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Association of refractive status with birth weight and gestational age

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Abstract

Background: Refractive error is a major cause of childhood blindness worldwide and more than 13 million children are visually impaired.(1) With the advent of modern technology, many low birth weight babies are surviving. To improve the quality of life it is mandatory to screen them to prevent the development of amblyopia. The present study aims to find out whether birth weight and gestational age have any correlation with the refractive status.

Materials & Methods: Cross sectional study conducted in 100 eyes of 50 preterm & 50 term babies from the paediatric ophthalmology and paediatric neonatal unit of a tertiary centre in south India. Babies were grouped according to their birth weight to three groups. Very low birth weight (< 1.5 Kg), low birth weight (1.5- 2.5 kg) and normal (≥2.5Kg). Gestational age was also considered. After adequate cycloplegia(2,3) retinoscopy was done to detect the refractive status. Statistical analysis was done using spss version 16.

Results: There was a significant correlation between birth weight and refractive status. Myopia was the commonest refractive error in preterm and hypermetropia in term babies. The incidence of myopia was found to be inversely proportional to birth weight. There was no significant relation between the degree of myopia and birth weight. Anisometropia was seen more in preterm with statistical significance. The incidence of anisometropia decreases with increase in birth weight.

Keywords: Refractive error, Gestational age, Low birth weight.

Introduction

As per the WHO statistics nearly half of the blind or visually impaired people are suffering from uncorrected refractive errors, with more than 13 million of them being children.(1) The visual problems secondary to complications of prematurity are well known(4,5,6,7) like retinopathy of prematurity, Strabismus and refractive errors.

Simple hypermetropia is the normal optical condition in infants and persists throughout life in 50% of the population.(8) In few percent of neonates myopia can occur even in the absence of retinopathy of prematurity.(9) At birth, all eyes are hypermetropic to the extent of 2.50 to 3.00 diopters and it reduce rapidly during the first year of life. This process of emmetropisation, will be completed in 82% of full term infants by 12months of age.(10) Association of myopia and prematurity has been described by several authors.(11)

There are only few studies from south India on refractive status in low birth weight babies. In order to improve the quality of survival of these neonates, it is important to detect any visual problems at the earliest.

Aim of the study

1. To study the association of birth weight and refractive status in term and preterm babies.
2. To compare the refractive status of term and preterm babies at 6 weeks of corrected postnatal age.

Materials & Methods

This cross sectional study was conducted for a period of 12 months from September 2014, after the approval from institutional research and ethics committee, 100 eyes of 50 preterm and 100 eyes of 50 term babies were studied. Babies at 6 weeks of corrected postnatal age (after completing 40 weeks) obeying the inclusion criteria were selected randomly from the pediatric ophthalmology clinic and pediatrics department of a tertiary care Centre in South India. They were divided into preterm if the gestational age is less than 37 weeks and term if the gestational age is more than or equal to 37 weeks as per the WHO classification of weight independent gestational age classification.(12) Gestational age was calculated from the date of last menstrual period (LMP)or by New Ballard score if LMP was unavailable.(13) The babies were grouped according to their birth weight (according to the international standards for newborn weight) as very low birth weight (if the birth weight is less than 1.5 kg), low birth weight (if the birth weight is less than 2.5 kg, but more than or equal to 1.5 kg), and normal birth weight (if birth weight ≥ 2.5Kg). Weight was measured using electronic weighing machine. Patients with congenital ocular anomalies, ROP, and those with debilitating illness who could not undergo cycloplegic refraction were excluded. Patient data was collected with relevant history according to the proforma.

Torch light examination of anterior segment was performed to rule out any congenital anomalies. Cycloplegia and mydriasis were attained by cyclopentolate hydrochloride 1% and phenylephrine hydrochloride 5% combination eye drops after

excluding the contraindications.[2,3] Single drop was instilled in each eye 10 minutes apart for 3 times. Adequate cycloplegia with mydriasis were obtained after 45- 60 minutes. Then wet retinoscopy was performed using Welch Allyn self-illuminated streak retinoscope in a darkroom at a distance of 2/3 of a meter (approximately 66 cm). The dioptric power in the vertical and horizontal meridians were found out. Fundus examination was performed using indirect ophthalmoscope and 20 diopter lens to rule out any posterior segment pathology. The refractive status was calculated from the retinoscopy values by subtracting 2.0D from the original value (for adjusting the distance and cycloplegic effect of cyclopentolate). Anisometropia was documented when there is more than 2.0 diopter difference between the two eyes. The mean values of mean spherical equivalent, astigmatism and anisometropia in both term and preterm babies were analyzed. Values for both eyes were also analyzed statistically using SPSS 16 software.

Results

50 preterm and 50 term babies were included in this study. Among them 46 were males and 54 were females. Out of 100 cases 24% (n=24) were with very low birth weight, 26% (n=26) were with low birth weight and 50%(n=50) were with normal birth weight. The types of refractive errors in these groups with respect to birth weight and gestational age were analyzed both in right and left eyes separately and the results are plotted in Tables 1, 2, 3 and 4.

Table 1: Distribution of refractive status according to the birth weight in right eye

Birth weight (Kg)		Myopia	Hypermetropia	Astigmatism	Total	
Very low	frequency	12	10	02	24	P value 0.006
	%	50%	41.7%	8.3%	100%	
Low	frequency	11	11	04	26	
	%	42.3%	42.3%	15.4%	100%	
normal	frequency	07	27	16	50	
	%	14%	54%	32%	100%	
Total	frequency	30	48	22	100	
	%	30%	48%	22%	100%	

Table 2: Distribution of refractive status according to the birth weight in left eye

Birth weight (Kg)		Myopia	Hypermetropia	Astigmatism	Total	
Very low	frequency	13	08	03	24	P value 0.012
	%	54.2%	33.3%	12.5%	100%	
Low	frequency	10	11	05	26	
	%	38.5%	42.3%	19.2%	100%	
normal	frequency	08	25	17	50	
	%	16%	50%	34%	100%	
Total	frequency	31	44	25	100	
	%	31%	44%	25%	100%	

In both eyes, as birth weight increases, the incidence of myopia decreases and that of hypermetropia increases. This was statistically significant in both the eyes. (p value 0.006 in RE and 0.012 in LE)

Table 3: Distribution of refractive status in preterm and term in right eye

Gestational Age		Myopia	Hypermetropia	Astigmatism	Total	
Preterm	frequency	23	21	06	50	P value 0.001
	%	46%	42%	12%	100%	
Term	frequency	7	27	16	50	
	%	14%	54%	32%	100%	
Total	frequency	30	48	22	100	
	%	30%	48%	22%	100%	

Table 4: Distribution of refractive status in preterm and term in left eye

Gestational Age		Myopia	Hypermetropia	Astigmatism	Total	
Preterm	frequency	23	19	08	50	
	%	46%	38%	16%	100%	
Term	frequency	08	25	17	50	P value

	%	16%	50%	34%	100%	0.003
Total	frequency	31	44	25	100	
	%	31%	44%	25%	100%	

In the right eye, the majority of preterm babies showed myopia (46%, n=23) and majority of the term babies showed hypermetropia (54%, n=27) as their refractive status. This was statistically significant with a p value of 0.001.

In the left eye also majority of the preterm babies showed myopia as their refractive status (46%, n=23) and majority of term babies showed hypermetropia as their refractive status (50%, n=25). This was statistically significant with a p value of 0.003.

The degree of myopia is illustrated in both eyes in Fig. 1.

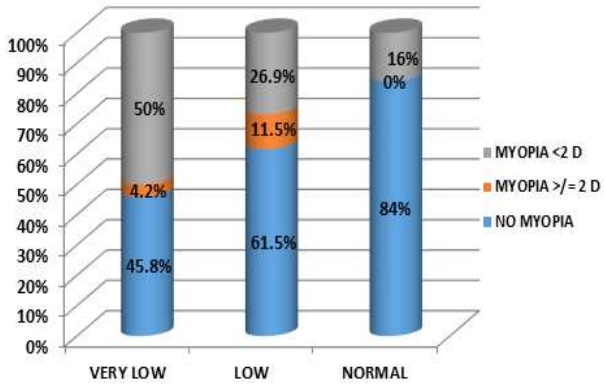

Fig. 1: Distribution of degree of myopia in both eyes according to birth weight.

In all the 3 groups majority had myopia less than 2 dioptre with a p value of 0.003 in both eyes. Distribution of degree of myopia in preterm and term babies are shown in Fig. 2 and 3

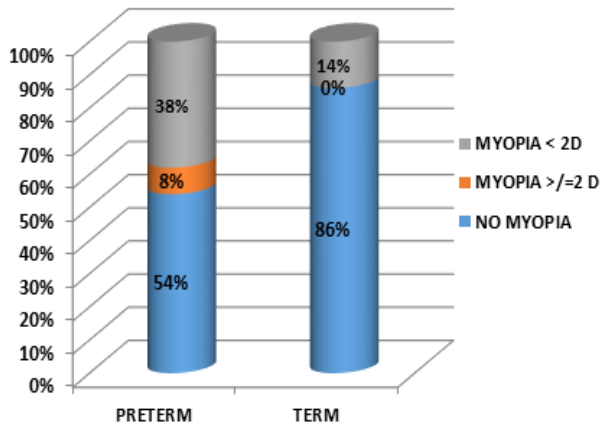

Fig. 2: Distribution of the degree of myopia in preterm and term babies in right eye

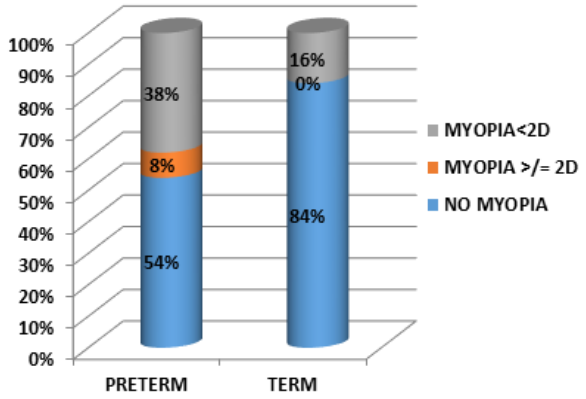

Fig. 3: Distribution of the degree of myopia in preterm and term babies in left eye

In both eyes, myopia of more than or equal to 2 dioptres was seen only in preterm babies (8% in both eyes). Term babies showed myopia of only less than 2 dioptres (14% in right eye and 16% in left eye). This showed statistical significance in both the eyes. (p value 0.003)

For analysing astigmatism, the type, degree and pattern were studied separately in both right and left eye. In right eye, 4.2% of very low, 15.4% of low and 18% of the normal birth weight babies showed astigmatism more than or equal to 1 dioptre. In left eye, 15.4% of low birth weight, 22% of normal birth weight babies showed astigmatism more than or equal to 1 dioptre. While considering the gestational age there was no astigmatism in 88% (N=44) of preterm and 68% (N=34) of term babies in the right eye. In the left eye 84% (N= 42) of preterm and 66% (N=33) term babies did not have astigmatism. In the right eye, astigmatism of more than or equal to 1 dioptre was seen in 10% (N=5) of preterm and 18% (N=9) of term babies. In the left eye, astigmatism of more than or equal to 1 dioptre was seen in 8% (N=4) of preterm and 22% (N=11) of term babies. Both preterm and term babies showed compound hypermetropic variety as the commonest type in both eyes. The commonest pattern of astigmatism observed was with the rule variety. There was no statistical significance of type, degree and pattern of astigmatism.

Distribution of anisometropia according to birth weight is shown below as charted in Fig. 4.

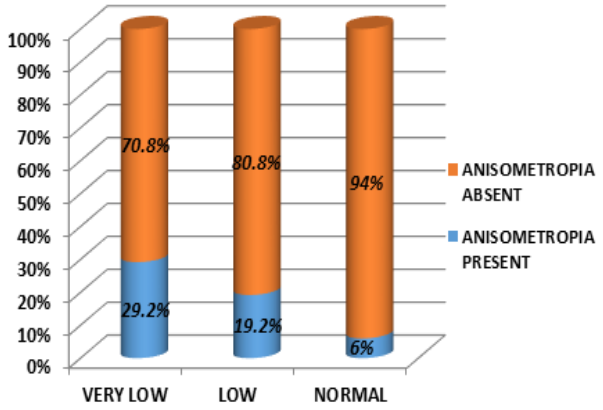

Fig. 4: Distribution of anisometropia according to the birth weight

Anisometropia showed decreased incidence on increase in birth weight with a significant p value of 0.026. The incidence of anisometropia in term and preterm babies are shown below in Fig. 5.

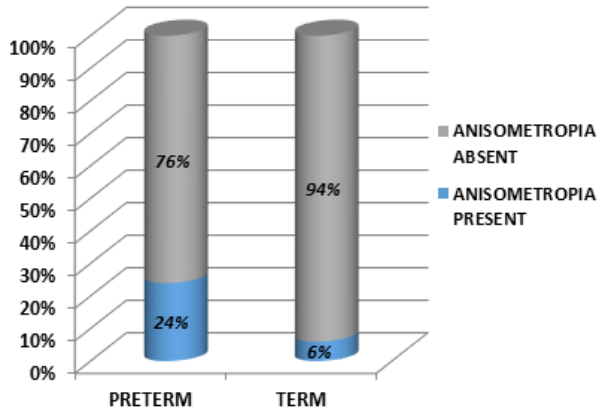

Fig. 5: Distribution of anisometropia in preterm and term babies

The incidence of anisometropia was found to be higher in preterm babies (24%, n=12) than term babies (6%, n=3), which was statistically significant with a p value of 0.012

Discussion

This study showed decrease in incidence of myopia and increase in incidence of hypermeropia as birthweight increases (p value of 0.003 in RE and 0.008 in LE). In all the 3 groups namely babies with very low birthweight, low birthweight and normal weight majority had myopia less than 2 dioptre with a p value of 0.003 in both eyes.

When astigmatism was analyzed compound hypermetropic astigmatism was found to be the commonest type in low and normal birth weight groups in both eyes. Very low birth weight group showed variable types of astigmatism. The pattern of astigmatism was also studied which showed, in very low birth weight group equal incidence of with the rule and against the rule astigmatism. But the low and normal birth weight groups showed increased incidence of with the rule pattern in both eyes. The association of type, degree and pattern was not statistically significant.

The present study also showed statistical significance in the association of gestational age with refractive status (p value of 0.001 in RE and 0.003 in LE); type of astigmatism (p value of 0.03 in RE and 0.04 in LE) and rule of astigmatism (p value of 0.04 in BE) in both eyes. Myopia was found to be the commonest refractive state in preterm babies (48% in RE and 46% in LE) whereas hypermetropia was found to be the commonest refractive state in term babies (56% in RE and 50% in LE). Myopia of more than or equal to 2 dioptres was seen in 8% of preterm babies. Term babies showed myopia of less than 2 dioptres only (14% in right eye and 16% in left eye). This showed statistical significance in both the eyes (p value 0.001 in RE and 0.003 in LE). This means that in term babies even if myopia is present it is not of a significant degree so that chances of emmetropization is there as the child grows.

The commonest type of astigmatism obtained in both groups of gestation was of compound hypermetropic variety with the rule. The astigmatism was more common in term babies than in preterm though it was not statistically significant. Increased incidence of astigmatism had a positive correlation with gestational age and birth weight in this study similar to the study by Verma et al.[5]

The incidence of anisometropia was found to be more in preterm and low birthweight groups. In very low birth weight babies the incidence was found to be 29.2%, in low birthweight it is 19.2% and in normal weight babies 6.0%.

Dr. Raji Mathew Varghese et al[15] studied refractive status, astigmatism, anisometropia and the mean refractive error against gestational age, birthweight, length and head circumference in indian babies.

They used tropicamide 0.8%with phenyl ephrine to achieve cycloplegia. Even though in the present study cyclopentolate, phenyl ephrine combination were used we also got the similar results. They found the decrease in the degree of hypermetropia and increase in myopia with increase in prematurity. There was significant correlation with birth weight and refractive status in their study. These results were comparable with our study.

In the present study anisometropia showed decreased incidence as increase in birth weight with a significant p value of 0.026. The anisometropia was found to be higher in preterm babies (24%, n=12) than term babies (6%, n=3), which was statistically significant with a p value of 0.012. Another indian study by Dr. Verma et al[5] showed that myopia has got an inverse relationship with gestational age with statistical significance. A similar trend was seen for

anisometropia also. It was observed that with decreasing weight, the incidence of myopia increased while hypermetropia decreased. The results of our study also concluded the same though the degree of myopia did not correlate with birth weight. Ingram and Barr etal in contrast observed no decrease in the incidence of hypermetropia among children from 1 year to 3 and half years.[16] Similarly a study on preterms from 2 weeks to 6 months of age from Israel reported no correlation of refractive error to gestational age or birth weight. Another study observed that refraction of prematurely born children was similar to that found in children born full term.[17] It is possible that refraction studies done later after emmetropization might have missed the initial refractive error. The inverse correlation of gestation and myopia was also noted by Dobson et al[18] Anisometropia was significantly correlated with decreasing gestation and birth weight in our study. Changes occurring in the corneal curvature, lens, media or axial length of the eye in low birth weight babies are responsible for complete emmetropisation later. Hence initial refractive error during the critical phase of visual development may be an important factor determining the visual defects in later life.

Limitation of this study was inability to use the potent cycloplegic agent atropine which is desirable in indian babies to get accurate retinoscopy value. The sample is small as it was a hospital based study.

Conclusion

Hypermetropia was the commonest refractive status of term babies and myopia was that of preterm babies in this study. The incidence of myopia was inversely proportional to the birth weight. However the degree of myopia was not related to birth weight. The incidence of anisometropia was more in preterm than in term babies and it was found to be inversely proportional to the birth weight. There was no statistically significant difference between the refractive status of right and left eye.

Hence all low birth weight babies irrespective of gestational age should be screened early for refractive errors to prevent amblyopia.

References

1. Eugene M. Helveston MD, Andrea Molinari MD, Visvaraja Subrayan MD, and Radhika Chawla OD. Vision and Refraction; Orbis International. Refractive Errors and vision loss; page:7
2. Serdal Celebi and Umit Aykan. The comparison of cyclopentolate and atropine in patients with refractive accommodative esotropia by means of retinoscopy, autorefractometry and biometric lens thickness. Acta Ophthalmologica Scandinavica. Volume 77, Issue 4.
3. Khoo BK1, Koh A, Cheong P, Ho NK. Combination cyclopentolate and phenylephrine for mydriasis in premature infants with heavily pigmented irides. J Pediatr Ophthalmol Strabismus. 2000 Jan-Feb;37(1):15-20.
4. Quinn GE, Dobson V, Kivlin J, Kaufman LM, Repka MX, et al. (1998) Prevalence of myopia between 3 months and 5 1/2 years in preterm infants with and without retinopathy of prematurity. Cryotherapy for Retinopathy of Prematurity Cooperative Group. Ophthalmology 105:1292–1300.
5. Verma M, Chhatwal J, Jaison S, Thomas S, Daniel R (1994) Refractive errors in preterm babies. Indian Pediatr 31:1183–1186
6. Vohr BR, Garcia Coll CT. Increased morbidity in low birth weight survivors with severe retrolental fibroplasia. J Pediatr 1985,106:287-291.
7. Hungerford J, Steward A, Hope P. Ocular sequelae of preterm birth and their relation to ultrasound evidence of cerebral damage. Br J Ophthalmol 1986,70:463-468.
8. Mehra KS, Khare BB, Vaithilingam E (1965) Refraction in full-term babies. Br J Ophthalmol 49:76–277.
9. Alistair R Fielder, Graham E Quinn et al; Myopia of prematurity: nature, nurture, or disease? Br J Ophthalmol1997;81:2-3 doi:10.1136/bjo.81.1.2
10. Saunders KJ, McCulloch DL, Shepherd AJ, Wilkinson AG (2002) Emmetropisation following preterm birth. Br J Ophthalmol 86:1035–1040.
11. Fletcher MC, Brandon S. Myopia of prematurity. Am J Ophthalmol 1955,40:474-481.
12. WHO Statistical Information Systems (WHOSIS). 2011. http://www.who.int/whosis/indicators/compendium/2008/2bwn/en/index.html.
13. Ballard JL, Khoury JC, Wedig k, Wang L, Eilers-Walsman BL and Lipp R. New Ballard Score,. Journal of Paediatrics; 1991;119:417-23.
14. Muna Al Oum, Simone Donati, Luigi Cerri, Massimo Agosti and Claudio Azzolini. Ocular alignment and refraction in preterm children at 1 and 6 years old. ClinOphthalmol. 2014;8:1263–1268.
15. Raji Mathew Varghese, VishnubhatlaSreenivas, Jacob MammenPuliyel, Sara Varughese et al. Refractive Status at Birth: Its Relation to Newborn Physical Parameters at Birth and Gestational Age. PLo S ONE | www.plosone.org. 4 February 2009 | Volume 4 | Issue 2 | e4469.
16. Ingram RM, Barr A. Changes in refraction between the ages of 1 to 3 years. Br J Ophthalmol 1979,63:339-342
17. Shapiro A, Yanko L, Nawralzki I, Merin S. Refractive power of premature children at infancy and early childhood. Am J Ophthalmol 1980,90:234-238.
18. Dobson V, Fulton AB, Salem D, Petersen RA. Cycloplegic refractions of premature infants. Am J Ophthalmol 1981,91:190-195.