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Vision Screening in Infants Attending Immunization Clinics in a Developing Country

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Abstract

Background: Vision screening in infants is an important part of the medical care of children as some eye abnormalities, if not treated in the first few months or years of life, can lead to irreversible vision loss. **Objective:** The objective of this cross-sectional, descriptive study was to identify ocular anomalies among infants attending immunization clinics in Nigeria and refer promptly and appropriately. **Methodology:** Infants were screened across 6 immunization clinics. Screening activities included relevant ocular history, vision assessment, external ocular examination, ocular motility, Hirschberg's test, pupil examination, and the red reflex test. Infants with abnormal findings were referred for comprehensive eye examination. **Result:** Of the 142 infants who underwent vision screening, 29 were referred. These referrals were either as a result of ocular abnormalities (n = 22) or presence of risk factors from history (n = 7). The prevalence of ocular abnormalities was 15.5% and neonatal conjunctivitis (38%), was the commonest ocular abnormality found. Others were bacterial conjunctivitis (14%), nasolacrimal duct obstruction (14%), strabismus (14%), capillary hemangiomas (10%), iris nevi (5%), and vernal keratoconjunctivitis (5%). Of the 7 infants referred based on history alone, 6 (85.7%) had a history of prematurity. **Conclusion:** Conjunctivitis, strabismus, congenital nasolacrimal duct obstruction, and capillary hemangioma are some of the prevalent disorders seen in infants at immunization clinics in Nigeria. Babies at risk of retinopathy of prematurity (preterm birth and oxygen therapy) can be identified. Immunization clinics can serve as good points of vision screening for infants in developing countries to facilitate prompt referral and treatment.

Keywords
vision screening, infants, immunization clinics

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Introduction

Vision screening is an evaluation to detect reduced visual acuity or risk factors that threaten the healthy growth and development of the eye and visual system.[1] It is an important part of the medical care of children as some eye abnormalities, if not treated in the first few months or years of life, can lead to irreversible vision loss; thereby increasing the magnitude of childhood blindness.[2,3]

Children are born with an immature visual system and need clear, focused images for normal visual development to occur.[4] Amblyopia following failure of normal visual maturation cannot be corrected in adult life. Early recognition and treatment of childhood eye diseases, such as cataract, congenital glaucoma, corneal opacities, hereditary retinal dystrophies, lesions of the optic nerve, and retinopathy of prematurity,[5,6] is therefore crucial to the prevention of blindness.[4,7] Visual loss may also be an early indication of serious or life-threatening diseases, such as retinoblastoma or lipid storage disorders.[2]

The American Academy of Ophthalmology (AAO)[1] and the American Academy of Pediatrics (AAP)[3,8] recommend visual assessment from birth and during all routine health supervisory visits. The AAP guidelines include screening

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from the newborn period to age 3 years, by using the following components: ocular history, vision assessment, external examination, ocular motility, pupil examination, and red reflex examination. Infants with a known risk (retinopathy of prematurity, Down's syndrome, etc) or significant family history (congenital glaucoma, strabismus) should be referred for further evaluation.[8]

Many strategies and suggestions have been put forward regarding the effective vision screening of infants and young children worldwide.[9-14] Vision screening programs have been stratified by age; and several studies support the screening of infant/preschool children, highlighting its importance in the prevention of amblyopia and blindness.[15-17] In developed countries[18] and in Africa,[19,20] such screening exercises have been conducted in schools at various levels but targeting well-child clinics will facilitate assessing children's eyes at an earlier age. The Minnesota Expert Panel on Childhood Vision Screening[21] therefore advocates the screening of infants for ocular anomalies at every well-child visit, following the usual schedule. The well-child clinics of the Western world are analogous to our immunization clinics in Nigeria.[22]

Immunization clinics are not just a tool to combat infectious diseases but also an avenue for health education and routine health examination. The National Program on Immunization (NPI),[23] formerly Expanded Program for Immunization, has been in existence in Nigeria since 1979 and its immunization schedule describes vaccination of children from birth to 12 months of age. Over the years, the NPI has adopted and implemented strategies that aim to improve coverage and deliver other relevant child health interventions such as distribution of insecticide-treated nets, vitamin A supplementation, antihelminthics distribution, and so on.[23,24] This provides a potential avenue for the incorporation of eye screening exercises into the NPI which, because of good coverage, will have a significant impact.

This study, therefore, aims to carry out vision screening on infants attending immunization clinics in Enugu North Local Government Area, Enugu State, Nigeria. This would provide an avenue for prompt referral of previously unidentified ocular anomalies for specialist care, thus contributing to the prevention of childhood blindness.

Methods

This is a prospective cross-sectional descriptive study in which infants attending randomly selected immunization clinics in Enugu North Local Government Area (LGA), Enugu State, Nigeria, underwent eye screening. Enugu state in southeast Nigeria is made up of 17 LGAs. The sample size was calculated using the Cochran formula for qualitative cross-sectional studies of infinite populations.[25] A multistage sampling method was used. First, the 17 wards in Enugu-North LGA with health facilities offering immunization services were grouped into 6 clusters (A-F) based on location. From each of these groups, an immunization center was selected by simple random sampling method, using the balloting technique.

Subsequently, the children to be screened in each immunization center were selected. Based on the calculated minimum sample size, a target of 21 infants per center was set. A systematic sampling method was applied in which every second infant from an attendance list, whose parents or guardians had given consent, was screened. Ethical approval for this study was obtained from the Health Research Ethics Committee of University of Nigeria Teaching Hospital, Enugu (NHREC/05/01/2008B-FWA00002458-1RB00002323).

An interviewer-administered structured questionnaire was used to generate information on the sociodemographic and socioeconomic characteristics of the patient. The relevant ocular history included questions on the parents' observation (Have you observed any problem with your child's eye?) and infant visual behavioral patterns for certain age groups. Family history as regarding risk factors for ocular morbidity and blindness included first-degree relatives with congenital cataracts, congenital glaucoma, squint in childhood, or retinoblastoma. These questions were aided by picture representations of these conditions. Participants then underwent vision screening as recommended by the AAO, American Association for Pediatric Ophthalmology and Strabismus (AAPOS), and AAP for different age groups.[1,8] (See summary tables in Supplementary Files 1 and 2.)

Visual acuity was assessed by the blink response to bright light in infants less than 3 months, and binocular fix and follow response in infants 3 months and above. The external structures of the eye were examined with a pen torch and a head loupe. Then, the corneal light reflex was assessed for proper alignment using the Hirschberg's method. Ocular motility was assessed with a light source or a bright object/toy moving in the directions of gaze, for infants who could fix and follow (from 3 months). The red reflex was assessed using the direct ophthalmoscope to view both eyes simultaneously. This was done from approximately 60 cm away, with a broad beam directed so that both eyes were illuminated at the same time.

On completion of the screening examinations for each infant, a provisional diagnosis was made where applicable and the duration of the examination was documented. Each child in whom an abnormality was detected was promptly referred to the nearest specialist center for a comprehensive eye evaluation and treatment. All infants with no relevant ocular history or normal findings on examination were considered to have passed the screening.

Data management was done using the IBM SPSS Statistics for Windows (version 23.0; IBM Corp, Armonk, NY).

Results

A total of 142 infants were screened, across 6 NPI centers. Seventy-six (53.5%) were male and 66 (46.5%) were female,

Table 1. Demographics of Infants Screened.

Demographic Parameters	n (%)
Gender	
Male	76 (53.5)
Female	66 (46.5)
Age group (months)	
≤1	30 (21.1)
>1-3	60 (42.3)
>3-6	27 (19.0)
>6-9	13 (9.2)
>9-12	12 (8.5)
Tribe	
Igbo	134 (94.4)
Non-Igbo	8 (5.6)
Highest educational qualification of mothers	
Primary	8 (5.6)
Secondary	66 (46.5)
Tertiary	68 (47.9)

giving a male:female ratio of 1.15:1. The age range was from a day (0.03 months) old to 363 days (11.93 months) with a mean age of 91.63 ± 7.10 days (3.05± 0.24 months). The demographics of the infants screened is shown in Table 1.

The majority of infants (42.3%) were aged >1 to 3 months. Of the 142 infants screened, 113 (79.6%) passed the test and 29 were referred (20.4%). The distribution of infants who passed the screening and those referred across the 6 screening centers is illustrated in Figure 1. The infants referred were either as a result of ocular abnormalities (n = 22) or the of risk factors from history (n = 7). Thus, the prevalence of ocular abnormalities was 15.5%. The screening findings are summarized in Table 2.

Of those referred, 11 were males and 18 females (male:female 1:1.64). While conjunctivitis was the most frequent reason for referral overall (n = 12), the risk of retinopathy of prematurity was the most frequently occurring history (n = 6). Provisional diagnoses were made on 21 infants and included conditions such as neonatal conjunctivitis, bacterial conjunctivitis, nasolacrimal duct obstruction, vernal keratoconjunctivitis, strabismus, iris nevi, and capillary hemangiomas as illustrated in Figure 2. No infants with congenital cataract, congenital glaucoma, corneal opacities or ptosis were seen.

Out of the 22 infants with abnormalities, 12 (54.5%) parents suspected something was wrong with their child's eyes. Of the 7 infants referred based on history, 1 had a positive first-degree family history of childhood squint. Six had a history of prematurity, 5 of whom had oxygen therapy.

Neonates accounted for most of the referrals (n = 11, 38%) and only 1 (3%) infant in the >9- to 12-month age group was referred as shown in Figure 3.

The time for examination ranged from 1.10 to 6.53 minutes per infant, with an overall average of 3.54 ± 0.10 minutes for infants who passed, and 4.37 ± 1.2 minutes for those who were referred. This is further illustrated in Figure 4.

Discussion

The largest proportion of the infants screened were less than 3 months of age. This could be due to a greater compliance with NPI appointments among parents with younger infants, as expected. The highest number of referrals was found in infants aged 1 month and below. The prevalence of neonatal/bacterial conjunctivitis and history of prematurity among them could account for this; as these were the most frequently occurring reasons for referral. Also, there were a decreasing number of infants attending NPI clinic after 6 months of age. These findings may support the screening of infants during their immunization visits at 6 weeks and 6 months.

The prevalence of ocular anomalies in this study was 15.5%, which was surprisingly high for a study with its sample size. Similar figures (14.93%) were obtained by Goyal et al.[26] However, this[26] study included posterior segment examination. The study done in Hawaii,[14] though the sample size was similar to that of the index study (137), had a prevalence of 8%. This discrepancy may be attributed to the fact that diagnoses, in the index study, were provisional and on confirmation, may reduce in number.

The study had 29 referrals; 22 (15.5%) had ocular abnormalities and 7 (4.9%) referrals were due to presence of risk factors for ocular morbidities. All infants in this study with a history of prematurity were referred for comprehensive ocular examination to rule out retinopathy of prematurity. Nie et al[27] similarly referred all 27 infants with a history of prematurity; however, an immediate comprehensive ocular examination was carried out in the field with handheld slit lamps and mydriatic examination.

All screened infants passed the pupil examination and no defective ocular motility was documented. This may be as a result of the rarity of optic neuropathies and restrictive motility syndromes, as was found by other authors.[26] One participant was referred on account of a defective red reflex test alone and no provisional diagnosis was made. Most anomalies were detected on external ocular examination and ocular discharge was the most common feature. Neonatal conjunctivitis has been documented as the commonest acquired ocular abnormality in a neonatal ocular screening study[27] and this was similar to the findings in this study. Other studies[26,28] found retinal hemorrhages to be the major abnormality detected on screening. However, these authors[26,28] also performed dilated fundus examination with the RetCam wide-field digital imaging system, which was not used in this study. Three infants with neonatal jaundice were encountered and referred for pediatric evaluation.

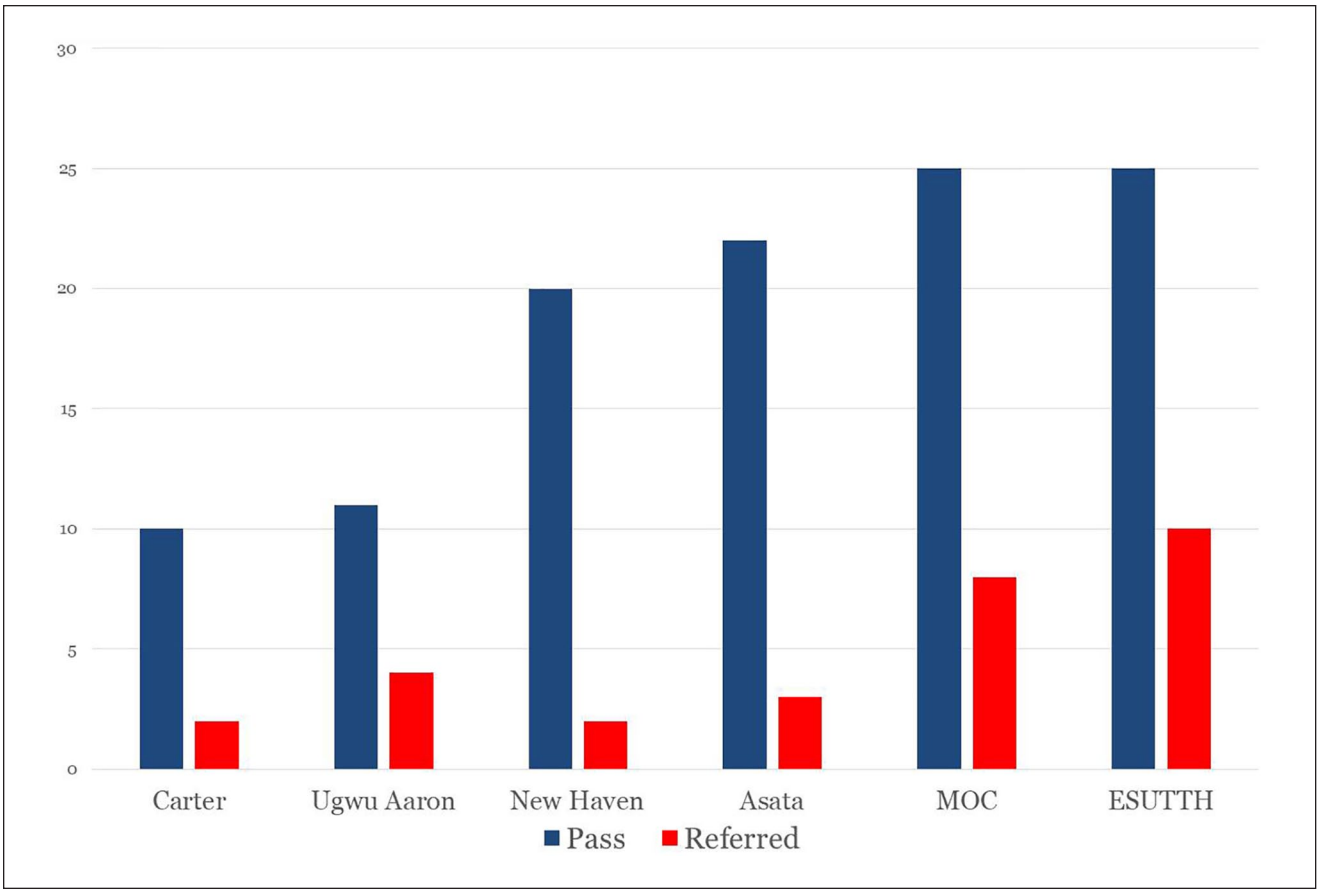

Figure 1. Distribution of infants across screening centers.

Table 2. Summary of Screening Findings.

Reason for Referral[a]	n (%)
Relevant ocular history	7 (20.7)
Abnormal vision assessment	1 (2.9)
Abnormal external ocular exam	18 (52.9)
Abnormal ocular motility	0 (0)
Abnormal corneal light reflex	3 (8.8)
Abnormal pupillary examination	0 (0)
Abnormal red reflex examination	5 (14.7)

[a]Some infants had more than 1 abnormal finding.

Congenital ocular anomalies such as ptosis, corneal opacity, congenital cataract, and congenital glaucoma were not noted in this study. This may be attributable to the low incidence of these congenital disorders.[29] Li et al[28] screened 3573 infants within their first 42 days and found 7 cases of optic nerve dysplasia, 2 cases of congenital cataracts, 2 cases of persistent fetal vasculature, and 1 corneal leucoma. Nie et al[27] screened 15 398 neonates and identified congenital ptosis in 2 cases (0.013%), congenital corneal opacity in 6 cases (0.039%), congenital cataract in 15 cases (0.097%), and no congenital glaucoma. This shows that these conditions could be identified when screening a large number of infants; as will be the case with the inclusion of regular eye screening into the NPI.

Though the examinations in this screening exercise were performed by ophthalmologists-in-training, these examinations can easily be carried out by nurses or community health workers who have had adequate training.

The average duration of examination per infant was 3.54 minutes. This was determined in order to establish the additional time required to attend to an infant in the immunization clinic, if vision screening is incorporated. The longest duration of examination was 6.53 minutes which suggests that the benefits of additional eye screening will far outweigh the additional time spent in the immunization clinic.

Most of the studies regarding the screening of infants for eye abnormalities were carried out in Europe, America, or Asia. The previous reports from Africa and Nigeria in particular, generally address vision screening in children of preschool, primary school, and secondary school age.

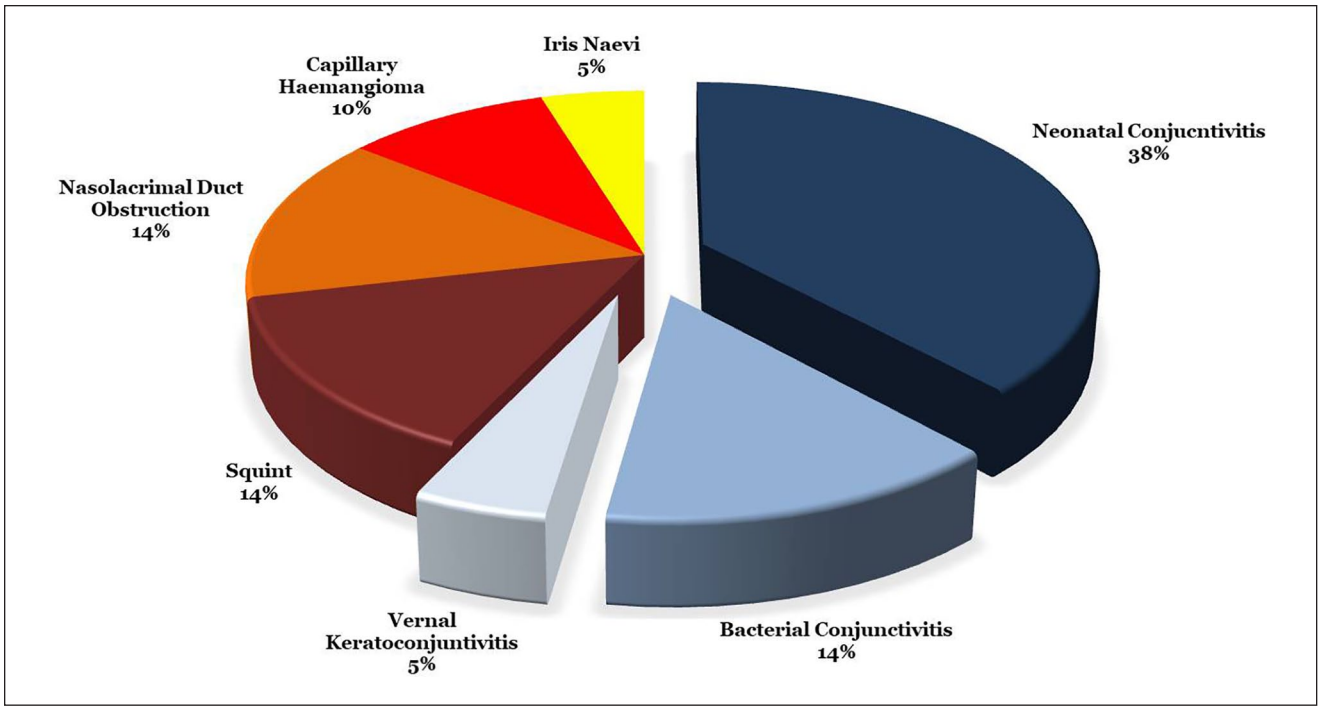

Figure 2. Provisional diagnoses of referred infants.

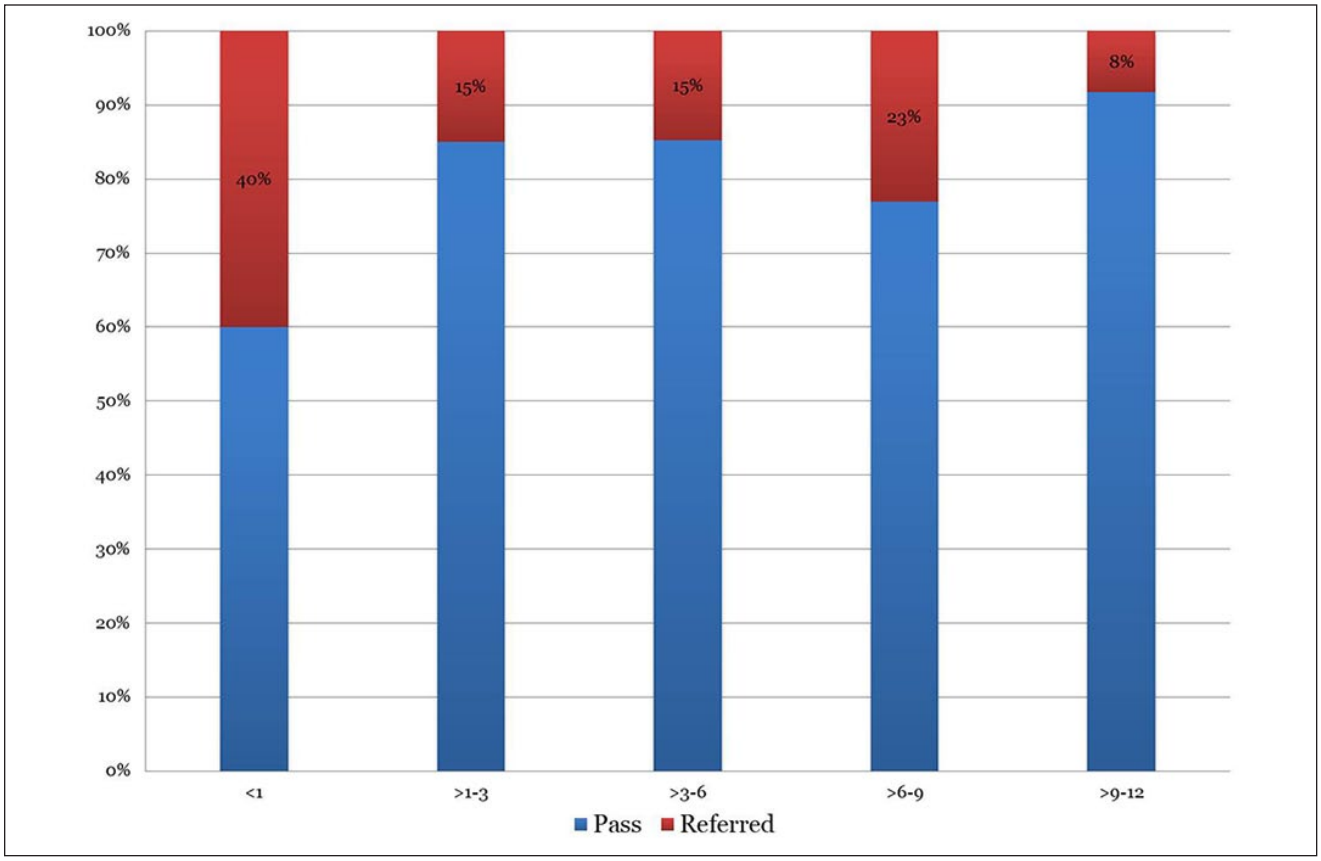

Figure 3. Proportion of referrals across the age groups (months).

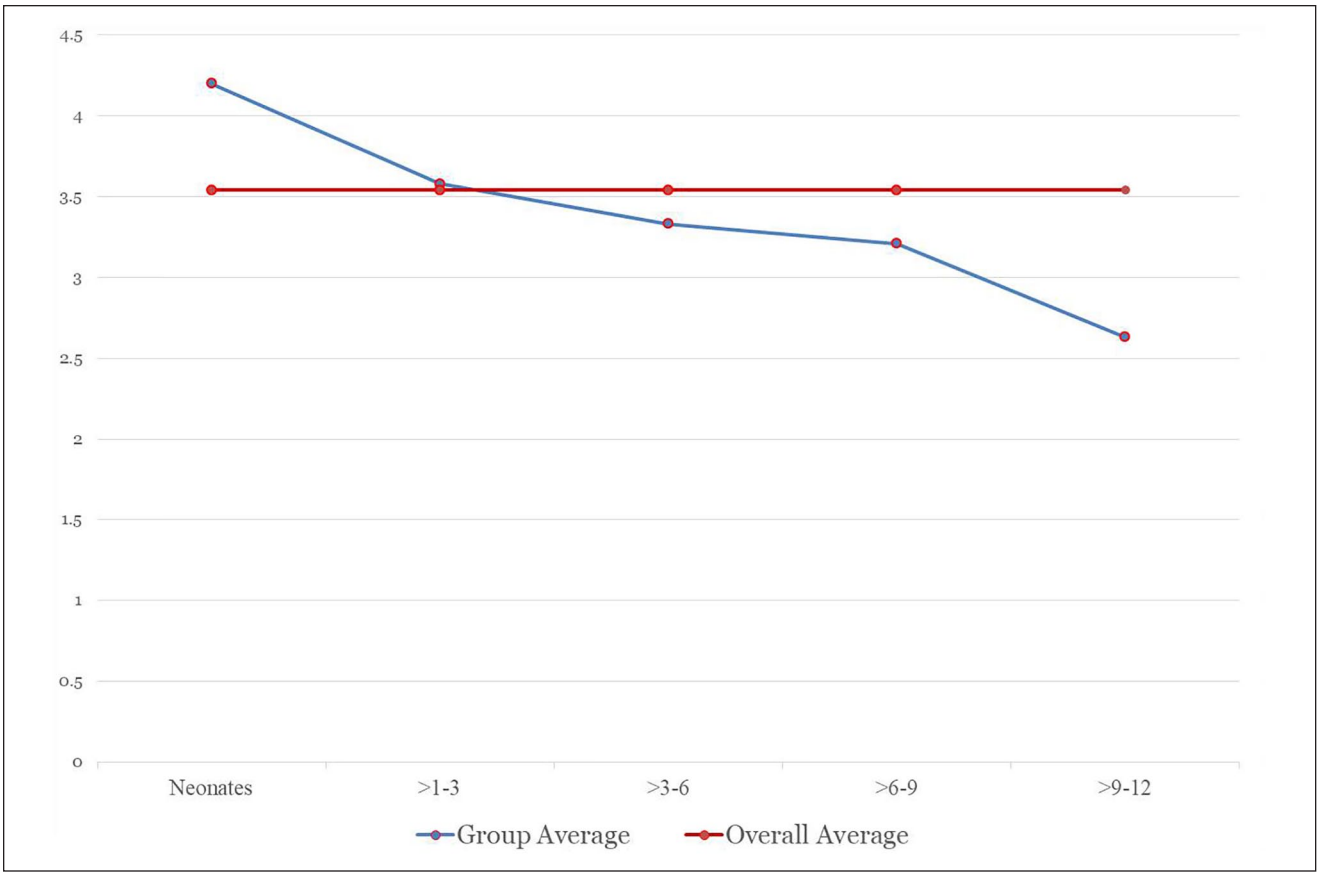

Figure 4. Average time for examination across the age groups (months).

The lack of eye screening in neonates and infants is attributable to the misconception that vision screening in this age group must be expensive, time-consuming, and cumbersome, and hence unacceptable to both health care providers and recipients. This article has illustrated that there are quick, easy and efficient screening tests to detect eye abnormalities in infants on a large scale, with subsequent adequate referral. It has also shown that, through a government-endorsed partnership, the national immunization program can be maximized to ensure extensive coverage of primary eye care in children nationwide, beginning at infancy.

Limitations

Almost all the parents and caregivers gave negative responses about the family history of ocular diseases. This could have been a reflection of their poor knowledge of the disease conditions rather than a true absence of such history.

Several studies[13,14,30] have been done on the efficacy, sensitivity and specificity of photo-screening devices. The use of these devices would have permitted screening of larger number of infants in less time and definitive diagnosis such as refractive error made on field.

Conclusion

Conjunctivitis, strabismus, congenital nasolacrimal duct obstruction, and capillary hemangioma are some of the prevalent disorders seen in infants at immunization clinics. Babies at risk, such as those with a history of prematurity and oxygen therapy or those with positive relevant family ocular history, can be identified at immunization clinics and referred for comprehensive eye evaluation. This study has also shown that vision screening can be effectively carried out on infants attending immunization clinics, which makes a strong case for the incorporation of regular infant vision screening into the Immunization program of developing countries.

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Author Contributions

The authors listed have significant contributions, including conception and design, data collection, analysis and interpretation. All authors approved the final submitted version of this article.

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Supplemental Material

Supplemental material for this article is available online.

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