Original Article

Prevalence of ocular morbidity among tribal children in Jawadhi hills, southern India: A cross-sectional study

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Purpose: Childhood blindness is second to cataract in terms of blind person years; population-based prevalence of ocular morbidity among tribal children has not been studied. We conducted this study to determine the prevalence of ocular morbidity in tribal children age 15 years or younger in Jawadhi hills, southern India. **Methods:** A population-based cross-sectional study was conducted in four tribal villages where all children below 15 years of age were invited to participate in the study. After appropriate consent/assent, an optometrist assessed uncorrected vision refraction and best-corrected visual acuity using suitable techniques. A comprehensive ophthalmic examination was also done by an ophthalmologist to determine the presence of ocular morbidity. Children requiring cycloplegic refraction or further treatment were referred to the base hospital. **Results:** Among 260 children examined, the prevalence of ocular morbidity was 10.8% [95% confidence interval (CI): 6.3–13.7]. Vitamin A deficiency (VAD) was the foremost morbidity: 4.6% (95% CI 1.6–6.3) followed by refractive error (2.7%). Three (10.7%) children had more than one ocular morbidity. Nearly 1 in 10 tribal children suffer from ocular morbidity and 1 in 57 had low vision. **Conclusion:** VAD is a public health problem in this tribal region which requires immediate intervention with prophylaxis and treatment. Uncorrected refractive errors in school-age children also need to be attended.

Access this article online

Website: www.ijo.in

DOI: 10.4103/ijo.IJO_795_18

Quick Response Code:

Key words: Low vision, ocular morbidity, refractive error, tribal children, vitamin A deficiency

Childhood blindness is defined as best-corrected visual acuity (BCVA) less than 3/60 in the better eye in those 16 years and younger. It is second only to cataract in terms of "blind person years."[1] Childhood blindness affects a child socially as well as his or her educational and personal aspects.[2] Estimates show that 1.4 million children suffer from visual impairment worldwide and three-quarters of them are in developing countries.[1]

According to population-based studies conducted in India, the prevalence of ocular morbidity in children varies from 1.3% to 6.54%,[3-5] and data from school-based studies from India and developing countries show a prevalence of 13%–45%.[6-18]

Common childhood ocular morbidities are refractive errors and whole globe anomalies.[5] Refractive errors constitute a major burden of avoidable blindness.

We conducted this study in Jawadhi hills which are extensions of the Eastern Ghats spread across parts of Tiruvannamalai and Vellore districts of Tamil Nadu. A total of 80,000 people, mostly *Malayali* tribes from low to moderate socioeconomic backgrounds, live in these hills with poor road access, drinking water, and sanitation. There is no single established ophthalmologist in these hills, and people with ocular problems come down to the plains for treatment. In this tribal area, penetration of the National Vitamin A Prophylaxis Programme (NVAPP) is questionable due to access issues, poor medical facilities, and migration out of the area for several months in a year for employment. The objective of the study was to determine the pattern of ocular morbidity in children 15 years of age or younger in the Jawadhi tribal area in southern India.

Methods

A population-based cross-sectional study was conducted in the Jawadhi hills in April and May 2014 involving the Departments of Ophthalmology and Community Health.

Ethics

The study was cleared by the institutional ethics and review board and conformed to the Declaration of Helsinki and the ethical guidelines for biomedical research on human participants enunciated by the Indian Council of Medical Research.

Sample size

Large multistaged population-based studies found a low prevalence of ocular morbidity ranging from 1.3% to

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Manuscript received: 27.06.18; Revision accepted: 25.10.18

Cite this article as: Mahesh KM, John D, Rose A, Paul P. Prevalence of ocular morbidity among tribal children in Jawadhi hills, southern India: A cross-sectional study. Indian J Ophthalmol 2019;67:386-90.

6.54%,[3-5] and school-based studies reported prevalence of 13%–44.7%.[6-18] These were multistaged, whereas in our study the ophthalmologist was to examine all the children. We assumed a prevalence of 20% which was between the two values from different study designs. For a power of 80% and alpha of 0.05, using the formula: $N = 4pq/d^2$ [(where p is the prevalence from previous study, q is 100 – p, and d is the allowable error (25% of p)]; the sample size was 256 children 15 years of age and younger.

Identification of study subjects

The "probability proportional to size" model was used to select the study villages (from a total of 40 villages) to yield the required number of 256 children below the age of 15 years, from previous enumeration of the population. All children in the age group of 0–15 years who were residing in this address for more than 6 months, who were willing to participate, and whose parents gave consent were included in the study. Health workers identified the enumerated eligible children and invited them to predetermined study sites in the respective villages.

Consent

Informed consent and child assent among children 8 years and older was obtained by a trained health worker.

Procedures at study site

A team of three optometrist trainees were trained in assessing vision and performing refraction for the study children. Each child was tested for presenting visual acuity by trainees using techniques suitable for age, depending on the child being verbal or preverbal and school-going or not. The methods used were Cardiff cards for nonverbal and nonschool-going verbal children and Snellen's chart for school-going children. Best corrected visual acuity in verbal children was done when possible.

The child was subjected to routine anterior segment eye examination by the ophthalmologist using flash light examination (LED torch light) and handheld slit lamp (Heine HSL 150). Following this, pupillary dilatation was done using using pediatric tropicamide (0.4%) drops. Wet refraction was done and posterior segment examined using indirect ophthalmoscopy (Appasamy AAIO-7) with 20D lens. Treatment for ocular morbidity [e.g. vitamin A deficiency (VAD)] was done at site when feasible, and children requiring spectacles were given the same. Children with VAD were given vitamin A capsules according to World Health Organization (WHO) guidelines. Children requiring cycloplegic refraction and/or surgical management were referred to the Department of Ophthalmology.

Ocular morbidity was defined as an abnormality in any of the ocular structures, which may or may not be visually significant and which may or may not require/improve with treatment; *myopia* is a spherical equivalent (SE) of −0.50 dioptre sphere, *hyperopia* a SE of +2.00 dioptre sphere, and *astigmatism* a cylindrical power of −0.50 dioptre cylinder or greater in either eye. *Amblyopia* was a difference of two lines or more in best-corrected vision between the two eyes or a best-corrected vision of 6/12 or worse in the affected eye. *Blindness was defined as* BCVA <6/60 and low vision <6/18–6/60 or more in the better eye.

Statistics

Prevalence of ocular morbidity was determined along with 95% confidence interval (CI). Frequencies of categorical variables and descriptive statistics for continuous variables were calculated. We used logistic regression to assess association of age of the child, literacy of parent, socioeconomic status (SES), gender, birth order, history of being breastfed, previous eye examination in those with ocular morbidity, and VAD. Statistical analysis was done using SPSS for Windows, Version 16.0. Chicago, SPSS Inc.

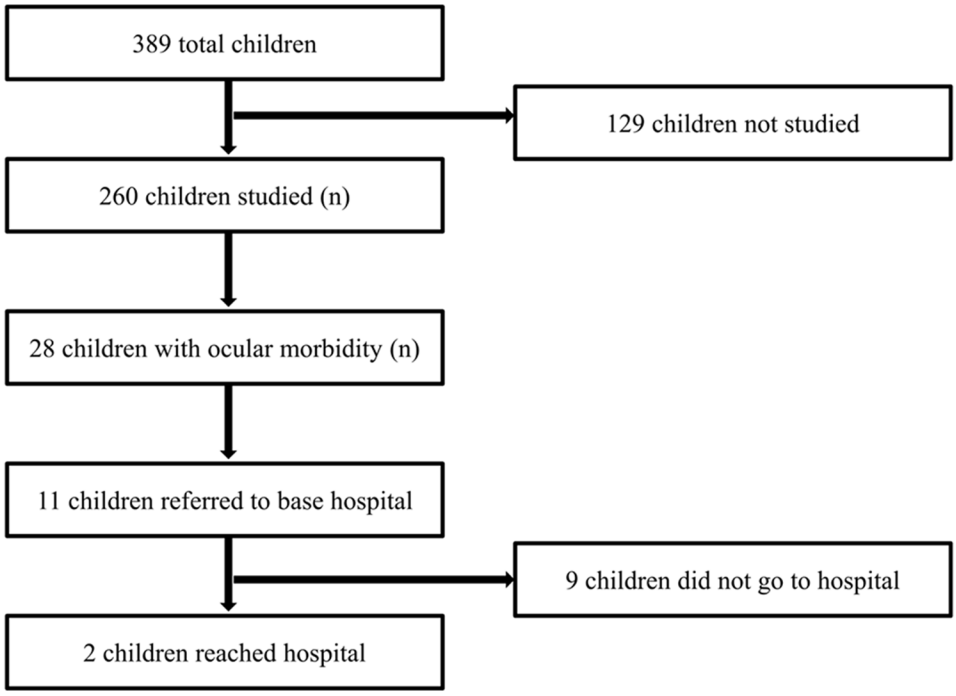

Figure 1: Flow of study

Results

The study was conducted among children age 15 years or younger, belonging to four different villages in Jawadhi hills during the months of April and May 2014. These four villages had a total population of 1105 including 389 children (29.1%) age 15 years or younger as per enumeration. Of these 389 children, we were able to study 260, thus the coverage was 66.8% [Fig. 1]. The remaining 129 (33.2%) children could not be studied, as 81 (20%) had temporarily migrated out of the region during the period of the survey (in hostels/out of town) and 48 (12%) were not willing to participate in the study.

There were no statistically significant differences between the two groups (children studied and not studied) in terms of age distribution ($P = 0.87$), gender ($P = 0.84$), or SES ($P = 0.42$). Most families belonged to the lower socioeconomic groups (55.4%), which was statistically significant ($P = 0.003$).

Children below 15 years of age were examined. The mean age was 7.5 years (standard deviation 4.07 years). Most children (66%) were in the age group of >5 years, as shown in Table 1. The majority (63.5%) of the parents included in the study were literate; most (98.5%) parents had no knowledge about vitamin A prophylaxis. There were 42 children (16.2%) age 2–5 years going to a *balwadi* and 173 children (66.5%) attending school. About 68.5% of children were of birth order of 1 or 2. The majority [258 (99%)] of the children in the study group reported normal developmental milestones.

Most deliveries [229 (88%)] were conducted at home. Only six (23%) children were not breastfed, and 45% of the children were breastfed for a minimum of 2 years. Immunization cards were kept at primary health centers.

Among the 260 children studied, 28 children had ocular morbidity, and thus the prevalence was 10.8% (95% CI 6.3%–13.7%). VAD was the most common morbidity (42.9%), in the form of conjunctival xerosis and Bitot's spots, followed by refractive error (25%), episcleritis (7.1%), lid injuries (lid abrasion and lid scar) (7.1%), strabismus (7.1%), and retinitis pigmentosa (3.6%) [Fig. 2]. Three (10.7%) children had more than one ocular morbidity. Of the 28 children with ocular morbidity, those who had refractive error (7), episcleritis (2), and strabismus (2) were referred. The prevalence of Bitot's spot and xerosis in our study was 3.5% and 1.2%, respectively.

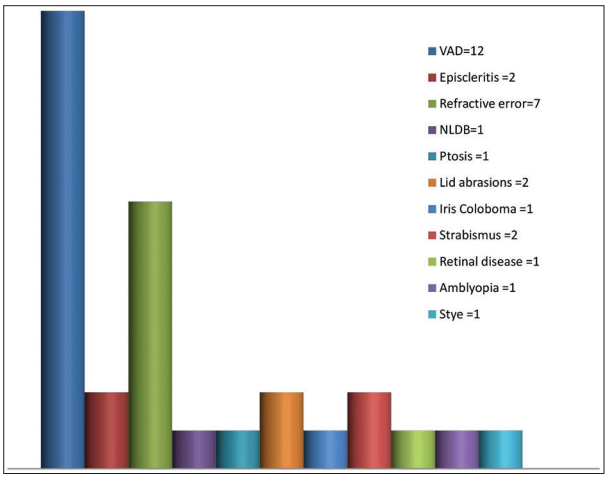

Figure 2: Distribution of ocular morbidity

On performing univariate logistic regression, ocular morbidity is significantly associated with age >5 years. Even after adjusting for gender, SES, and parents' educational level, children >5 years had five times the odds of having ocular morbidity when compared with children <5 years. The wide CI in the analyses is a reflection of the sample size [Table 2]. In our study, two children were found to have low vision at presentation, of which one child had amblyopia due to strabismus [Table 3].

Discussion

This study gives us preliminary insight into the profile of ocular morbidity among children in the tribal hamlets of Jawadhi Hills, southern India. In this study, prevalence of ocular morbidity was 10.8%. This was higher than other population-based studies reported by Nirmalan *et al.* in a

Table 1: Demographic distribution of children examined in the study

Age (years)	Number of children, *n* (%)		Total, *N* (%)
	Males	Females	
0-2	17 (47.23)	19 (52.77)	36 (13.9)
2.1-5	30 (57.7)	22 (42.3)	52 (20.1)
>5	92 (53.5)	80 (46.5)	172 (66.0)
Total	139 (53.5)	121 (46.5)	260 (100)

Table 2: Factors associated with ocular morbidity

Risk factors	Odds ratio (confidence interval)	Adjusted odds ratio (confidence interval)
Age (years)		
≤5 years	1	1
>5 years	3.04 (1.14-10.15)	5.28 (1.17-23.74)
Sex		
Male	1	1
Female	0.61 (0.27-1.37)	0.46 (0.17-1.31)
Socioeconomic status		
Normal (high and middle)	1	1
Low	1.35 (0.53-3.41)	1.13 (0.4-3.18)
Parental education		
Literate	1	1
Illiterate	0.63 (0.29-1.39)	0.53 (0.19-1.47)

Table 3: Best-corrected visual acuity of children examined

Age groups (years)	Best-corrected visual acuity, *n* (%)			Total, *N*
	Normal	Low vision	Blind	
<5	88 (100)	0 (0)	0 (0)	88
>5	170 (98.83)	2 (1.16)	0 (0)	172
Total	258 (99.23)	2 (0.7)	0 (0)	260

Normal: 6/6–6/18, low vision: <6/18-6/60, blind: <6/60

south Indian population (2.8%)[4] and the Andhra Pradesh eye disease study[3] by Dandona *et al.* (1.3%). The higher prevalence of ocular morbidity in our study was influenced by the study model and methodology where all children were examined by an ophthalmologist. In other population-based studies, children were initially screened by trained field workers and only those suspected to have ocular morbidity were referred to the base hospital.[3,4]

Two children with episcleritis were given ketorolac eye drops and referred to the base hospital for further management along with children who had refractive error and strabismus. In our study, VAD was the most common ocular morbidity (4.2%) which manifested as Bitot's spots and conjunctival xerosis, comparable to the findings by Prajapati p *et al.*[15] among adolescents (10–19 years) of Gujarat (3.8%) and Jayanth *et al.*[14] (3.53%) among school children (10–16 years) in rural Maharashtra.

A reason for the relatively high prevalence of VAD in our study maybe because this was done in a tribal area where the majority belonged to low SES group and the local food habits. *Samai* rice is the staple diet of the region which is rich in proteins but has negligible amounts of vitamin A. Also, the region is isolated from urban areas by geographic and cultural differences.

The prevalence of Bitot's spot and xerosis in our study was 3.5% and 1.2%, respectively, which was higher than the WHO criteria (Bitot's spot 0.5%, xerosis 0.5%) for pronouncing it a public health problem.[19] In the National Family Health Survey-3, children age 12–35 months who received a vitamin A dose in the last 6 months (Tamil Nadu) were reported to be 49.1% in urban and 41.1% in rural areas.[20] Unlike our study, the tribal study from Odisha, TOES, did not report any ocular morbidity due to nutritional deficiency. This study was done in Odisha in eastern India. They found a prevalence of ocular morbidity of 2.6% among tribal children in an urban school.[21] TOES 4 study done among tribals in Odisha using photorefractor has found refractive error as a significant cause of ocular morbidity.[22]

While our study was not powered to determine the prevalence of VAD, these results warn of the prevailing public health problem in the Jawadhi region which requires immediate intervention and further study with higher sample sizes involving all 250 villages in the area. The intervention needs three stages: creating awareness through public health education, immunization for factors predisposing to VAD, and intensified NVAPP and sustainable food–based solutions along with suitable treatment of existing cases.

In our study, two children had low vision (<6/18–6/60). The reasons for visual impairment seen in these children were strabismus and uncorrected refractive error.

School eye screening program needs to be strengthened; otherwise, these children with low vision will underperform not only as students but also later as adults. The fact that prevalence of ocular morbidity is significantly higher among children over 5 years proves that it is sufficient to screen children in the school rather than in the general population.

Of the 11 children referred to the Department of Ophthalmology, only two (18%) reported for treatment. The remaining children did not turn up for further examination in spite of repeated counseling by the ophthalmologist and instructions from field workers. The attitude may be a reflection of barriers to access and their health-seeking behavior. These findings also reflect the urgent need to strengthen the NVAPP and school eye screening programs in tribal areas and the need to provide specialized eye care in the Jawadhi area.

Limitations

Our study determined a prevalence of ocular morbidity of 10% which was lower than expected during calculation of sample size. The wide CIs for the regression analysis are a further reflection of the same. These findings therefore serve as a flag for further research and intensifying eye care services in this region.

This being a tribal population, it is inherently migrant as reflected in the study coverage (66%). The paucity of literature from previous years on eye care in the tribal population, except one school-based study, does not permit meaningful comparisons; furthermore, poor accessibility to these villages resulted in an inability to manage all affected children.

Conclusion

One in 10 tribal children suffers from ocular morbidity and 1 in 57 has low vision. VAD is the foremost ocular morbidity among children of the Jawadhi hills followed by refractive error, mainly in those age 5 years and above. Poor availability of eye care in the hills coupled with poor eye health-seeking behavior magnifies the problem.

Acknowledgements

The authors acknowledge with gratitude the contribution of health workers, parents, and children who participated in the study.

Financial support and sponsorship

Institutional fluid research grant.

Conflicts of interest

There are no conflicts of interest.

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