Original Article

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Prevalence of Visual Impairment in Low Birth Weight and Normal Birth Weight School Age Children

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Abstract

Objective: Studies demonstrated that 5-10% of preschool children have visual impairment. By age seven, up to 13% of children will have some defect in visual acuity. Both prematurity and low birth weight have been associated with an increased incidence of ophthalmic disorders. In this study we determined prevalence of visual impairment in low birth weight and normal birth weight school age children in Mashhad.

Methods: This is a cross sectional study. The target population consisted of all children referred to educational organizations for screening before entering school in Mashhad, Iran. 2400 children enrolled in the study and were evaluated for amblyopia, refractive errors, color vision disturbance and optic nerve problems. Data were analyzed by SPSS.

Findings: Prevalence of ophthalmic problems in all children was 5.43% and in low birth weight and normal birth weight 8.29% and 5.74% respectively. Incidence of ophthalmic problems was significantly (P=0.029) higher in low birth weight children than in normal birth weight children. The most common ophthalmic disease in both low birth weight and normal birth weight children was refractive errors 81.5% vs. 68.8 % (P<0.05). Prevalence of myopia, amblyopia and color vision disturbance was also higher in low birth weight than in normal birth weight children.

Conclusion: Low birth weight children are at greater risk of the visual impairment that may occur at an early age and result in long term morbidity. Visual outcome of low birth weight neonates should be evaluated routinely.

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Key Words: Visual impairment; Low birth weight; School age children; Refraction errors

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Introduction

Vision plays a vital role in a child's interpretation of the world. Visual impairment impacts severely on a child's physical and emotional development [1]. Visual impairment has significant impact on the affected child with regard to education, future employment, and social welfare throughout life[2].

Studies demonstrated that 5-10% of preschool children have visual impairment, 2-5% being amblyopia[3]. By age seven, up to 13% of children will have some defect in visual acuity [4]. Both prematurity and low birth weight have been associated with an increased incidence of ophthalmic disorders[5].

Myopia is a leading cause of correctable visual impairment in the developed world and a leading cause of blindness in developing countries[6]. The Refractive Error Study in Children, a population-based study of 5 to 15-year-olds in 6 Asian[7-11], African[12] and South American countries[13], was the most recent study of visual impairment in children.

Retinopathy of prematurity (ROP), optic atrophy and cerebral amblyopia were the main causes of visual impairment in the children born prematurely. Myopias and strabismus are common in preterm infants and generally necessitate emergent intervention [14].

There are numerous reports of an increase in refractive errors and amblyogenic factors in the low birth weight population relative to children born at full term. This raises the question of whether additional long term ophthalmic screening is required [15]. If a child has problem in vision and it is not detected in school, it can influence learning. In this study we determined prevalence and kind of ophthalmic problems in six-year-olds born low birth weight (LBW) and compared them with that of normal birth weight (NBW) children.

Subjects and Methods

The target population consisted of all children referred to special educational organization for screening before entering school in Mashhad, Iran. Between June 2005 and June 2006 we enrolled 2400 6-7 year-old children. Cluster sampling method was used for selecting the subjects. From 25 centers of special educational organization, 10 centers were randomly selected and 240 samples of each center entered the study. Inclusion criteria consisted of physically and mentally healthy children age 7 or less than 7, presence of mother during interview and being resident in Mashhad city.

Exclusion criteria included no cooperation for visual testing, unwilling of parents for entering the study, unavailability of birth records and positive history of head or eye injury.

Weight, length and occipito-frontal head circumference were documented at birth and at the age of 6 years.

Written consent from at least 1 parent, in addition to the assent of the child, was obtained before examination. Approval for the study was obtained from the Human Research Ethics Committee.

Parental education was defined as the highest level of education completed by either parent. This ranged from never having attended school to having completed a higher degree. Socioeconomic status was based on home ownership by the child's parents and their employment status.

The anthropometric data is presented as means (±SD). For quantitative variables, comparison among groups was performed by using independent t test. Categorical variables were analyzed using the chi square and Fisher's exact test. For control of confound variables, logistic regression was used. The cut-off level for significance was $P \leq 0.05$.

Findings

Eighty one of 2400 samples in this study were excluded because of non availability of their birth weights. Of 2319 samples studied 8.3% were LBW. In LBW group, 85.5% had a birth weight of 1500-2500g, 13.5% 1000-1500g and 1% below 1000g.

Average of birth weight, birth length and head circumference in LBW children was 1999.7 (±353.2) gram, 47.3 (±3.0) cm and 33.2 (±2.8) cm respectively and in NBW children was 3294.8 (±401.0) gram, 50.6 (±2.3) cm and 34.6 (±1.7) cm, respectively.

Demographic and childhood characteristics are illustrated in table 1. As shown in table 1 weight, length and head circumference in NBW was significantly more than in LBW. Also LBW children had lower economic status than NBW. According to the data prevalence of ophthalmic problems in all samples was 5.43% and in LBW and NBW 8.29% and 5.74% respectively. There was significant difference between the two groups (*P*=0.03). The most common ophthalmic disease in both LBW and NBW children were refractive errors (81.5% vs. 68.8 %, *P*=0.3). Prevalence of myopia in all samples was 5.4%, 6.8% in LBW and 4.18% in NBW. Chi-square test revealed significant difference between the two groups (*P*=0.0001).

Prevalence of amblyopia was higher in LBW than in NBW children (1.04% vs. 0.19%, *P*=0.5). Optic nerve problems and glaucoma were rare in the two groups. Color vision disturbance in LBW children was 4.1% and in NBW children 2.7%; although this rate was higher in LBW children, chi-square test did not show significant difference (*P*= 0.2), (Table 2).

Refractive errors in low birth weight group were more than in normal birth weight children; in the right eye it was significant statistically (*P*=0.01) (Table 3).

Influence of confound variables on ophthalmic problems was controlled by logistic regression. Only head circumference had significant role on ophthalmic problems (*P*=0.04).

Discussion

Preterm infants are more likely than term infants to have major abnormalities of all organs especially in visual system that lead to reduced vision. Preterm infants have higher rates of amblyopia, strabismus, refractive error and cortical visual impairment [14].

This study showed that 8.3% of our study population had birth weight lower than 2500g and in this group visual impairment was 8.29%.

Roth et al (1993), Gross et al (1992), Erickson (1998) and Hack (2002) reported prevalence of visual Impairment to be 1%, 1%, 15% and 15% respectively in 4-15 year-old children[16-19].

In our study visual impairment (8.29%) is more than that reported by Roth and Gross and less than in Erickson and Hack study. Subjects in our study were low birth weight

Table 1: Demographic, family and childhood characteristics of two groups

Variable	Groups		Result
	≥2500gr	<2500gr	
Weight (kg) Mean(SD)	21.1 (3.1)	19.8±2.83	*P*=0.0001
Height(cm) Mean(SD)	51.5 (1.5)	50.68±1.67	*P*=0.0001
head circumference(cm) Mean(SD)	126.0 (±3.3)	117.4 (±6.3)	*P*=0.0001
Sex(male) No (%)	1127 (53)	94 (48.7)	*P*=0.251
Economic status low N (%)	1058 (50.4)	125 (65.1)	*P*=0.0001
Family ophthalmic problem N (%)	893 (42.0)	71 (36.8)	*P*=0.171

Table 2: Kind of visual impairment in two groups

Variable	Group		*P* value
	≥2500g (n=2080)	<2500g (n=190)	
Frequency of Myopia (%)	87(4.18%)	13(6.8%)	0. 0001
Frequency of Amblyopia (%)	4(0.188%)	2(1.036%)	0.02
Frequency of Color vision disturbances (%)	8 (4.1%)	56 (2.7%)	0.3

children, whereas Ross and Gross studied preterm, and Erickson and Hack very low birth weight children.

There are no universally accepted standards for visual acuity tests or norms in children. Study results also differ, depending on whether an isolated or a surrounded optotype is used [1]. The mean visual acuity of children in our sample was 20/25.78 in right eye and 20/25.15 in left eye by Snellen acuity. This is in close agreement with Robaei et al (20/25 Snellen acuity)[1] and Tong et al[20] on a sample of 7 to 9-year-old Singaporean children, confirming a well-known finding that the mean visual acuity of young children is slightly lower than adult values.

Refractive error and amblyopia are common causes of visual impairment in children [21]. In our study refractive error was the most common cause of visual impairment.

In our study overall prevalence of myopia was 5.4%. 6.8% in LBW vs 4.18% in NBW children expressed significant difference between two the groups. Amblyopia was higher in LBW than in NBW children too.

Studies indicated that there is a significant increment in incidence of myopia in low birth weight and preterm children. Refractive errors developed within low birth weight population maybe because of arrested growth of the anterior segment [22-25].

Robinson et al reported that prevalence of myopia in 6-year-old children was 6%. The estimated relative risk of myopia was increased significantly among children whose birth weight was <2500 gm[26]. In our study prevalence of myopia was close to their result.

Feldelius has reported high prevalence of myopia in children and adult but he found a change in refractor errors from age 10 to 18 in low birth weight infants. He followed up 137 LBW 10 years children until 18 years old. Re-examination of visual acuity showed corrected visual acuity in some of them [27]. The results of this study like ours point to high prevalence of myopia in low birth weight children.

O'Connor and his colleagues traced in a prospective study 505 infants who weighed <1701 gm at birth in 1980, in 10-22 years of age to determine how low birth weight alone

Table 3: Refractive errors in two groups

Variable		LBW (n=189)	NBW (n=2110)	*Range*	*P*-value
Refractive errors (mean±SD)	**Right eye**	20/27.25± 15.02	20/25.41±9.27	Minimum:15 Maximum: 200	0.01
Refractive errors (mean±SD)	**Left eye**	20/25.63± 5.85	20/25.32± 7.2	Minimum:5 Maximum: 200	0.6

and ROP (Retinopathy of Prematurely) might influence their final ophthalmic outcome. His results demonstrated that low birth weight Children were at increased risk of visual impairments compared with children who were born at full term [28].

Regional differences are due to unique environmental influences on visual acuity and risk factors of visual impairment in different groups. Further research into this area could provide important information regarding the etiology of refractive error.

Although this study showed a significant higher prevalence of ophthalmic disorders in LBW children, there are a few shortcomings in this study. Information given by parents may be confounded. A prospective study with birth data based on hospital records will not have this limitation.

Paramedical studies such as ultrasonographic findings will add more relevant data to ophthalmic anatomic changes found in those children.

Conclusion

Low birth weight child is at greater risk of the visual impairment than normal birth weigh. This problem may occur at early age and result in long term impediment. Therefore long term ophthalmic screening is required for this population. We recommend evaluating visual outcome of low birth weight neonates in different age routinely. Also more researches in this field are needed.

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