



**PREVALENCE AND FACTORS ASSOCIATED WITH RETINOPATHY
OF PREMATURITY SCREENING IN PRETERM INFANTS AT ST.
PAUL'S HOSPITAL MILLENNIUM MEDICAL COLLEGE, ADDIS
ABABA, ETHIOPIA**

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**APRIL, 2026 G.C
ADDIS ABABA, ETHIOPIA**



**St. Paul's Hospital
Millennium Medical College**
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ST. PAUL'S HOSPITAL MILLENNIUM MEDICAL COLLEGE SCHOOL OF MEDICINE

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Acronym & Abbreviation

AAP: American Academy of Pediatrics

AAO: American Academy of Ophthalmology

BW: birth weight

CPAP: Continuous Positive Airway Pressure

GA: gestational age at birth

HICs: high-income countries

HMIS: Health management information system

LMICs: low- and middle-income countries

NICU: Neonatal intensive care unit

PMA: post-menstrual age

ROP: Retinopathy of prematurity

SPHMMC: St. Paul's Hospital Millennium Medical College

UK: United Kingdom

Abstract

Introduction: Retinopathy of prematurity (ROP) remains a major, potentially preventable cause of blindness in preterm infants globally. With improved neonatal care and increased survival rates of preterm infants, ROP prevalence is rising, presenting a significant public health challenge. While timely screening, diagnosis, and treatment can prevent ROP-related blindness, national screening guidelines are lacking in many regions, particularly in Africa, where only two countries have implemented them.

Objective: To determine the prevalence of screening practices for Retinopathy of prematurity as well as factors affecting it in preterm infants at St. Paul Hospital Millennium Medical College in the past 12 months.

Methods: A hospital-based cross-sectional study was conducted among preterm infants who were admitted to the neonatal intensive care unit in St Paul Hospital Millennium Medical College between October 4 and December 4, 2025 G.C. The study was conducted on 296 preterm infants who were selected using a simple random sampling technique. The data was collected using an abstraction tool by the data collectors. The data was analyzed using SPSS version 27. The final result is presented in the form of a descriptive, bi-variable, and multi-variable analysis.

Result: A total of 296 neonates were included in the study. Among them, 16 were excluded because they had incomplete documentation. Taking the remaining 196 eligible neonates, who were alive at the age of screening, the overall prevalence of ROP screening was 43.4% (n=85). After adjusting for all covariates, only the link to the ophthalmology department and length of stay in NICU remain as statistically significant independent predictors of ROP screening status. Other variables, including gestational age ($p = 0.101$), birth weight ($p = 0.677$), CPAP support ($p = 0.741$), residential location ($p = 0.070$), and oxygen support ($p = 0.791$) initially had statistically significant associations in bi-variable analysis but were not independently associated with screening status in the adjusted model (multi-variable analysis).

Conclusion: The overall prevalence of ROP screening among eligible neonates was substantially lower than that of high-income countries and lower-income countries with national guidelines. The analysis revealed that systemic and logistical factors, rather than clinical risk factors, were the independent predictors of whether an eligible infant received screening. Suggesting that, in St. Paul, the failure to screen is primarily a systemic failure of coordination and follow-up, rather than a failure to identify the clinically high-risk infant. Multi-centered studies and qualitative studies are recommended in order to gain a full insight of ROP screening status of the country.

Keywords: Retinopathy of prematurity, screening, blindness

1.Introduction

1.1 Background

Retinopathy of prematurity is a major preventable cause of blindness in preterm infants worldwide. It was first reported in 1942 by Terry in Boston, United States of America (1). It is characterized by abnormal blood vessel development in the retina. Normal retinal vascular development begins at the optic nerve head around 12 weeks in utero and continues from the center to the periphery until at least 22 weeks of gestation. The process is completed between 40 and 44 weeks of post-menstrual age. (2) However, in premature infants, this development is interrupted. This makes the preterm infant vulnerable to the development of abnormal vascularization that can lead to ROP. If this abnormal vascular growth is not managed on time, it can progress to retinal detachment and result in irreversible vision loss or complete blindness. (2)

The incidence and severity of retinopathy of prematurity (ROP) are inversely proportional to both gestational age and birth weight. Infants who were born earlier and weigh less are at greater risk of developing severe ROP. Kim et al. (2018) identified low birth weight (particularly <1500g) and gestational age under 32 weeks as the most significant predictors of ROP development. In addition to these primary risk factors, neonatal interventions such as prolonged oxygen therapy, mechanical ventilation, blood transfusions, and photo-therapy have been shown to disrupt retinal vascular stability, increasing the likelihood of disease progression. Systemic complications such as sepsis, respiratory distress syndrome, apnea of prematurity and intraventricular hemorrhage further compound this risk. Maternal factors, including pre-eclampsia and multiple gestation, along with emerging genetic links involving VEGF and Norrie disease genes, have also been implicated in the disease development. (3)

To aid in the early detection of ROP, screening guidelines have been established globally, even if the cutoff points vary in different countries. Current guidelines from organizations such as the American Academy of Pediatrics (AAP) and the American Academy of Ophthalmology (AAO) recommend initiating ROP screening for infants born at or before 30 weeks of gestational age or with a birth weight of 1500 grams or less. The first examination is recommended to be conducted

between 4 to 9 weeks of chronological age, or by 31-32 weeks post-menstrual age, whichever is later. The examination will then continue until the retina is fully vascularized or the ROP has regressed or been treated. By identifying and treating ROP early, the disease process can be stopped. This helps in preventing the burden of blindness. (4)

In Africa, only two countries have established national guidelines for retinopathy of prematurity (ROP) screening. Despite an increase in the number of premature births and expanding neonatal services, Ethiopia lacks formal ROP screening protocols. There is also a lack of data on current practices. (5) St. Paul's Hospital Millennium Medical College, one of the country's largest public referral centers with a high NICU admission rate, offers a unique opportunity to assess current ROP screening practices. Understanding whether screening exists, how ROP and what factors affect the screening process is essential for improving neonatal outcomes and laying the foundation for national policy development.

1.2 Statement of the problem

In Ethiopia, neonatal mortality has declined from 60 to 33 deaths per 1,000 live births over the last three decades, with the fastest reduction occurring after 2010. (6) This improvement is largely due to increased availability of antenatal care, an increase in hospital deliveries, and the establishment of Neonatal Intensive Care Units staffed with trained neonatologists. (1) As a direct consequence of enhanced neonatal care and improved survival rates of preterm infants, the prevalence of Retinopathy of Prematurity (ROP) has emerged as a growing concern. The trend of ROP diagnoses in Ethiopia shows an increase in incidence of ROP from 2 cases in 2016 to 33 cases in 2020. (1) A prospective screening conducted in two Ethiopian NICUs also shows that 32.2% of admitted neonates had ROP.(7)

Despite ROP being a prevalent condition with increasing public health significance, there is a critical gap in research concerning its screening practices in Ethiopia. There are studies regarding the prevalence and risk factors of ROP but there is no published research on the prevalence of ROP screening itself. This lack of data is particularly concerning given that ROP is a preventable cause of visual impairment if timely screened and managed.

Ethiopia currently lacks an established national screening protocol to guide timely referral or a systematic screening process nationwide. This absence of a standardized national guideline significantly hinders early detection efforts and contributes to an increased prevalence of infants with preventable visual impairment across the country.

Furthermore, even in referral hospitals equipped with the necessary infrastructure, such as St. Paul's Hospital Millennium Medical College, there is a lack of information regarding their ROP screening practices. In Addis Ababa, three major government referral hospitals with equipped NICUs that can manage preterm infants exist: Black Lion Specialized Hospital, Menelik II Referral Hospital, and St. Paul's Hospital Millennium Medical College. A prospective study assessing ocular diseases across these institutions identified 16 preterm infants diagnosed with ROP, 12 of whom were from St. Paul Hospital. (8) Despite this disproportionately high number of cases, there is no existing research that explores the specific screening protocols used at St. Paul, the criteria guiding those screenings, or the institutional and systemic factors that influence the process.

This study aims to address these critical gaps by investigating the prevalence and factors affecting ROP screening at St. Paul Hospital NICU, thereby contributing valuable data to inform both institutional practice and potential national guideline development.

1.3 Significance of the study

As neonatal care in low-income countries like Ethiopia improves, leading to a third epidemic of Retinopathy of Prematurity (ROP), the need for the development of national screening guidelines becomes increasingly important. Without concomitant improvements in ROP screening, the reduction of ROP-associated visual loss will remain a significant public health challenge. This makes research that tries to identify current screening practice and gaps essential for laying the groundwork for evidence-based national screening protocols that can prevent avoidable childhood blindness.

This research will provide essential statistical data on the prevalence of ROP screening at St. Paul Hospital. This data will serve as a mirror to see the hospital's current efforts towards the secondary prevention of ROP. By quantifying the screening rates, we can identify the extent of the screening gap and measure the effectiveness of current practices. This information is vital for internal quality improvement initiatives.

This study will also identify the factors that affect the ROP screening process. By analyzing patient-related and system-related variables, we can pinpoint the specific factors that affect timely screening. Identifying these factors is the first step towards developing targeted interventions to overcome them, thereby making the screening process more successful and equitable.

Finally, and most importantly, this study will identify the existing working system of screening within St. Paul Hospital, laying the foundation for the development of a future national ROP screening guideline for Ethiopia.

2. Literature Review

2.1. ROP disease process

Retinopathy of prematurity is an ocular disease (except the aggressive type) that develops in a predictable pattern following the two-phase hypothesis. This hypothesis describes the disease progression from initial vascular insult to abnormal vessel proliferation. Phase 1 is called the Vaso-obliterative phase. It occurs immediately after birth when the preterm infant is exposed to a relatively hypoxic environment as compared to a hypoxic in-utero one. This exposure will then cause cessation of normal retinal vessel growth, leading to ischemia. (1,9) This ischemia then triggers Phase 2: the vaso-proliferative phase. During this phase, the avascular retina produces pro-angiogenic factors like VEGF, which leads to uncontrolled and abnormal neovascularization that can result in hemorrhage, fibrosis, traction, and ultimately retinal detachment and severe vision loss if untreated. (2,9) Understanding this two-phase model is crucial for guiding the timing of screening, disease staging, and treatment rationale. (1)

2.2 Magnitude of ROP and the Third Epidemic

According to WHO, approximately 13.4 million babies were born preterm worldwide in 2020, with the majority of them residing in South Asia and Sub-Saharan Africa. (10) Due this increase in preterm survival rate along with the advancement of NICU care, ROP has become one of the major global health challenges. A meta-analysis that was done in 2024 found that the global ROP prevalence was 31.9%, with severe ROP at 7.5%. (11) In 2019, the age-standardized prevalence rate of vision loss due to ROP was 86.4 per 100,000 populations globally.

The global distribution of ROP varies geographically. It has progressed from being a concern of high-income countries to a burden for low-income countries. This is best explained with the three epidemic histories of ROP. The first 2 epidemics occurred between 1940 and 1980, both in high-income countries like USA and Western Europe. The first one was due to unmonitored high O₂ supplementation during resuscitation. Later advancement of NICU, leading to increased preterm survival, was added as an additional factor to create the second epidemic. The third epidemic, the one we are currently facing, has shifted to middle and low-income countries,

particularly Sub-Saharan Africa, where improving neonatal survival rates are challenged by inconsistent oxygen monitoring, inadequate resources, and limited awareness, making ROP an emerging cause of preventable childhood blindness. (1,12–14) Ethiopia, as a low-income country with improving neonatal survival rates, is now facing these challenges, making ROP an emerging public health concern in the country (1,2,15)

2.3. ROP Screening Criteria

Even though there is no one internationally accepted ROP screening guideline that works for every country, general principles still exist. All screening guidelines agree on using gestational age and birth weight as major criteria for determining eligibility for ROP screening, even if the cutoff point varies in different countries. This is due to differences in neonatal care resulting in a difference in epidemiology of ROP. (2) High-income countries like the United States recommend screening for infants with birth weight $\leq 1500\text{g}$ or GA ≤ 30 weeks, capturing extremely premature infants at high risk. (4) In contrast, middle and low-income countries have adopted broader criteria to include more mature and heavier infants that are at risk of developing severe ROP due to inconsistent oxygen management, nutritional deficiencies, and higher comorbidity rates. (12) Common recommendations for the first examination are by 31-32 weeks PMA or 4-5 weeks of chronological age, depending on the gestational age at birth. Subsequent examinations are performed every 1-2 weeks, depending on the initial findings and the infant's risk factors. This continues until retinal vascularization is complete or treatment is successful. (4,16)

Only two African countries have established national guidelines, both using GA < 32 weeks and BW $< 1500\text{g}$. Ethiopia is not among them. A 2020 retrospective study done in Ethiopia found that all vision-threatening ROP cases fell within UK criteria (GA < 32 weeks or BW $< 1501\text{g}$). But generalization with this data is difficult, as the majority of the infants included in this study were referred from a private NICU where a higher quality of care is provided. (1) Another prospective screening survey done between June 2019 and June 2020 in two level 3 public NICUs using the United Kingdom (UK) guideline suggests that the screening should include infants with a BW of $< 1800\text{g}$ or a GA of ≤ 33 weeks, but further studies should be done to include level 2 and private NICUs before this is used as national cutoff criteria. (7)

2.4 Prevalence of ROP screening

The prevalence of ROP screening and the factors influencing its implementation vary across different regions and healthcare systems. These discrepancies are more visible, especially between high-income countries (HICs) and low- and middle-income countries (LMICs). In HICs, such as the United States and the United Kingdom, established national guidelines and advanced healthcare infrastructure have led to high rates of ROP screening for at-risk infants. For example, in the UK, a study reported a screening uptake of over 96% for eligible infants. (17) In contrast, many LMICs face challenges in achieving high ROP screening rates. A systematic review of ROP in Africa found that screening is very limited across the continent, with only a few countries having established national guidelines. (5) In South Africa, one of the two African countries with national guidelines, a study reported a screening completion rate of 60%. (18) In Ethiopia, the situation is particularly challenging. As there are no established national ROP screening guidelines, the prevalence of screening is largely unknown.

2.5. Benefits of ROP Screening and Factors Affecting Screening

ROP screening is critical for preventing irreversible vision loss through early detection and timely intervention. The Cryotherapy for ROP Trial showed early treatment reduced unfavorable outcomes from 48% to 27% and poor visual outcomes from 62% to 44%. (19) The ETROP Trial demonstrated that treating high-risk pre-threshold ROP improved visual outcomes. (20) Beyond preventing blindness, screening enhances quality of life, provides cost-effectiveness compared to long-term care costs, generates valuable epidemiological data, and supports research into ROP pathophysiology. (21,22) However, multiple factors affect the prevalence of screening, particularly in resource-limited settings. Infant-level factors include clinical instability and early discharge. Clinical care factors involve oxygen therapy management, NICU stay duration, and sepsis. System-level barriers, particularly prevalent in African countries, include a lack of oxygen monitoring equipment, inadequate data systems, scarcity of screening equipment, and a shortage of trained ophthalmologists. (12,13,15,22) Socioeconomic factors like parental education and distance from hospitals also affect compliance. South Africa addressed these barriers and increased screened infants from 33 to 292 per year within six years, demonstrating that targeted interventions can overcome these challenges. (15)

3. Objective

3.1 General Objective

- To assess the prevalence of screening practices for ROP as well as factors affecting it in preterm infants at St. Paul Hospital in the past 12 months.

3.2 Specific objective

- To quantify the proportion of preterm infants screened for ROP
- To explore factors affecting ROP screening

4. Methodology

4.1 Study Area

The study was conducted at St. Paul Hospital, a major tertiary referral hospital located in Addis Ababa, Ethiopia. St. Paul Hospital is one of the largest public hospitals in Ethiopia, offering comprehensive medical services to patients from Addis Ababa and the surrounding regions. The hospital's Neonatal Intensive Care Unit (NICU) is a specialized unit equipped with modern neonatal care facilities, including mechanical ventilation, photo-therapy, and continuous monitoring systems, providing Level III neonatal care services for critically ill and premature infants.

The hospital has both functioning NICUs and an ophthalmology department, making it one of the few institutions in Ethiopia with the capacity to provide ROP screening services. As mentioned in previous studies, St. Paul Hospital has been identified as having a significant number of ROP cases, with 12 out of 16 preterm infants diagnosed with ROP in a multi-center study done on three referral hospitals. This therefore highlights its role as a major center for neonatal care and the relevance of conducting ROP screening research at this facility. The hospital's patient population is diverse, serving both urban and rural populations, and represents a significant portion of Ethiopia's high-risk neonatal cases. This makes it an ideal setting for investigating the prevalence and factors affecting ROP screening practices in the Ethiopian context.

4.2 Study design

In this study, an institution-based cross-sectional study was conducted.

4.3 Study period

The study was conducted from October 4 to December 4, 2025 G.C.

4.4 Source population and study population

The source population for this study included all preterm infants admitted into St Paul Hospital Millennium College NICU in the past 1 year. The study population was all selected preterm infants admitted into SPHMMC NICU in the past year and fulfilled the inclusion criteria.

- **Inclusion criteria**

This study included preterm infants with gestational age ≤ 32 weeks or birth weight ≤ 1500 grams.

- **Exclusion criteria**

This study excluded Preterm infants with congenital ocular disease.

4.5 Sample size determination

The sample size of the study participants is determined using a single population proportion formula based on the following assumption: P-prevalence of ROP screening =50% proportion (since there is no prevalence study done in our country), $Z_{\alpha/2}$ - critical value at 95% confidence level of certainty = 1.96, d- The margin of error between the sample and the population = 5%
Estimation of a single population proportion

$$n = \frac{Z^2 p(1-p)}{d^2}$$

$$n = 384$$

Thus, based on the single population formula, our sample size will be 384. However, for a finite population where n_0 is above 5 % of the source population correction formula is needed to avoid unnecessary sampling.

$$n = \frac{\bar{n}_0}{1 + \frac{\bar{n}_0}{N}}$$

n_0 is the sample size calculated via a single population formula.

N is the source population.

Annually, about 898 preterm infants are admitted to SPHMMC NICU; thus, our source population is 898. Using this correction, n was adjusted to 269. After adding 10% contingency for incomplete documentation, the final sample size was 296. (A pilot study was done on 5% of the charts, and the percentage of incomplete cards was 6%. Therefore, no adjustment to the sample size was made.)

4.6 Sampling Technique

The study was conducted using a systematic random sampling technique. This is a more feasible sampling technique, considering the sample will be extracted from hand written admission log. Using this method, participants were selected based on a fixed interval, which is calculated by dividing the total population size by the desired sample size.

$Kth = N/n$, where N is the total number of admitted preterm infants over the study period and n is the desired sample size.

$$Kth = 898/296 = 3$$

After a random starting point is determined from 1 and k using a lottery method, every kth patient ID was selected by the data collector from a list of eligible preterm infants, which is ordered in chronological order, until the desired sample size is achieved. This approach ensured that each infant had an equal chance of being selected, thereby minimizing time-based bias. Finally, the data collector used those selected patients ID to obtain data from the HMIS and digital MRN data base using the abstraction tool.

4.7 Variables of the study

Dependent variable

- ROP Screening Status of the preterm infant

Independent variables

- a) Infant characteristic

- Gestational Age
 - Birth Weight
 - Sex
 - APGAR Score at 5 minutes
- b) Clinical and NICU factors
- Respiratory Support (prolonged oxygen therapy or put on a mechanical ventilator/ CPAP)
 - Comorbidity
 - Length of NICU Stay
- c) System-level
- Availability of an ophthalmologist checkup
 - Timing of admission and date of discharge
 - Documentation completeness
- d) socioeconomic level
- Household income (payment Status)
 - Residual location

4.8 Operational definition

- **ROP Screening Status:** It refers to a documented clinical status that indicates whether the infant has received a retinal examination within the recommended time-frame to check for the presence of ROP. It is classified as screened or not screened.
- **Screened Neonate:** A preterm neonate who received ROP screening within the recommended window (typically within 4 weeks of birth).
- **Not Screened Neonate:** A preterm neonate with no documentation of ROP screening during NICU hospitalization.
- **Comorbidity:** any illness other than ocular anomalies
- **Prolonged oxygen therapy:** an infant receiving oxygen support for 2 week or more(1)

- **Payment status:** Refers to financial clearance of a patient during hospital admission, i.e., whether the parents have active insurance coverage or have received approval for payment exemption through a social worker.
- **Residual location:** it will be classified as parents living in rural or urban areas.

4.9 Data collection technique

Data was collected using an abstraction checklist created by the investigator, since there is no single internationally accepted format. Data collectors used this abstraction checklist to extract information from the hard-copy patient record (HMIS) and MRN data base.

Data was collected from September to October 2025 on preterm infants who were admitted to the NICU of St. Paul's Hospital Millennium Medical College over the past 12 months via Google Docs.

4.10 Data quality management

A pretest was conducted on 5% of randomly selected patient charts to refine the abstraction tool and clarify ambiguous variables. Maternal education status was absent in all the patient documents and was removed from the abstraction tool.

A one-day training session was held with two clinical students regarding the objective, ethical considerations, inclusion/ exclusion criteria, definitions/coding of each variable, and application of the abstraction tool to ensure quality of the data. Data collection was monitored daily to ensure completeness and consistency. Double-entry was applied to 10% of the dataset, and those with transcription errors were reentered.

16 Charts with major missing data on core variables (i.e., gestational age, birth weight, or screening status) were excluded to minimize bias.

4.11 Data processing and analysis

After data collection was done, the data were checked and entered into SPSS (Statistical Package for Social Science) version 27 for analysis. Descriptive analysis, such as frequency,

percentage, means, and standard deviation, was used to characterize demographic and clinical characteristics of preterm infants as well as estimate the prevalence of ROP.

Association between independent variables and ROP screening status was analyzed using Chi-square tests for categorical variables and independent t-tests for continuous variables. Seven variables were included in the multivariable logistic regression model based on p-value of < 0.2 from bi-variable analysis, provided that the events-per-variable (EPV) rate of 12.

The seven variables that met this threshold (gestational age, birth weight, length of NICU stay, oxygen support, CPAP use, residual location, and linkage to ophthalmology) are also established clinical predictors of ROP screening based on prior literature. Therefore, the final model included these seven variables, ensuring that both statistical significance and clinical relevance guided variable selection. (Gestational age, Birth weight, Respiratory support and length of stay were the variables that were considered essential for inclusion regardless of their bi-variable p-value).

Multicollinearity was assessed using Variance Inflation Factor (VIF) and tolerance values. All predictors had $VIF < 5$ and tolerance > 0.2 , indicating no evidence of serious collinearity.

To measure the presence and strength of association between the independent variable and the outcome (screening status), adjusted odds ratios (AORs) with 95% confidence intervals (CI) and P-value were used. From the final model, variables with a P-value of < 0.05 were considered significantly associated with ROP screening.

Model fit was assessed by the Hosmer–Lemeshow goodness-of-fit test, and a cutoff point of 0.5 was used to assess the predictive probability of the final model.

5. Ethical consideration

The study was conducted after obtaining a formal written clearance from the Research and Publication Directorate of SPHMMC. Since there was no interaction with patients, a waiver of informed consent was obtained from the SPHMMC Institutional Review Board. Confidentiality of participants' information was strictly maintained by de-identifying data and storing it securely with restricted access.

6. Dissemination of Results

The result of this study will be submitted to St. Paul's Hospital Millennium Medical College School of Public Health and made available in both hard and soft copies in the institutional library for use by future researchers. Additionally, the findings of the study will be disseminated to the Ethiopian Ministry of Health and SPHMMC Pediatric Department offices to support institutional improvement and national development of the screening guidelines.

7. Result

7.1 Descriptive Analysis

7.1.1 Socio-demographic and Clinical Characteristics of Study Participants

A total of 296 neonates were included in the study. Among them, 16 were excluded because they had incomplete documentation. Out of the 280 neonates, 53.8% of them were females (149). The mean gestational age at admission was 31 weeks (SD = 2.3), indicating that most infants were born between 29 and 33 weeks. The mean birth weight was 1337 g (SD = 357), with most infants weighing between approximately 980 g and 1694 g. 81% of the infants were born at a Gestational Age (GA) of less than 32 weeks, and 67.4% had a Birth Weight (BW) of less than 1500 grams.

Regarding the place of delivery, 238 were delivered in St. Paul, 3 were delivered at home, and 39 were delivered at a different hospital and were referred to St. Paul. The majority of them lived in rural area (56.3%). 50% of the neonates were treated for free, 3% had insurance, and 46.4% were cash payers.

Clinical comorbidity was prevalent, with Respiratory Distress Syndrome (RDS) being the most common (88%), followed by Sepsis (9%). Intraventricular Hemorrhage (IVH) and Bronchopulmonary Dysplasia (BPD) were rare, each identified in only one neonate. Furthermore, a very high percentage of infants received supportive care, with 92.9% receiving oxygen support and 87.9% receiving Continuous Positive Airway Pressure (CPAP). The average length of stay in the NICU was 19 days (range: 1–80 days).

<i>No</i>	<i>variable</i>	category	N	%
	<i>Total Sample Size</i>		280	100 %
<i>1</i>	<i>Sex</i>	Female	149	53.2 %
		Male	131	46.8 %
<i>2</i>	<i>Gestational age</i>	<32 weeks	226	80.7 %
		32- 34 week	39	13.9 %
		>34 week	14	5 %
<i>3</i>	<i>Birth Weight</i>	<1500g	188	67.1 %
		1500-2000	81	28.9 %
		>2000	10	3.6 %
<i>4</i>	<i>Place of Delivery</i>	St. Paul's Hospital	238	85 %
		Other hospital	39	13.9 %
		Home delivery	3	1.1 %
<i>5</i>	<i>Residence</i>	Rural	157	56.1 %
		Urban	122	43.6 %
<i>6</i>	<i>Payment method used</i>	Free/ waived	140	50%
		Cash (self pay)	130	46.4 %
		Insurance	9	3.2 %
		Not documented	1	0.4 %

7	<i>Comorbidity</i>	RDS	249	88.8%
		Sepsis	27	9 %
		BPD	1	0.4 %
		IVH	1	0.4%
		TTN	4	1.4 %
8	<i>CPAP</i>	Yes	246	87.9 %
		No	34	12.1 %
9	<i>Oxygen Support</i>	Yes	260	92.9%
		NO	20	7.1 %

Table 1: Descriptive analysis

7.1.2. Eligibility and Prevalence of ROP Screening

Of the 280 neonates included in the study, 84 (30%) died before reaching the appropriate age for screening and were therefore considered ineligible for ROP screening. The remaining 196 neonates survived to the screening age and are used to analyze the prevalence and link to ophthalmology, as well as to conduct inferential analysis.

Among these 196 eligible neonates, the overall prevalence of ROP screening was 43.4% (n=85), while 56.6% (n=111) were not screened despite meeting the eligibility criteria.

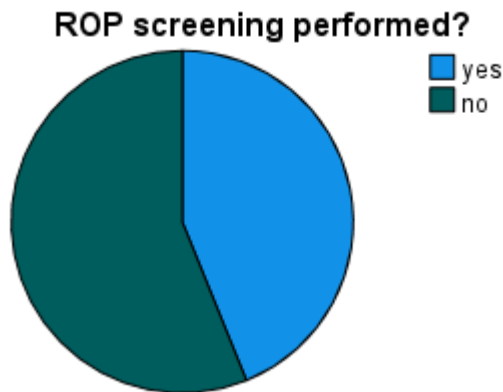


Figure 1: Prevalence of ROP screening

7.1.3 Timing of Linkage and ROP Screening Performance

Out of the 196 neonates, 52 (26%) were linked after screening, 22 (11.2%) were linked before screening, and the majority (n=122, 62.2%) were not linked to ophthalmology services.

This means out of 196 eligible neonates, 52 of them were screened in the NICU and were linked to the ophthalmology department for follow-up. Whereas 20 of those screened in the NICU were not linked to ophthalmology upon discharge.

For those neonates who were eligible for screening but were discharged before the age of screening (n=124), only 22 of them were linked to ophthalmology for evaluation. Out of those linked, 13 of them were screened for ROP.

7.1.4 Reasons for Not Screening Among Study Participants

The reasons for non-screening were analyzed for the 280 neonates. The primary barrier was eligible neonates who were discharged with no linkage to the Ophthalmology Department, 34.6% (n=97), followed by mortality, with 30% (n=84) of infants dying before screening could be performed. Additionally, 3.2% had an unknown reason, 1.4% (n=4) were in critical condition at the time of screening, and 0.4% (n=1) were due to parents leaving against medical advice.

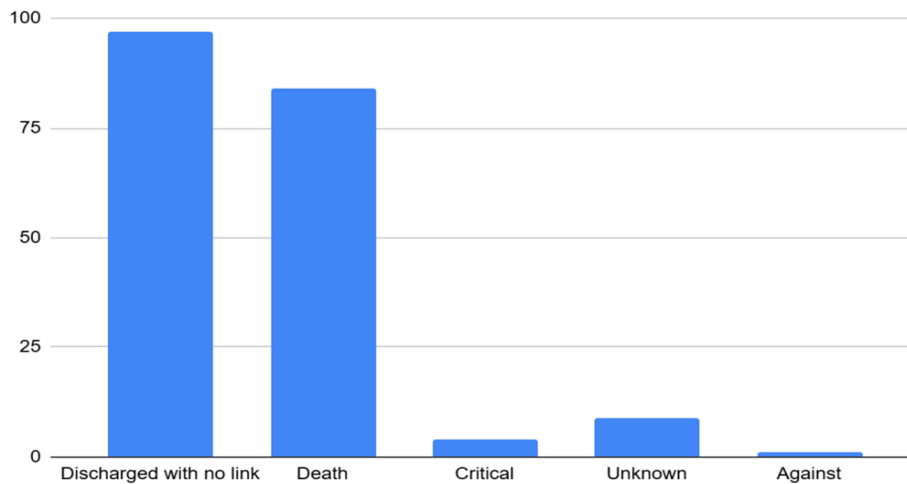


Figure 2: Reason for not being screened

7.2. Bi-variable Analysis of Factors Associated with ROP Screening

Bi-variable analysis was done on 196 neonates who were eligible for screening, excluding those who died before the age of screening. Independent variables were analyzed against ROP screening status using Chi-square tests for categorical variables and independent t-tests for continuous variables.

7.2.1. Association with Categorical Variables (Chi-Square Test)

The bi-variable logistic regression analysis for categorical variables revealed that the link to ophthalmology was the strongest predictor of ROP screening status. Infants with a link to

ophthalmology were approximately 29 times more likely to be screened for ROP compared to those without a link (Crude Odds Ratio [COR] = 28.9; 95% CI: 12.657–66.404; $p < 0.001$).

Supportive care (CPAP use) and primary residential location also have a statistically significant association with the screening status. The use of Continuous Positive Airway Pressure (CPAP) was significantly associated with ROP screening status (COR = 3.14; 95% CI: 1.209–8.180; $p = 0.015$). Infants who received CPAP were over three times more likely to be screened than those who weren't supported with CPAP. Residential location showed a statistically significant association as well (COR = 1.809; 95% CI: 1.015–3.24; $p = 0.043$), showing that urban residence may be associated with a higher likelihood of screening compared to rural residence.

However, oxygen support showed a marginal association with screening status (COR = 3.38; 95% CI: 0.925–12.412; $p = 0.052$). While the p-value is slightly above the conventional $P = 0.05$ threshold, the wide confidence interval suggests a potential trend.

The remaining categorical variables, such as Sex ($P = 0.273$), Place of Delivery ($P = 0.987$), Household Income/Payment Method ($P = 0.934$), and Comorbidity identified at time of management ($P = 0.231$) did not show a statistically significant association with the ROP screening status.

variables	ROP Screening		Crudes Odds ratio (COR) (95% CI)	P- Value
	Yes	No		
Sex				
Female	49(57%)	54 (49.1%)		
Male	37(43%)	56 (50.9%)	0.728 (0.413- 1.284)	0.273
Place of Delivery				
In St. Paul	72 (83.7%)	92 (83.6%)		
Outside St. Paul	14(16.3%)	18 (16.4%)	0.994 (0.463-2.133)	0.987
Link to Ophthalmology dep.				
No	24 (27.9%)	101 (91.8%)		
yes	62 (72.1%)	9 (8.2%)	28.991 (12.657–66.404)	<0.001
CPAP use				
No	6(7%)	21 (19.1%)		
Yes	80 (93%)	89 (80.9%)	3.14 (1.209–8.180)	0.015
Oxygen support				
No	3(3.5%)	12(10.9%)		
Yes	83 (96.5%)	98 (89.1%)	3.38 (0.925–12.412)	0.052
Residential location				
Rural	44 (51.2%)	72 (65.5%)		
Urban	42 (48.8%)	38 (34.5%)	1.809 (1.015–3.24)	0.043
Payment Method				
Self -Payer	37 (43%)	48 (43.6%)		
Free of Payment	49 (57%)	62 (56.4%)	1.025 (0.580- 1.812)	0.932
Comorbidity				
Has a comorbidity	82 (95.3%)	100(90.9%)		
Has no comorbidity	4 (4.7%)	10 (9.1%)	0.488 (0.148-1.613)	0.231

(Reference Category: Male, born in St. Paul , No link to ophthalmology department , No CPAP support, No oxygen support, Rural, self-payer, has a comorbidity)

Table 2: bi-variable analysis of categorical variables

7.2.2. Association with Continuous Variables (Independent Samples T-Test)

The t-test analysis was done on gestational age, birth weight, length of stay at NICU, and APGAR score at 5th min. The results show that three of the four showed a statistically significant association with ROP screening status.

A highly significant difference was observed in the Gestational Age of the neonate screened (mean (196) = -5.320, $p < 0.001$). The negative mean difference suggests that the group of neonates who were screened had a significantly lower mean gestational age compared to the group that was not screened. The same goes for the birth weight. A highly significant difference was found (mean (196) = -4.146, $p < 0.001$). Neonates who were screened had a significantly lower mean birth weight compared to the group that was not screened.

Neonates who stayed longer in the NICU had a higher chance of being screened compared to those who were discharged earlier (mean difference(196) = 10.625, $p < 0.001$).

On the other hand, the APGAR score at the 5th minute ($p = 0.704$) did not show a significant difference between the screened and non-screened groups.

7.3. Multi-variable Analysis of Independent Predictors

Seven variables with p-value < 0.2 from bi-variable analysis were included in the multi-variable logistic regression model, provided that the events-per-variable (EPV) rate of 12.1.

Two multi-variable logistic regression models were constructed and tested. The first model included continuous variable for gestational age, birth weight and length of stay while the second model used categorical form for those variables. Both models demonstrated acceptable

performance with consistent direction of association for key predictors. However, the continuous- variable model provided more precise estimate and was therefore selected for reporting.

The final logistic regression model was statistically significant (Omnibus test of model coefficients: $\chi^2 = 158.61$, $df = 7$, $p < 0.001$), indicating that the set of predictors reliably distinguished between infants who were screened and those who were not. The model explained a substantial proportion of the variance (74%) in screening status (Nagelkerke $R^2 = 0.744$) and demonstrated good fit (Hosmer–Lemeshow test: $\chi^2 = 7.37$, $df = 8$, $p = 0.498$). Overall classification accuracy was 89.3%, with sensitivity of 87.1% and specificity of 91.0% at the cutoff probability of 0.5.

After adjusting for all covariable, link to the ophthalmology department and length of stay in NICU were statistically significant predictors of ROP screening status. Infants linked to the ophthalmology department had markedly higher odds of being screened (AOR = 45.45, 95% CI: 0.007–0.072, $p < 0.001$), and each additional day of hospitalization was associated with a 12% increase in the odds of being screened (AOR = 1.118, 95% CI: 1.069–1.168, $p < 0.001$).

Other variables, including gestational age ($p = 0.101$), birth weight ($p = 0.677$), CPAP support ($p = 0.741$), residential location ($p = 0.070$), and oxygen support ($p = 0.791$), were not independently associated with screening status in the adjusted model.

Variable	Adjusted Odds Ratio (OR)	95% Confidence Interval	P value
Gestational Age	0.816	0.639 – 1.041	0.101
Birth Weight	1.000	0.998 – 1.001	0.677
CPAP Given?	1.768	0.060 – 51.711	0.741
Linked to the Ophthalmology Dept.	45.45	0.007 – 0.072	< 0.001
Residential Location	2.839	0.919 – 8.775	0.070
Length of Stay	1.118	1.069 – 1.168	< 0.001
Oxygen Support Given?	1.675	0.037 – 76.422	0.791

Table 3: multi-variable regression Model 1 with GA, Birth weight and length of stay in continuous variable

variables	ROP Screening		Crudes Odds ratio (COR) (95% CI)	Adjusted OR (AOR) (95%CI)	P- Value
	Yes	No			
Gestational Age					
>32wk	10(11.6%)	35 (31.8%)			
32wk and <32wk	76 (88.4%)	75 (68.2%)	3.547	2.385(0.677-8.4)	0.176
Birth Weight					
>1500g	17 (19.8%)	30 (27.3%)			
<1500g	69 (80.2%)	80 (72.7%)	1.491	2.856(0.868-9.391)	0.084
Link to Ophthalmology dep.					
No	24 (27.9%)	101 (91.8%)			
yes	62 (72.1%)	9 (8.2%)	28.991 (12.657– 66.404)	59.498(17.643-200.648)	<0.001
CPAP use					
No	6(7%)	21 (19.1%)			
Yes	80 (93%)	89 (80.9%)	3.14 (1.209–8.180)	1.159 (0.101-13.287)	0.906
Oxygen support					
No	3(3.5%)	12(10.9%)			
Yes	83 (96.5%)	98 (89.1%)	3.38 (0.925– 12.412)	0.475 (0.022-10.37)	0.636
Residential location					
Rural	44 (51.2%)	72 (65.5%)			
Urban	42 (48.8%)	38 (34.5%)	1.809 (1.015– 3.24)	0.385(0.131-1.130)	0.083
Length of Stay					
<30 days	53(61.6%)	8 (7.3%)			
>30 days	33 (38.4%)	102 (92.7%)	0.049 (0.021-0.113)	0.027 (0.008-0.090)	<0.001

Table 4: multi-variable regression Model 2 with all variables recorded as categorical variables

8. Discussion

8.1 Prevalence of screening for ROP

Out of 280 neonates admitted, 196 survived to the age of screening and were eligible. Among these, the overall prevalence of ROP screening was 43.4% (n = 85), while 56.6% (n = 111) were not screened despite meeting eligibility criteria. This screening rate is substantially lower than those reported in high-income countries, such as the United Kingdom (over 95%) and the United States (over 90%), where national guidelines and structured referral systems ensure near-universal coverage. In contrast, it is comparable to findings from other low- and middle-income countries, such as South Africa (~60%) and India (30–60%), where screening uptake remains limited due to resource constraints and weak referral pathways.

8.2 Factors Affecting Screening for ROP

Two multivariable logistic regression models were tested during the analysis. The first model included continuous variable for gestational age, birth weight and length of stay while the second model used categorical form for those variables. Model fitness indicators, including overall model significance, explained variance, sensitivity, and specificity, were assessed for both models and demonstrated acceptable performance, although the exact values differed between models. Both models showed consistent direction of association for key predictors; length of hospital stay and linkage to ophthalmology services. However, the model using continuous variables provided more precise estimates and better utilization of the data as it avoids loss of information associated with categorization and allows more accurate estimation of associations. Therefore, the continuous-variable model was selected as the primary model for interpretation and reporting of adjusted effect.

In bi-variable analysis, factors like gestational age, birth weight, CPAP use, residential location, oxygen support, and linkage to ophthalmology were significantly associated with screening status. However, after adjusting for confounders in the multi-variable logistic

regression model, only linkage to the ophthalmology department and length of NICU stay remained independent predictors of screening.

This study found that infants who were linked to the ophthalmology department were 45.45 times more likely to be screened compared to those who were not linked (AOR = 45.45, 95% CI: 0.007–0.072, $p < 0.001$). The bi-variable analysis further supported this, showing that infants with a link were approximately 29 times more likely to be screened (COR = 28.9). A systemic review in Sub-Saharan Africa reported that weak referral pathway is one of the leading barriers to screening uptake aligning with this research result suggesting that system-level barriers, such as inadequate referral pathways, are major predictors of screening failure in resource-limited settings. It was also noted that the primary barrier for screening was eligible neonates who were discharged with no linkage to the Ophthalmology Department, 34.6% (n=97), followed by mortality, with 30% (n=84) of infants dying before screening could be performed. Although the adjusted odds ratio for linkage to ophthalmology was highly significant and precise in multivariable logistic regression, the reduced sample size due to neonatal mortality limits the generalizability of this finding.

The study also shows that length of stay in the NICU was a significant independent predictor of ROP screening. Similarly, a hospital based study in Tanzania found that prolonged NICU admission increased the likelihood of screening, supporting our observation that each additional day of hospitalization raised screening odd by 12% (AOR = 1.118, 95% CI: 1.069–1.168, $p < 0.001$). This shows that prolonged NICU admission provides additional opportunities for healthcare providers to detect eligibility and conduct ROP examinations before the infant is discharged.

The use of Continuous Positive Airway Pressure (CPAP) was significantly associated with screening status in the bi-variable analysis (COR = 3.14, $p = 0.015$), with infants receiving CPAP being over three times more likely to be screened. This finding corresponds with research identifying oxygen therapy management and clinical care factors as key influences on ROP screening prevalence. However, this association did not remain significant in the multi-variable

model ($p = 0.741$), suggesting that the effect of CPAP may be mediated by other factors such as the severity of illness or length of stay.

Residential location also showed a significant association in the bi-variable analysis ($COR = 1.809$, $p = 0.043$), indicating that urban residence may be associated with a higher likelihood of screening compared to rural residence. This is consistent with socioeconomic factors identified in a study done in South Africa, such as distance from hospitals and parental education, which affect compliance with screening protocols.

Interestingly, our study did not find a significant independent association between gestational age or birth weight and screening status in the multi-variable model, despite their high significance in the bi-variable analysis ($p < 0.001$). This contrasts with the general principle that lower GA and BW are the primary criteria for screening eligibility. This difference might be because, in our setting, the logistical factors of linkage and stay duration are more decisive in whether a "high-risk" infant actually receives the screen than the clinical risk itself.

The remaining variables, such as Sex ($P = 0.317$), Place of Delivery ($P = 0.982$), Household Income/Payment Method ($P = 0.544$), APGAR score at the 5th minute ($p = 0.704$), and Comorbidity identified at time of management ($P = 0.171$) did not show a statistically significant association with the ROP screening status.

9. Limitations of the study

In this study, screening prevalence was calculated only among neonates who survived to the appropriate age for examination (n=196). The exclusion of 30% of admitted high-risk neonates (n=84) who died before reaching screening age, while methodologically necessary, restricts the ability of the analysis to reflect the full burden of ROP risk within the NICU population. It might also contribute to large COR and wide CI seen in some variables.

Variables like comorbidity, oxygen support, place of delivery and income status had sparse data leading to wide CI. Merging of data was done for the three excluding oxygen support, to stabilize the model. For respiratory support; while merging oxygen and CPAP into a single 'respiratory support' variable could have stabilized the model, this approach masked the distinct effect of CPAP, which is clinically relevant. Therefore, the variables were retained separately, but this decision may have limited statistical power and result should be interpreted cautiously.

Since HMIS log book was used to obtain data rather than actual individual chart of the neonate variables such as comorbidity and reason for not screening might not fully capture the complete clinical picture.

Although St. Paul Hospital is one of the few institutions in Ethiopia with both NICU and ophthalmology services, and thus an ideal setting for ROP screening research, this study was limited to a single institution. Therefore, the findings may not be generalizable to other hospitals with different resources or patient populations.

10. Conclusion

This study provides the first quantitative assessment of Retinopathy of Prematurity (ROP) screening practices in a major tertiary referral hospital in Ethiopia. The overall prevalence of ROP screening among eligible neonates at St. Paul's Hospital Millennium Medical College was found to be substantially lower than that of high-income countries and lower-income countries with national guidelines.

The multi-variable logistic regression analysis revealed that systemic and logistical factors, rather than clinical risk factors, were the independent predictors of whether an eligible infant received screening. Specifically, a link to the ophthalmology department was the strongest predictor, with infants who were linked had markedly higher odds of being screened. Furthermore, a longer length of stay in the NICU was positively associated with screening suggesting that prolonged hospitalization provides a crucial window of opportunity for screening to occur. The non-significance of traditional clinical risk factors such as gestational age, birth weight, comorbidity, and oxygen support in the final adjusted model suggests that, in this setting, the failure to screen is primarily a systemic failure of coordination and follow-up, rather than a failure to identify the clinically high-risk infant. The high proportion of non-screened infants discharged without linkage further supports this conclusion, indicating a critical breakdown in the referral pathway.

This also suggests that even if national guidelines should still define GA and BW cut-offs to standardize care, strengthening referral pathways and NICU follow-up is essential to ensure that eligible infants are actually screened.

11. Recommendation

- **St. Paul's Hospital Millennium Medical College and Department of pediatrics and child health**

The NICU, as one unit in the department of pediatric and child health, works effectively in screening those neonates who reach the age of screening before discharge. However, when the neonates are discharged before the age of screening, most of them are not linked to ophthalmology. This study recommends that the administrative body should enforce a protocol that mandates linking high- risk neonate to the ophthalmology department upon discharge.

- **Ministry of Health**

The Minister of Health should develop a national guideline that is tailored based on current clinical data, as well as incorporate a protocol that addresses institutional systemic barriers. The Ministry of Health should also prioritize integrated strategies that strengthen neonatal intensive care to reduce mortality while simultaneously establishing structured ROP screening protocols.

- **Future researcher**

Further study is needed to determine the practical cut-off point that can be used nationally. Multi-institution centered study is also recommended to provide a more representative picture of ROP screening practices across Ethiopia. It is also recommended to conduct qualitative studies (e.g., interviews with NICU staff, ophthalmologists, and parents) to gain a deeper understanding of the operational, logistical, and socioeconomic barriers that contribute to the low linkage and screening rates.

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13. Annexes

13.1 Abstraction Checklist

Study Title: prevalence of and factor affecting ROP screening in preterm infant admitted in SPHMMC NICU over the past 1 yr.

Date of data collection: _____

Name of data collector: _____

Section A: Patient Identification

Patient Medical Record Number (MRN): _____

Section B: Infant Characteristics

Date of Birth : _____

Gestational Age (at birth, in weeks): _____

Birth Weight (in grams): _____

Sex: ☐ Male ☐ Female

APGAR Score at 5 minutes: _____

Section C: Clinical and NICU Factors

Date of NICU Admission _____

Date of NICU Discharge _____

Length of NICU Stay (in days): _____

Respiratory Support (prolonged Oxygen Therapy): ☐ Yes ☐ No

If Yes, duration in days: _____ days

Was put on mechanical ventilator: ☐ Yes ☐ No

Comorbidity (check all that apply):

☐ Sepsis

☐ Respiratory Distress Syndrome (RDS)

☐ Intraventricular Hemorrhage (IVH)

☐ Other (please specify): _____

Section D: ROP screening status

ROP Screening Performed: ☐ Yes ☐ No ☐ Not Documented

If yes, date of first ROP screening _____

If No, reason for not screening (if documented): _____

Section E: System-Level Factors

Availability of Ophthalmologist Checkup (linked to ophthalmology department): ☐ Yes ☐ No

Documentation Completeness (all key variables available): ☐ Complete ☐ Incomplete

Section F: Socioeconomic Factors

Household Income (Payment Status):

☐ Self-pay ☐ Insurance ☐ Free/Waived ☐ Not Documented

Residential Location (if documented):

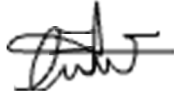
☐ Urban ☐ Rural ☐ Not Documented

Declaration

I, the undersigned student, declare that this research project is my original work in partial fulfillment of the requirement for the **Degree of Doctor in Medicine, MD**. I also declare that it has never been presented in this or any other higher institution and all resources and materials used in the research work have been duly acknowledged.

Name of the student: Elsabeth Tesfaye

Signature



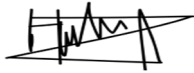
Date: 27/3/2026

Approval of Advisors

This research work has been submitted for the examination with my approval.

Name of school of Public health advisor 1: Mr. Hailemichael Bizuneh

Signature:



Date: 27/3/2026

Name of Clinical advisor 2: Dr. Melatemariam

Signature: _____



Date: 27/3/2026