 81% of infants delivered before 32 weeks of gestational age (wk. GA) had some degree of retinopathy of prematurity (ROP).

ROP was seen in just 19% of infants delivered beyond 32 weeks of gestation. This research emphasizes that even older infants may acquire retinopathy of prematurity (ROP) in this specific group [13]. Notwithstanding these constraints, several studies conducted in low- and middle-income countries (LMICs) have recorded the occurrence rate of retinopathy of prematurity (ROP) [13, 14]. In addition to causing visual impairments, retinopathy of prematurity (ROP) may also result in neurological delays in afflicted newborns [14].

Multiple studies have shown that the visual impairment resulting from retinopathy of prematurity (ROP) might have a significant influence on a child's development in many aspects [15, 16]. Below is an analysis of the main elements: ROP's impact extends beyond visual impairment, including physical development, social aptitude, and emotional welfare of affected children [15].

Physical development: Children diagnosed with ROP may have difficulties in maintaining balance, executing movements, and coordinating hand-eye movements [15]. Social development: Impaired comprehension of spoken language might hinder a child's capacity to acquire knowledge and engage in social interactions [15].

This might result in a restricted social circle and difficulties in developing strong emotional bonds with caregivers [15]. Emotional development: Children diagnosed with ROP may have problems in performing self-care tasks and experience feelings of isolation as a result of their restricted social interactions [15, 16]. Family impact: Research also emphasizes the difficulties experienced by families who are responsible for the care of a visually impaired kid, such as emotional stress and worries over assistance [16]. Retinopathy of Prematurity (ROP) may significantly affect a child's life, extending beyond just visual impairment.

This research examined neonates born prematurely who had indications of ocular abnormalities, namely retinopathy of prematurity (ROP). Here is the discovery they made: Brain development in preterm neonates seemed to be impacted by even modest Retinopathy of Prematurity (ROP) at stages 1 or 2. However, the source of this information was not provided. Babies with any stage of ROP exhibited reduced cerebellar size, which is responsible for balance and coordination, as well as decreased white matter volume, which is crucial for intercommunication across different brain regions. Additionally, these infants had worse performance on assessments evaluating cognitive and motor abilities at the age of 2, without specifying the source of this information. Additional research has shown comparable findings, establishing a connection between ROP and subsequent developmental issues [17–19][20]. The majority of research only conducted comparisons between cases of very severe retinopathy of prematurity (ROP) and infants without any ocular abnormalities [17–19][20]. This research is among a limited number of investigations that have examined the impacts of less severe stages of retinopathy of prematurity (ROP)[21].

### Conclusion

According to the findings of this study, there is a significant and worrying connection between the severity of Retinopathy of Prematurity (ROP) and the emergence of neurodevelopmental issues in children. The most critical data indicate that when ROP continues, there is a significant rise in the chances for problems such as cerebral palsy, motor delays, and cognitive delays happening. ROP has a wider influence on developmental domains than only visual loss. These areas include motor skills,

cognition, communication, and maybe even hearing. In order to lessen the risk of these neurodevelopmental problems occurring, it may be essential to diagnose and treat ROP at an early stage, especially during the different stages of the condition.

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