

# Prevalence of retinopathy of prematurity in Latin America

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**Abstract:** The purpose of this work was to review the studies published over the last 10 years concerning the prevalence of retinopathy of prematurity (ROP) in Latin American countries, to determine if there was an improvement in ROP prevalence rates in that period, and to identify the inclusion criteria for patients at risk of developing ROP in the screening programs. A total of 33 studies from ten countries published between 2000 and 2010 were reviewed. Prevalence of any ROP stage in the regions considered ranged from 6.6% to 82%; ROP severe enough to require treatment ranged from 1.2% to 23.8%. There was no routine screening for ROP, and there was a lack of services for treatment of the disease in many countries. Inclusion criteria for patients in the studies ranged between birth weight  $\leq 1500$  g and  $\leq 2000$  g and gestational age  $\leq 32$  and  $< 37$  weeks. Use of different inclusion criteria regarding birth weight and gestational age in several Latin American studies hindered comparative analysis of the published data. Highly restrictive selection criteria for ROP screening in relation to birth weight and gestational age should not be used throughout most Latin American countries because of their different social characteristics and variable neonatal care procedures. The studies included in this review failed to provide adequate information to determine if the prevalence of ROP has decreased in Latin America.

**Keywords:** retinopathy of prematurity, prevalence, incidence, Latin America

## Introduction

Retinopathy of prematurity (ROP) is an important cause of avoidable childhood blindness in high human development index countries and also in several countries with emerging economies. According to Gilbert et al, it is estimated that over 50,000 children in the world have ROP-related blindness and half of these children live in Latin America, which is an alarming finding.<sup>1,2</sup>

Several Latin American countries have reported increased survival rates of preterm infants due to improved quality of perinatal care. Consequently, more affected children has been observed, as well as an increased incidence of ROP-induced blindness. Many neonatal intensive care units have been established in this region in recent years, but without implementation of effective detection and treatment programs for ROP.<sup>3,4</sup>

In several Latin American countries, insufficient data on the prevalence of ROP hinder the establishment of strategies to minimize occurrence of the disease.<sup>1</sup> A reduction in ROP-induced childhood blindness relies on implementation of preventive measures, such as monitoring of oxygen delivery and early detection and treatment of affected patients.<sup>4</sup>

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To date, there are no studies analyzing ROP prevalence data between the different Latin American countries. Increased knowledge on the current scenario of ROP in this region may be a valuable tool in the prevention of childhood blindness. This review of published data on the prevalence of ROP in Latin America aims to analyze the inclusion criteria for patients at risk of developing ROP in the studies and to determine if there has been an improvement in ROP prevalence rates in the period under review.

## Materials and methods

This is a database review of published prevalence data for ROP in Latin America from 2000 to 2010. The region under study comprised 16 Spanish-speaking or Portuguese-speaking countries located in North, South, and Central America (Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay, and Venezuela, in addition to Cuba and the Dominican Republic in the Caribbean region). Our review focused on articles that described the prevalence of any stage ROP (defined according to the International Classification of ROP)<sup>5,6</sup> and of ROP severe enough to require treatment (defined according to local treatment guidelines). Articles focusing on the prevalence of ROP are presented in table form in order to summarize the data. Other articles identified from the region and published within the same period but focusing on aspects of ROP other than prevalence were used only for discussion purposes in order to analyze data on guidelines and neonatal care procedures that could affect the prevalence of ROP in these countries.

Search terms used were “retinopathy of prematurity”, “retinopatía del prematuro”, “retinopatia da prematuridade”, “prevalence”, “incidence”, “prevalencia”, “incidencia”, “prevalência”, and “incidência”. Databases searched were PubMed (<http://www.ncbi.nlm.nih.gov/sites/entrez>), Lilacs (<http://lilacs.bvsalud.org>), Scielo (<http://www.scielo.org/php/index.php>), and DOAJ (<http://www.doaj.org>).

## Results

This literature review yielded 33 articles related to ROP prevalence, including 18 prospective studies, 13 retrospective studies, and two articles that did not specify the study design. Twenty-nine papers were institution-based studies and four were multicenter studies, two from Argentina,<sup>7,8</sup> and one each from Chile<sup>9</sup> and Cuba.<sup>10</sup>

All but one of the reviewed studies showed a cross-sectional analysis of prevalence. One article from Colombia described regional prevalence of ROP in a longitudinal manner.<sup>11</sup>

Screening criteria for inclusion of patients in the different studies ranged between birth weight  $\leq 1500$  g and  $\leq 2000$  g and gestational age  $\leq 32$  and  $< 37$  weeks. Prevalence of any stage ROP ranged from 6.6% to 82% and of severe ROP ranged from 1.2% to 23.8%. Papers that included national guidelines for ROP screening were from Argentina<sup>12,13</sup> and Brazil.<sup>14</sup>

Papers with screening inclusion criteria for patients that mentioned birth weight  $\leq 1500$  g and/or gestational age  $\leq 32$  weeks originated from Argentina,<sup>8</sup> Brazil,<sup>4,15–20</sup> Chile,<sup>9,21</sup> and Colombia.<sup>11,22</sup> In this group of papers, the prevalence of any stage ROP ranged from 24.2% in Brazil<sup>18</sup> to 62% in Colombia.<sup>22</sup> The prevalence of severe ROP requiring treatment ranged from 5.3%<sup>15,18</sup> to 9.3%<sup>19</sup> in Brazil. Table 1 describes ROP prevalence rates and the main characteristics of the 33 studies included in this review. Most of the published data from Latin America was identified in a non-PubMed database, ie, Scielo, which is an important tool for recovering published articles from this region.

## Discussion

Only papers on prevalence of ROP are included in Table 1. Papers concerning aspects of ROP other than prevalence were included to collect data on guidelines and neonatal care procedures that could affect the prevalence of ROP in these countries, but are not included in Table 1. Use of different inclusion criteria for patients in the screening programs performed in several Latin American countries, as well as in the reviewed studies, limited any comparative analysis of the published data. Most studies provided insufficient data to enable detailed analysis of the prevalence of ROP in the region. The studies also failed to provide adequate information to determine if the prevalence of ROP is decreasing in Latin America.

### Argentina

The scenario of ROP is quite complex in Argentina. Until recently, Argentina had the highest rate of ROP-induced blindness of all the Latin American countries, with an ROP prevalence of about 60%, a rate three times higher than that usually reported in industrialized countries in the early 1990s, according to data from Gilbert et al.<sup>1,2</sup>

Guidelines and recommendations for ROP screening were published in Argentina in 1999<sup>12</sup> and revised in 2008.<sup>13</sup> These guidelines recommend that an ROP examination should be performed in all infants with a birth weight  $\leq 1500$  g and/or gestational age  $\leq 32$  weeks, and in older babies (gestational

**Table 1** Studies on the prevalence of retinopathy of prematurity in Latin America

Country (Reference)	Year of publication	Study design	Patients (n)	Inclusion criteria, (BW, GA)	% any stage ROP	% ROP requiring treatment
Argentina <sup>47</sup>	2004	R	584	<2000 g; <36 weeks	26.4%	N/R
Argentina <sup>7</sup>	2006 multicenter	R	4,561	<2000 g	N/R	19% <1000 g
Argentina <sup>8</sup>	2010 multicenter	R	956	≤1500 g; ≤32 weeks	26.2%	7%
Bolivia <sup>34</sup>	2002	R	84	N/R	14.3%	N/R
Brazil <sup>25</sup>	2001	N/R	50	<1750 g; <36 weeks	28%	N/R
Brazil <sup>17</sup>	2006	P	114	<1500 g; <32 weeks	27.2%	5.3%
Brazil <sup>26</sup>	2007	P	286	≤37 weeks	20%	2%
Brazil <sup>4</sup>	2007	P	300	<1500 g; <32 weeks	24.7%	6%
Brazil <sup>16</sup>	2007	P	329	<1500 g; <32 weeks	25.5%	5.5%
Brazil <sup>30</sup>	2010	P	70	≤1500 g	35.7%	10%
Brazil <sup>20</sup>	2010	R	73	≤1500 g; ≤32 weeks	53.4%	N/R
Brazil <sup>27</sup>	2009	R	147	N/R	23%	3%
Brazil <sup>28</sup>	2009	R	663	≤1500 g; ≤36 weeks	62.4%	N/R
Brazil <sup>18</sup>	2009	P	450	≤1500 g; ≤32 weeks	24.2%	5.3%
Brazil <sup>17</sup>	2009	P	407	<1500 g; <32 weeks	25.5%	5.8%
Brazil <sup>19</sup>	2010	P	152	≤1500 g; ≤32 weeks	27.8%	9.3%
Chile <sup>21</sup>	2000	P	248	<1500 g; <32 weeks	28.2%	N/R
Chile <sup>32</sup>	2003	R	253	<1500 g; <34 weeks	33.6%	1.2%
Chile <sup>33</sup>	2004	P	205	<1500 g	71.2%	12.3%
Colombia <sup>11</sup>	2006	R	1174	<1500 g; <32 weeks	N/R	8%
Colombia <sup>22</sup>	2007	R	234	<1500 g; <32 weeks	62%	N/R
Cuba <sup>36</sup>	2006	N/R	227	<1700 g; <32 weeks	6.6%	9.5%
Cuba <sup>37</sup>	2007	P	66	<1750 g; <35 weeks	24.2%	4.5%
Cuba <sup>10</sup>	2008 multicenter	R	4,396	<1700 g; <35 weeks	11.2%	2%
Cuba <sup>38</sup>	2010	P	31	<1500 g	25.8%	12.9%
Cuba <sup>39</sup>	2010	P	137	<1750 g; <35 weeks	15.3%	5.1%
Guatemala <sup>40</sup>	2010	P	88	<2000 g; <35 weeks	49%	13%
Mexico <sup>42</sup>	2005	P	57	<1500 g	28%	10.5%
Mexico <sup>43</sup>	2007	P	2,014	<1500 g	22.3%	11.4%
Mexico <sup>44</sup>	2008	P	29	<1500 g; <34 weeks	24.1%	10.3%
Mexico <sup>48</sup>	2006	P	170	<1500 g; <35 weeks	10%	2.7%
Nicaragua <sup>45</sup>	2004	R	77	<36 weeks	82%	23.8%
Peru <sup>46</sup>	2007	R	136	<1500 g	70.6%	19.1%

**Abbreviations:** BW, birth weight; GA, gestational age; N/R, not reported; ROP, retinopathy of prematurity.

age <37 weeks) with an unstable clinical course or with risk factors.

In 2003, a multicenter collaborative working group was created to address the prevention of ROP-induced childhood blindness in Argentina. This group, affiliated with the Ministry of Health and Environment in Argentina, published the results of a nationwide survey involving 100 neonatal centers in 2006. The survey was designed to increase knowledge about the characteristics of these units with regard to ROP screening programs. Only 47 centers participated in the survey effectively (36 provided all the information requested, but five of these centers did not perform ROP screening). Eleven centers provided general information, but failed to provide data on screening and prevalence of ROP. The study included a total of 4561 patients from all institutions that

performed ROP screening. Infants were divided according to birth weight, as follows: birth weight <1000 g (n = 336); birth weight 1000–1500 g (n = 1353); and birth weight 1501–2000 g (n = 2872). Among the patients with birth weight <1000 g, 19% (64/336) required treatment for severe ROP compared with 6.9% (93/1353) in the group with birth weight 1000–1500 g and 1.6% (47/2872) in the group with birth weight 1501–2000 g. In addition, five patients with birth weight >2000 g required treatment, and 13 infants missed the opportunity for treatment. The study reported that 57% of neonatal unit care centers were still unaware of the incidence of ROP and more than 70% of these centers felt that this issue was out of control or improving slowly. Moreover, the study reported deficiencies in efforts to prevent ROP as a result of an insufficient number of nurses,

oximeters, and pulse oximeters, and inadequate monitoring of oxygen saturation. Diagnosis of ROP was hampered by a lack of trained ophthalmologists to diagnose and treat the disease outside the city of Buenos Aires, the capital of Argentina. Lack of adequate ophthalmological examination using indirect binocular ophthalmoscopy in screening was also reported. Mortality among patients with a birth weight <1500 g was high, reflecting inadequate neonatal care procedures. Several ROP cases were detected as a missed opportunity for treatment. The authors stated that the data presented provided an unrealistic representation of ROP in Argentina, because many centers had no ROP screening programs and, therefore, the disease was still likely to be under-reported in this country.<sup>7</sup>

A study published in 2007 investigated 809 patients admitted to a pediatric hospital in Buenos Aires between 1996 and 2003 for treatment of ROP. The sample also included infants with a birth weight >1500 g and gestational age >35 weeks. Of these patients, 55% (443/809) had a threshold ROP or greater (stage 4 or 5 ROP and aggressive posterior ROP), and 25.7% were considered atypical (or unusual) cases, ie, had severe ROP associated with birth weight >1500 g and gestational age >31 weeks. These atypical findings were probably due to unequal levels of assistance according to the source of referral of patients for treatment of ROP in Buenos Aires. Of 809 patients referred for treatment, 89% (n = 718) received treatment, 59 patients missed the opportunity for treatment due to late referral, and 32 patients did not require treatment. This study showed an alarming increase in the number of patients with severe ROP among infants with higher birth weight and older gestational age.<sup>23</sup>

An excellent publication on technical guidelines for the management of ROP in Argentina was published by the Secretary of Health of the Federal Government in 2008 and is available on the Internet.<sup>24</sup>

## Brazil

Guidelines for ROP screening and treatment were published in Brazil in 2007, and recommended that ROP examination be performed in all infants with a birth weight  $\leq$ 1500 g and/or gestational age  $\leq$ 32 weeks.<sup>14</sup> The selection criteria for screening in Brazil are similar to those recommended in Argentina.<sup>12,13</sup>

Currently, there are no population-based studies in Brazil that enable analysis of ROP epidemiology as a whole in such an ethnically and socially diverse population. On the other hand, 12 institution-based studies were identified, enabling

a reasonable understanding of the behavior of the disease in Brazil.

In 2001, the prevalence of any stage ROP was determined to be 28% among 50 preterm infants of gestational age <36 weeks and birth weight <1750 g in the northeastern region of Brazil. This study, with a small number of patients and including babies with a birth weight >1500 g and/or older than 32 weeks' gestational age, was published before the Brazilian guidelines were established and did not report data on the prevalence of severe ROP.<sup>25</sup>

In a prospective study conducted in the city of Joinville, southern Brazil, Bonotto et al investigated 286 preterm infants of gestational age  $\leq$ 37 weeks at birth and reported a 20% prevalence of ROP of any stage. However, their inclusion of patients with a gestational age  $\leq$ 37 weeks may have underestimated the prevalence of ROP, especially among those requiring treatment, since the authors reported that all infants who required treatment had a birth weight <1399 g and a gestational age <33 weeks.<sup>26</sup>

In 2009, Lorena and Brito studied 147 patients in the state of São Paulo, southeastern Brazil, and reported that 23% of these patients had any stage ROP and 3% (only one patient) required treatment. Of 35 patients with ROP, 97% (n = 34) developed ROP stage 1 with spontaneous regression. This study failed to describe the inclusion criteria or mean and standard deviation for birth weight and gestational age, which limited any comparative data analysis. Risk factors for ROP were assessed, but no logistic regression was performed to determine their influence in relation to birth weight and gestational age, which are important risk factors for ROP.<sup>27</sup>

In 2009, Schumann et al reported a 53.4% incidence of ROP in 73 patients with a birth weight  $\leq$ 1500 g and/or gestational age  $\leq$ 32 weeks in the state of Rio de Janeiro, southeastern Brazil. Although this study did not report data on the prevalence of severe ROP, the patient inclusion criteria were in accordance with the Brazilian guidelines.<sup>20</sup>

In a study conducted in the city of Natal, northeastern Brazil, Pinheiro et al retrospectively analyzed data from 663 preterm infants with a birth weight  $\leq$ 1500 g and/or gestational age  $\leq$ 36 weeks, and reported a 62.4% prevalence of ROP between 2004 and 2006. The study included appropriate considerations regarding risk factors for ROP using logistic regression.<sup>28</sup>

In five prospective studies from Porto Alegre, southern Brazil, Fortes Filho et al investigated ROP prevalence rates after 2002. Among babies with a birth weight  $\leq$ 1500 g and/or

gestational age  $\leq$  32 weeks, the prevalence of any stage ROP was reported to be about 25%, whereas prevalence of severe ROP was reported to be about 5%.<sup>4,15-18</sup> The occurrence of ROP was significantly higher in babies with a birth weight  $<$ 1000 g and/or gestational age  $<$ 28 weeks, reaching about 45% and 17%, respectively, for any stage ROP and severe ROP.<sup>29</sup> All of these studies were in accordance with the Brazilian guidelines, included a higher number of patients, and clearly described their methods and results in order to allow comparisons with international studies on the same topic.

In 2010, Shinsato et al prospectively reported a 35.7% incidence of ROP among 70 patients with birth weight  $\leq$ 1500 g in the state of São Paulo, southeastern Brazil. This study had a small sample size and failed to establish a cutoff point for gestational age or the mean and standard deviation (or median and interquartile range) for birth weight and gestational age in the cohort of patients, thereby hindering a comparative analysis of results.<sup>30</sup>

Significant variations in prevalence of ROP observed in several Brazilian studies reflect the heterogeneity of the population across regions as well as the different screening criteria used, and reflect a marked variation in neonatal care procedures currently performed in the country. Zin et al recently recommended that ROP programs in Brazil use a wider criterion of birth weight  $\leq$ 1500 g or gestational age  $\leq$ 35 weeks until further evidence-based criteria become available, although this would mean a slight increase in workload for the ophthalmologists performing ROP screening. These authors also suggested that survival rates for very low birth weight preterm infants in neonatal intensive care units reflect the quality of local neonatal care. Local neonatal intensive care unit screening criteria could be better adjusted, according to data on survival rates for babies with a birth weight  $<$ 1500 g.<sup>31</sup>

## Chile

Chile is one of the countries in Latin America with a high level of neonatal health care. In 1998, a national commission for follow-up of preterm infants was established, consisting of neonatologists who, working jointly with the Ministry of Health of Chile, undertook progressive follow-up of patients of low birth weight and gestational age, obtaining data from birth to the age of 7 years. In 2005, national guidelines and protocols were published in Chile, with the aim of standardizing neonatal care in that country, thus enabling better comparative analysis of the results obtained.<sup>9</sup>

In 2000, Bancalari et al analyzed 248 very low birth weight preterm infants and reported a 28.2% rate for any stage ROP, although the number of infants treated for severe ROP was not described. The sample included infants with birth weight  $<$ 1500 g, and 13% of these patients had any stage ROP. Nine infants with birth weight  $<$ 1000 g and 15 infants with birth weight 1000–1500 g developed severe ROP (stage 3, 4, or 5). This situation is different from that usually observed, whereby a higher incidence of ROP is expected in infants of lower birth weight. However, this study did not reported enough data to allow comparison.<sup>21</sup>

In 2003, another study investigated 253 patients with birth weight  $<$ 1500 g and/or gestational age  $<$ 34 weeks. ROP of any stage was identified in 33.6% of patients. Total blindness arising from ROP was detected in three patients (1.2%).<sup>32</sup> In 2004, Salas et al reported 12.3% of severe ROP cases as needing treatment, as well as a rate of 71.2% for any stage ROP in 205 preterm infants with birth weight  $<$ 1500 g.<sup>33</sup> In 2006, another Chilean study reported clinical follow-up of preterm infants with birth weight  $<$ 1000 g, and included infants with ROP in the analysis. The mortality rate among extremely low birth weight preterm infants was 55.2%. Among the surviving infants, 80% ( $n = 76$ ) had ROP of any stage and 11.5% ( $n = 11$ ) required laser treatment; the study reported no cases of ROP-induced blindness. This study was not specifically designed to investigate ROP and so is not included in Table 1. However, indicators of prenatal antecedents, sequelae, complications, and mortality rates among extremely low birth weight preterm infants were reported in the study, indicating excellent perinatal care in Chile.<sup>34</sup> Current analysis of ROP in Chile is available on the Internet at <http://www.retinopatiadelprematuro.cl/> and at [http://www.prematuros.cl/webfebrero06/rop/rop\\_chile.htm](http://www.prematuros.cl/webfebrero06/rop/rop_chile.htm).

## Colombia

According to a study published by Zuluaga et al, until 2006 there were no government directives in Colombia indicating that routine screening of infants should be performed for detection and treatment of ROP. This longitudinal study from 2001 to 2005 investigated 1174 patients with a birth weight  $<$ 1500 g and/or gestational age  $<$ 32 weeks, and reported that the proportion of newborns screened increased from 29.3% to 98.9% and that children requiring treatment decreased from 18% to 4.9% during the same period.<sup>11</sup> Studies of ROP are still scarce in Colombia, but most regions are awakening to the importance of investigating

for the disease. Protocols are in place and professionals are being trained to diagnose patients at risk of developing ROP accurately and early, given that ROP was one of the main causes of blindness in the city of Cali in 2005.<sup>35</sup>

## Cuba

A program to address ROP was launched in 1997 for Latin American countries, and Cuba decided to adopt this program. In 2003, all Cuban neonatal centers joined the program and the first results were published in 2006. These results were from an institution-based study analyzing 227 infants with birth weight <1700 g and gestational age <32 weeks, and reported that 6.6% of patients had ROP of any stage and 9.5% developed ROP stage 3. Most infants with ROP had a birth weight <1500 g. This study failed to describe the number of patients effectively treated and whether there were cases of blindness due to progression of ROP, although an ROP 3 incidence of 9.5% was reported.<sup>36</sup> Inclusion of patients weighing up to 1700 g at birth may be an interesting piece of information for Cuba, but hinders further consideration of the prevalence of the disease in that country.

An institution-based study conducted between 2003 and 2005 and published in 2007 analyzed data from 66 preterm infants with birth weight <1750 g and gestational age <35 weeks. Any stage ROP was diagnosed in 24.4% of patients, and 4.5% developed ROP 3 requiring treatment.<sup>37</sup> However, this study used inclusion criteria that were quite different from those used in the previous investigation, despite being published only one year later, so a comparison of the two studies was not appropriate, nor with any other Latin American studies or studies from industrialized countries, due to the small sample and broad inclusion criteria.

A Cuban multicenter study from 2008 included data on 4396 preterm infants with birth weight <1700 g and gestational age <35 weeks from 33 neonatal intensive care units around the country, and reported a 11.2% rate of any stage ROP and a 2% rate of severe ROP needing treatment.<sup>10</sup> Cuba, according to published data, appears to have a good survival rate and low incidence of severe ROP among very low birth weight preterm infants for Latin American countries, but rates of 2%–12.9% for treatable ROP are still high rate compared with rates in industrialized countries. However, multicenter or population-based studies with much larger numbers of patients are needed for comparison with studies from other Latin American countries. Data from two other studies from Cuba are shown in Table 1. Both studies

included a small number of patients and different criteria for selection of patients,<sup>38,39</sup> so a comparison between them is not possible, nor with other Latin American studies or studies in industrialized countries.

## Guatemala

A Guatemalan study of 88 infants with birth weight <2000 g and gestational age <35 weeks published in 2010 showed a ROP prevalence of 43%. Of these patients, 13% developed ROP 3 and were referred for treatment. Three patients (3%) undergoing treatment progressed to ROP 5. This study was the first to analyze ROP in Guatemala and demonstrated a high prevalence of severe ROP (stage 3, 4, or 5), despite including infants weighing up to 2000 g at birth. The authors suggested that a formal ROP screening program be introduced in all neonatal centers, since no screening examination is currently performed for detection of ROP in that country and only a few infants are examined by ophthalmologists after hospital discharge when recommended by a neonatologist.<sup>40</sup>

## Mexico

Local studies on the prevalence of ROP in Mexico are scarce<sup>41</sup> despite the existence of a well structured national protocol for ROP screening. Guidelines for the management of ROP were published by the Secretary of Health of the Federal Government in 2008, and are available on the Internet at [http://www.generosaludreproductiva.gob.mx/IMG/pdf/WEB-Lineamiento\\_Rinopatia\\_2007.pdf](http://www.generosaludreproductiva.gob.mx/IMG/pdf/WEB-Lineamiento_Rinopatia_2007.pdf) and also on the Program for the Prevention of Blindness due to Retinopathy of Prematurity at Hospital de Clínicas de Porto Alegre (PROROP) website: [http://prorop.com/files/arq\\_ptg\\_6\\_1\\_254.pdf](http://prorop.com/files/arq_ptg_6_1_254.pdf).

A study published in 2005 analyzed 57 preterm infants with a birth weight <1500 g and showed a 28% prevalence of any stage ROP and 10.5% of severe ROP. Two patients became blind despite treatment.<sup>42</sup> Another study published in 2007 included data on 2014 preterm infants with birth weight <1500 g. The reported occurrence of severe ROP was 11.4%.<sup>43</sup> Both studies reported that patients were included in the screening protocol according to the criteria defined by the American Academy of Pediatrics and the American Academy of Ophthalmology, which are criteria intended for industrialized countries with excellence in perinatal care, and this is not available in most Latin American countries. This situation needs to be revised in Latin America due to the risk that patients not included in screening programs

because of restrictive selection criteria may develop ROP severe enough to require treatment, as often mentioned in the published literature.<sup>4,31</sup>

Another Mexican study, published in 2008, analyzed data from 29 patients with birth weight 900–1500 g and gestational age <34 weeks, and reported that 24.1% of patients developed ROP and 10.3% required treatment. One infant became blind despite treatment.<sup>44</sup> This study had a small sample size, so further comparison was not possible, but inclusion of patients up to 34 weeks' gestational age appears to be appropriate for the Mexican scenario.

## Nicaragua

The only study on ROP in Nicaragua, published in 2004, reported data for 77 preterm infants. Of these, 81.8% had any stage ROP and 54.8% developed higher-stage, threshold disease, or stage 4A, 4B, or 5 disease. Only 23.8% of cases were treated with cryotherapy or laser. The study was institution-based, had a small sample size, failed to describe patient inclusion criteria regarding birth weight, and showed a very high incidence of severe ROP. Moreover, the authors reported that only half of the patients were treated, demonstrating that strategies for the prevention of ROP-induced blindness are still in the early stages of development in this country.<sup>45</sup>

## Peru

Peru still lacks strategies for adequate diagnosis and treatment of ROP, thus increasing the likelihood of a poor prognosis when the disease occurs. Peru also lacks professional expertise and technology for treatment. A study on the prevalence of ROP involving 136 infants with birth weight 500–1500 g was published in Peru in 2007 and reported an incidence of 70.5% of any stage ROP. Of these patients, 19.1% required laser treatment and 2.2% of patients progressed to bilateral blindness despite treatment. Infants were examined before 4 weeks of life and weekly thereafter. The main problems identified were a lack of qualified ophthalmologists to care for preterm infants and unavailability of laser equipment, so that children often needed to be referred to centers with adequate resources for treatment. This situation limits access to timely treatment and also increases morbidity rates. Patients of gestational age <31 weeks were 2.7 times more likely to develop ROP and infants with birth weight <1190 grams were four times more likely to develop any stage ROP. The study is regarded as the first to analyze ROP statistics in Peru.<sup>46</sup>

## Summary

Additional multicenter and population-based studies are needed in Latin America to analyze further the high prevalence of ROP observed in these countries. It is necessary to improve the scientific quality of the information published in order to permit comparison with articles originating from more industrialized countries. Most of the international published data on prevalence of ROP includes cohorts of patients with birth weight  $\leq 1500$  g and/or gestational age  $\leq 32$  weeks, and it is suggested that future articles from Latin America use the same inclusion criteria to enable better comparison of data, despite broader inclusion criteria being used in the regional screening programs. Highly restrictive selection criteria in relation to birth weight and gestational age for detection of ROP, like those used in industrialized countries such as the USA, UK, and Canada, should not be used in Latin American countries because of the different social characteristics and neonatal care procedures involved. This was observed in studies from Mexico,<sup>42,43</sup> and the concept is reinforced by Zin et al<sup>31</sup> and by Fortes Filho et al.<sup>4</sup>

Some studies reviewed here reveal that there are few qualified ophthalmologists to care for preterm infants. On the other hand, papers from Chile, Brazil, Argentina, Cuba, and Mexico showed an improvement in the management of ROP, as well as those from Colombia and Peru. Nicaragua, Bolivia, and Guatemala are embarking on better management of ROP. It is thus of paramount importance that ophthalmologists, neonatologists, and nursing staff become fully aware of their role in neonatal intensive care units and that measures to prevent ROP be implemented with the support of health care managers, particularly in countries where public health is a commitment and duty of the State.

## Conclusion

According to the studies reviewed here, the prevalence of any stage ROP ranges from 6.6% to 82% and of severe ROP ranges from 1.2% to 25% in Latin American countries. Most studies have been cross-sectional and provide insufficient data to allow a detailed analysis of the prevalence of ROP in the regions. The studies analyzed also fail to provide adequate longitudinal information to determine whether or not the regional prevalence of ROP is decreasing. The use of different patient inclusion criteria in the studies limits a comparative analysis of the published data. Some studies have reported improvement in survival rates among preterm infants and improved quality of perinatal care. Difficulties reported include insufficient personnel and equipment, but

government support and technical published guidelines are provided for several countries.

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