Original Article

Risk Factors Associated With Amblyopia Among Primary School Pupils in Kosofe Town, Lagos State, Nigeria

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Abstract

Aim: To investigate the risk factors associated with amblyopia among primary school pupils in Kosofe town, Lagos State, Nigeria. **Materials and Methods:** A descriptive, cross-sectional, school-based study was conducted, in which a multistage random sampling technique was employed for recruiting the children. Data were collected using self-administered questionnaires by the parents or caregivers and from detailed ocular examinations performed by the investigators. Data analysis was performed using the IBM Statistical Package for Social Sciences software version 20.0. **Results:** A total of 1702 children participated in the study, with over 90% of the children being aged 4–10 years. Most (78.5%) of the mothers were aged 20–39 years at childbirth, and the mean age was 30.5 ± 7.8 years. Amblyopia was detected in 24 (1.41%) children. Following multivariate logistic regression analysis, children whose mothers had no formal education at childbirth had an 11-fold greater risk of having amblyopia [odds ratios (OR) = 11.25, 95% confidence intervals (95% CI) = 1.25–1.49], while those with birth weight <2500 g were 10 times more likely to have amblyopia at the time of examination (OR = 10.15, 95% CI = 0.70–0.90). In addition, children with a positive family history of crossed eyes had an eightfold greater risk of having amblyopia (OR = 8.14, 95% CI = 0.24–0.46). **Conclusion:** Mother's educational qualification at childbirth, low birth weight, and a positive family history of crossed eye were found to be strongly associated with the development of amblyopia.

Keywords: Amblyopia, primary school pupils, risk factors

INTRODUCTION

Amblyopia is a disorder of the visual system that is characterized by a decrease in the best-corrected visual acuity (BCVA) in an eye with no organic pathology.[1-3] There is no obvious ocular pathology underlying the reduced visual acuity (VA), but rather, there are some predisposing conditions that influence the development of VA after birth.[2]

Amblyopia is at least four times more common in children who were premature or small for their gestational age.[4-6] Robaei et al.[4] reported that children born at <37 weeks of gestation had a fivefold risk of having amblyopia, while those with birth weights <2500 g were almost five times more likely to have amblyopia at the time of examination. Mohammad et al.[5] during a cross-sectional study of 164 children aged 5–10 years, who were referred to an amblyopia clinic in Iran, showed a significant association between amblyopia and low birth weight (LBW), preterm birth, as

well as dystocia. Saunders et al.[6] reported that premature birth carries a risk of abnormal refractive development, because early emmetropization process differed in preterm infants from that of the full-term infants. Robaei et al.[4] also found that admission into a neonatal intensive care unit conferred a fivefold increased risk of developing amblyopia. However, amblyopia was not associated with LBW, preterm birth, maternal age, or maternal smoking during pregnancy in the Strabismus, Amblyopia, and Refractive Error in Young Singaporean Children (STARS) study[7] and the Sydney Paediatric Eye Disease Study (SPEDS).[8] Factors such as maternal smoking, drugs, and

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alcohol use during pregnancy may be associated with an increased risk of amblyopia.[9,10]

There are few studies on amblyopia in our community, and the majority did not investigate its associated factors. The effects of the mother's socioeconomic status, pregnancy and birth, and developmental, familial, and past ocular histories on the pattern of amblyopia in our community need to be adequately studied. This study investigates the risk factors associated with amblyopia among primary school pupils in Kosofe town with a view to identifying the modifiable ones for which preventive measures could be suggested. The following factors were assessed: mother's socioeconomic characteristics at birth, family's ocular history, past medical/ocular history, as well as pregnancy, birth, and early developmental history.

MATERIALS AND METHODS

A detailed description of the methodology used in this study has been published earlier.[11] This descriptive, cross-sectional study was conducted among 41 primary schools (21 public and 20 private) in Kosofe Township, Lagos, Nigeria during a nine-month period. Ethical approval was obtained from the Health Research and Ethics Committee of the Lagos University Teaching Hospital as well as the Lagos State Universal Basic Education Board prior to the commencement of this study. Written informed consent from the schools' head teachers and the parents of selected schools were also obtained before screening their wards. The research protocol adhered to the provision of the Declaration of Helsinki for research involving human beings.

Using a reported prevalence of amblyopia at 3.1[12] and 10% nonresponse, the calculated sample size was 1794. A multistage random sampling system was employed in recruiting the pupils. Presurvey training was conducted to enable the team to familiarize with the standard operating procedures involved in the study. Pilot studies were conducted in two schools (one government and one private) to validate the data collection forms and to minimize interobserver variations. The selected children were enumerated and given copies of the consent forms and questionnaires to take home with them. The questionnaires were used to collect detailed information on ethnicity, parental education, the place of residence, parent's occupation, ocular history, a history of prematurity, birth weight, a history of eye and vision abnormalities in first-degree family members, and a history of past and present medical problems. The questionnaires were serially numbered to avoid duplication. Efforts were made to obtain the telephone numbers of these parents/caregivers from the children or schoolteachers. Telephone communications were employed to inform the parents/caregivers of the study and encourage them to sign the consent forms, fill the questionnaires, and send them back through their children or wards.

VA tests were performed in each eye with the HOTV chart from a distance of 3 m. Pupils who had an unaided VA of <6/9 in at least one eye. Subsequently, refraction was done 30 min after the instillation of three drops of 1% cyclopentolate administered at 5-min intervals. Refraction was measured with a table-mounted autorefractor (Topcon 80,00®, Japan) whenever possible, or streak retinoscope (WelchAllyn RF18240, New York) when autorefraction was not possible. Five consecutive autorefractor readings were obtained from each participant, all of which had to be within 0.25 Diopter Sphere (DS) of each other. Postcycloplegic refraction was performed to determine the BCVA of the pupils. Ocular alignment was assessed using the Hirschberg light reflex, cover test, and prism cover–uncover test. The pupils underwent full ocular examination, and any pathology involving the anterior and posterior ocular segments were documented.

Unilateral amblyopia was defined as a $\geq$2-line difference in BCVA, when <6/9 in the worse eye, and with amblyogenic factors such as past or present strabismus, anisometropia ($\geq$1.00 DS difference in hyperopia, $\geq$3.00 DS difference in myopia, or $\geq$1.50 DS difference in astigmatism), and the past or present obstruction of the visual axis.[7,13,14] Bilateral amblyopia was defined as BCVA in both eyes of <6/12 in the presence of amblyogenic factors such as hyperopia $\geq$4.00 DS, myopia $\geq$−6.00 DS, or astigmatism $\geq$2.50 DS, or the past or present obstruction of the visual axis.[7,13,14] LBW was defined as birth weight <2500 g, while prematurity was defined as gestational age <37 weeks.[4,5,8]

The data obtained were entered into a database and analyzed using the IBM Statistical Package for Social Sciences software version 20.0 (IBM Corp., Armonk, NY). Descriptive statistics including frequencies, means, and standard deviations were generated to observe the distribution of sociodemographic and medical factors. Bivariate analyses were conducted with the use of cross-tables and chi-squared tests, whereas multivariate analysis was conducted using the logistic regression model to evaluate associations between variables. We report adjusted odds ratios (OR) and 95% confidence intervals (95% CI) for the following variables: mother's occupation at childbirth, mothers' educational qualifications at childbirth, birth weight, developmental milestones, a history of past eye complaints, a history of past spectacle use, a history of past ocular surgeries, a family history of wearing glasses, a family history of eye surgery, and a family history of crossed eyes. Analyses were considered to show statistically significant associations, when the *P*-values were <0.05.

RESULTS

Of the 1794 pupils eligible for this study, 1702 pupils were fully examined, representing a study completion rate of 94.9%. There were 899 male (52.8%) and 803 female (47.2%) students, with a male-to-female ratio of 1.1: 1.

Table 1: Age and sex distribution of the screened children

Age group (years)	Male (%)	Female (%)	Total (%)
<5	20 (1.2)	24 (1.4)	44 (2.6)
5–9	843 (49.5)	743 (43.6)	1586 (93.1)
10–14	35 (2.1)	36 (2.1)	71 (4.2)
>14	1 (0.1)	0 (0.0)	1 (0.1)
Total	899 (52.8)	803 (47.2)	1702 (100.0)

The age range was from 4 to 16 years, and the mean age was 7.5 ± 1.6 years [Table 1].

The age range of the mothers was from 17 to 55 years, while their mean age was 30.5 ± 7.8 years. Self-employed mothers accounted for 33.7%, 25.7% were civil servants, and 7.8% had no formal education at childbirth [Table 2]. Six hundred and sixty-nine (39.3%) mothers were ill during pregnancy, 137 (8.1%) indulged in tobacco, cigarette, or alcohol intake during pregnancy, and 245 (14.4%) took non-antenatal medications. Most (91.9%) deliveries were full term, with 27.9% having LBW [Table 3].

One thousand four hundred and twenty-five (83.7%) children have never worn spectacle, and 47 (2.8%) had a history of ocular surgery. Two hundred and four (12.0%) children had a positive family history of spectacle wear, 84 (4.9%) had for eye surgery, and only 71 (4.2%) had a family history of crossed eyes in their first-degree relatives [Table 4].

The proportion of children with amblyopia was highest in those born to mothers in the age group of 20–39 years, but this was not statistically significant. The proportion of children with amblyopia was statistically significantly higher in children whose mothers were self-employed or who had no formal education at the time of childbirth [Table 5].

LBW was statistically significantly associated with amblyopia. Only 1 (3.6%) child born prematurely at <34 weeks had amblyopia, and this was not statistically significant [Table 6].

The prevalence of amblyopia was higher among children with a history of past eye complaints, spectacle use, and past ocular surgery [Table 7]. A family history of wearing glasses, eye surgery, and crossed eyes were statistically significantly associated with amblyopia [Table 8].

On multivariate analysis of the statistically significant risk factor, children whose mothers had no formal education at childbirth had a 11-fold greater risk of having amblyopia ($OR = 11.25$, 95% $CI = 1.25–1.49$), while those with birth weight <2500 g were 10 times more likely to have amblyopia at the time of examination ($OR = 10.15$, 95% $CI = 0.69–0.90$) as shown in Table 9. In addition, children with a positive family history of crossed eyes also had an eightfold greater risk of having amblyopia ($OR = 8.14$, 95% $CI = 0.24–0.46$).

Table 2: Socioeconomic characteristics of the mothers of screened children

Variable	*N* (1720)	Proportion (%)
Mothers' age group at childbirth		
<20	130	7.6
20–29	697	41.0
30–39	639	37.5
40–49	233	13.7
50–59	3	0.2
Mean = 30.5 ± 7.8		
Mothers' occupation at childbirth		
Civil Servant	437	25.7
Self-employed	574	33.7
Unemployed	370	21.7
Student	284	16.7
Others	37	2.2
Mothers' educational qualification at childbirth		
No formal education	132	7.8
Primary education	253	14.9
Secondary education	735	43.2
Tertiary education	582	34.2

Table 3: Pregnancy, birth, and early developmental history of the screened children

Variable	*N* (1720)	Proportion (%)
Mothers' illness during pregnancy		
Yes	669	39.3
No	918	53.9
Cannot remember	115	6.8
Tobacco, cigarette, or alcohol intake during pregnancy		
Yes	137	8.1
No	1565	91.9
Birth asphyxia		
Yes	88	5.2
No	1614	94.8
Duration of pregnancy		
>39 weeks	17	1.0
37–39 weeks	1547	90.9
34–36 weeks	110	6.5
<34 weeks	28	1.6
Developmental milestones		
Within normal limits	1577	92.7
Outside normal limits	125	7.3
Birth weight		
≥3.5 kg	226	13.3
2.5–3.4 kg	1001	58.8
1.5–2.4 kg	392	23.0
<1.5 kg	83	4.9

DISCUSSION

This study found that mothers' occupation at childbirth, mothers' educational qualifications at childbirth, birth weight, a history of past eye complaints, a history of past spectacle use, a history of past ocular surgeries, a family

history of wearing glasses, a family history of eye surgery, and a family history of crossed eyes were associated with amblyopia on bivariate analyses. However, only mothers' educational qualifications at childbirth, LBW, and a positive family history of crossed eye were found to be strongly associated with the development of amblyopia following multivariate analysis.

There was a fairly equal enrollment of boys and girls into primary schools in this community (a male-to-female ratio of 1.1:1). This may be the result of public enlightenment on the advantages of educating the girl child. In this study, the children of mothers with no formal education at childbirth had an 11-fold risk of developing amblyopia. This compares favorably with the findings of The Joint Writing Committee for the Multiethnic Paediatric Eye Disease Study and the Baltimore Paediatric Eye Disease Study Groups, which reported that the lack of primary caregiver high school education was significantly associated with bilateral reduction in VA.[15] It is difficult to determine whether this association is the result of the poor performance of VA testing in the children of parents with no formal education or whether it is a true reflection of the state of amblyopia. On the other hand, Robaei *et al.*[4] in the Sydney Myopia Study and Pai *et al.*[8] in the SPEDS found no statistical association between amblyopia and the measures of socioeconomic status.

Children with LBW were 10 times more likely to have amblyopia in this study. The Sydney Myopia Study[4] found the odd of having amblyopia following LBW to be about fivefold (OR = 4.80, 95% CI = 1.90–11.80). This study also observed that children with a positive family history of crossed eyes had a fivefold greater risk of developing amblyopia. The STARS[7] study and the study by The Joint Writing Committee for the Multiethnic Paediatric Eye Disease Study and the Baltimore Paediatric Eye Disease Study Groups[16] established that strabismus was significantly associated with a positive family history of crossed eyes, but similar association was not established

Table 4: Past medical and ocular history of the screened children

Variable	N = 1702	Proportion (%)
Child immunization history		
Completed	1595	93.7
Not completed	107	6.3
History of chronic disease conditions		
Yes	51	3.0
No	1651	97.0
Types of chronic disease conditions (n = 51)		
Asthma	31	60.8
Sickle cell disease	10	19.6
Others	10	19.6
History of past eye complaints		
Yes	480	28.2
No	1222	71.8
History of past spectacle use		
Yes	277	16.3
No	1425	83.7
History of past ocular surgery		
Yes	47	2.8
No	1655	97.2

Table 5: Association between socioeconomic characteristics of mothers of screened children and amblyopia

Variable	Amblyopia			χ^2	P value	Odds ratio	95% CI
	Yes	No	Total				
Mothers' age groups at childbirth							
<20	0 (0.0%)	130 (100%)	130 (100%)	3.93	0.482	1.93	0.57–6.51
20–39	21 (1.6%)	1315 (98.4%)	1336 (100%)				
40–59	3 (1.3%)	233 (98.7%)	236 (100%)				
Total	24	1678	1702 (100%)				
Mothers' occupations at childbirth							
Civil servant	2 (0.7%)	282 (99.3%)	284 (100%)	25.60	0.007*	9.97	3.23–30.79
Self-employed	4 (10.8%)	33 (89.2%)	37 (100%)				
Unemployed	9 (1.6%)	565 (98.4%)	574 (100%)				
Student	6 (1.4%)	431 (98.6%)	437 (100%)				
Others	3 (0.8%)	367 (99.2%)	370 (100%)				
Total	24	1678	1702 (100%)				
Mothers' educational qualifications at childbirth							
No formal education	10 (5.5%)	172 (94.5%)	182 (100%)	32.16	<0.001*	6.25	2.74–14.30
Primary education	8 (2.3%)	337 (97.7%)	345 (100%)				
Secondary education	2 (0.3%)	621 (99.7%)	623 (100%)				
OND/NCE	4 (1.1%)	361 (98.9%)	365 (100%)				
First degree/postgraduate	0 (0.0%)	187 (100%)	187 (100%)				
Total	24	1678	1702 (100%)				

CI = confidence interval; NCE = national certificate of education; OND = ordinary national diploma. *Statistically significant.

Table 6: Association among pregnancy, birth, and early developmental history of the screened children and amblyopia

Variable	Amblyopia			χ^2	P value	Odds ratio	95% CI
	Yes	No	Total				
Duration of pregnancies							
>39 weeks	0 (0.0%)	17 (100%)	17 (100%)	2.82	0.339[†]	2.66	0.35–20.40
37–39 weeks	23 (1.5%)	1524 (98.5%)	1547 (100%)				
34–36 weeks	0 (0.0%)	110 (100%)	110 (100%)				
<34 weeks	1 (3.6%)	27 (96.4%)	28 (100%)				
Total	24	1678	1702 (100%)				
Birth asphyxia							
Yes	0 (0.0%)	88 (100%)	88 (100%)	1.33	0.632[†]	0.00	Undefined
No	24 (1.5%)	1590 (98.5%)	1614 (100%)				
Total	24	1678	1702 (100%)				
Birth weights							
≥3.5 kg	0 (0.0%)	226 (100%)	226 (100%)	17.61	0.001*,[†]	5.75	2.50–13.25
2.5–3.4 kg	9 (0.9%)	992 (99.1%)	1001 (100%)				
1.5–2.4 kg	15 (3.8%)	377 (96.2%)	392 (100%)				
<1.5 kg	0 (0.0%)	83 (100%)	83 (100%)				
Total	24	1678	1702 (100%)				
Developmental milestones							
Within normal limits	23 (1.5%)	1554 (98.5%)	1577 (100%)	0.04	0.44[†]	1.84	0.25–13.70
Outside normal limits	1 (0.8%)	124 (99.2%)	125 (100%)				
Total	24	1678	1702 (100%)				

CI = confidence interval. [†]Fisher's exact *P* value. *Statistically significant.

Table 7: Association between past medical and ocular history of the screened children and amblyopia

Variable	Amblyopia			χ^2	P value	Odds ratio	95% CI
	Yes	No	Total				
Child immunization history							
Completed	24 (1.5%)	1571 (98.5%)	1595 (100%)	1.63	0.396[†]	Undefined	Undefined
Not completed	0 (0.0%)	107 (100%)	107 (100%)				
Total	24	1678	1702 (100%)				
History of chronic disease conditions							
Yes	0 (0.0%)	51 (100%)	51 (100%)	0.75	1.000[†]	0.00	Undefined
No	24 (1.5%)	1627 (98.5%)	1651 (100%)				
Total	24	1678	1702 (100%)				
History of past eye complaints							
Yes	17 (3.5%)	463 (96.5%)	480 (100%)	24.57	<0.001*	6.37	2.63–15.47
No	7 (0.6%)	1215 (99.4%)	1222 (100%)				
Total	24	1678	1702 (100%)				
History of past spectacle use							
Yes	13 (4.7%)	264 (95.3%)	277 (100%)	25.65	<0.001*	6.33	2.81–14.28
No	11 (0.8%)	1414 (99.2%)	1425 (100%)				
Total	24	1678	1702 (100%)				
History of past ocular surgeries							
Yes	18 (38.3%)	29 (61.7%)	47 (100%)	446.1	<0.001*	170.59	63.12–461.0
No	6 (0.4%)	1649 (99.6%)	1655 (100%)				
Total	24	1678	1702 (100%)				

CI = confidence interval. [†]Fisher's exact *P* value. *Statistically significant.

between amblyopia and a family history of squint. The study also found no association between LBW and amblyopia.

There are some limitations in this study. First, mothers may have selectively under- or overreported or may have forgotten some of the answers to the questions (especially the section on "history of pregnancy, birth and early development") in the questionnaires. This recall bias may have some impact on the result of this study and may be attributable to the study design. Second, a finite number of potential risk factors were

Table 8: Association between family ocular history of the screened children and amblyopia

Variable	Amblyopia			χ^2	P value	Odds ratio	95% CI
	Yes	No	Total				
Family history of wearing glasses							
Yes	10 (4.9%)	194 (95.1%)	204 (100%)	20.24	<0.001*	5.46	2.39–12.47
No	14 (0.9%)	1484 (99.1%)	1498 (100%)				
Total	24	1678	1702 (100%)				
Family history of eye surgeries							
Yes	8 (9.5%)	76 (90.5%)	84 (100%)	44.84	<0.001*	10.54	4.37–25.39
No	16 (1.0%)	1602 (99.0%)	1618 (100%)				
Total	24	1678	1702 (100%)				
Family history of crossed eyes							
Yes	10 (14.1%)	61 (85.9%)	71 (100%)	85.61	<0.001*	18.93	8.09–44.34
No	14 (0.9%)	1617 (99.1%)	1631 (100%)				
Total	24	1678	1702 (100%)				

CI = confidence interval. *Statistically significant.

Table 9: Multivariate analysis (logistic regression) of risk factors for amblyopia

Variable	P value	OR	95% CI	
			Lower	Upper
Mothers' occupations at childbirth	0.979	70.55	0.00	
Mothers' educational qualifications at childbirth	0.011*	11.25	1.25	1.49
Birth weight	0.033*	10.15	0.69	0.90
Family history of crossed eyes	0.041*	8.14	0.24	0.46
History of past eye complaints	0.652	0.71	0.17	3.01
History of past spectacles use	0.221	0.38	0.08	1.79
History of past ocular surgeries	0.997	5.46	0.00	
Family history of wearing glasses	0.077	0.14	0.02	1.25
Family history of eye surgeries	0.733	0.69	0.08	5.95
Constant	0.989	0.001		

CI = confidence interval, OR = odds ratio. *Statistically significant.

investigated. It is possible that other unknown or unexplored factors known to affect development (such as maternal diet during pregnancy, maternal exposure to ionizing radiation during pregnancy, and environmental toxins in pregnancy) could also contribute to amblyopia. The effect of non-schooling in children may also be a possible risk factor in amblyopia development. Thus, we recommend the need for further studies to investigate these unexplored factors.

In conclusion, the development of amblyopia was significantly associated with mother's formal education, being LBW, and a positive family history of crossed eye. In the light of the foregoing, there should be increased awareness on the need to educate the girl child. Additionally, families with individuals having crossed eyes should be specially educated on the need for every child in the family to have regular and periodic eye examinations.

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Conflicts of interest

There are no conflicts of interest.

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