Original Article

Prevalence and causes of visual impairment in *Dongaria* indigenous (tribal) community. Tribal Odisha eye disease study # 12

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Purpose: To document the spectrum and magnitude of eye disorders and visual impairment in the *Dongaria*—a Particularly Vulnerable Tribal Group in the Rayagada district of Odisha, India. **Methods:** A door-to-door screening protocol included a record of basic health parameters, visual acuity for distance, and near and flashlight examination of the eyes. Spectacles were dispensed to those who improved; those who failed the screening were referred to fixed (primary and secondary) eye care centers. **Results:** We examined 89% (n = 9872/11,085) of people who consented for screening. The mean age was 25.5 ± 18.8 years; 55% (n = 5391) were female; 13.8% (n = 1361) were under-five children, and 39% (n = 3884) were 6 to 16 years. 86% (n = 8515) were illiterate. 12.4% (n = 1224) were visually impaired, of which 9.9% had early moderate VI, and 2.5% had severe VI and blindness. Uncorrected refractive error was detected in 7.5% (n = 744) and cataracts in 7.6% (n = 754); among the adults, 41.5% (n = 924/2227) had presbyopia. In children, 20% (n = 790) had vitamin A deficiency, 17% (n = 234) had global acute malnutrition, and 18% (n = 244) were stunted for their age. Almost two-thirds (62%, n = 6144) confirmed habitual intake of alcohol, and 4% (n = 389) of adults had essential hypertension. Following the screening, 43.5% (n = 837) of referred patients reported to the fixed centers, and 55% (134/243) of people advised underwent cataract surgery. Spectacles were dispensed to 1496 individuals. **Conclusion:** Visual impairment and malnutrition are high in *Dongaria* indigenous community. Permanent health facilities and advocacy would improve this community's health and health-seeking behavior.

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India is home to 461 tribal communities, constituting 8.2% of the country's population. Per the last census (2011), the eastern Indian state of Odisha is home to 9.5 million tribal people.[1] This is 22.8% of the state's population, and it is the third-largest tribal community in India.[2] Based on criteria that include people, habitat, livelihood opportunities, and literacy, the Government of India has designated 75 tribal communities as "Particularly Vulnerable Tribal Group" (PVTG). Thirteen such PVTG communities reside in over 62 small settlements in 14 districts of Odisha, India.[3,4] The Tribal Odisha Eye Disease Study (TOES)-PVTG was a collaborative project under a public–private partnership with the Ministry of Tribal Affairs, Government of India [11031/18/2020-TRI (17736)], designated tribal welfare and research organizations of the Government of Odisha, and L V Prasad Eye Institute, Bhubaneswar, with active ground-level support from the district administration and non-government organizations.[5] The district administration provided community resource persons (CRP) who helped implement the project at various levels. Hence, the services of Accredited Social Health Activists (ASHA) workers were not sought in this project.

The project had two primary objectives: (1) enumerating the prevalence of visual impairment and blindness among *Dongaria* people and (2) providing them with required eye care at no cost. The secondary objectives included documenting general health, nutritional deficiency (primarily manifest

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vitamin A deficiency in children), and lifestyle issues that may directly or indirectly impact these people's well-being.

Methods

The *Dongaria* community lives in small settlements spread over three administrative blocks (Bissamcuttack, Kalyansinghpur, and Muniguda) of the Rayagada district in Odisha, India [Fig. 1].[5] The total population of this community is 11,085, spread over 101 hutments at an altitude of about 5,000 feet above the mid-sea level.[3]

Study design

The TOES-PVTG study design has been published.[5] In brief, the screening protocol followed examination at three locations: (1) community—distance and near vision testing using appropriate vision charts by a community health worker (CHW), external eye examination with a flashlight, rapid on-site refraction with a handheld device (Folding Phoropter-FoFo), and dispensing spectacles where possible; (2) vision center (VC)—undilated eye examination using a slit lamp, subjective and objective refraction, dispensing of spectacles for people who improved beyond 6/12 and referral for people who fail to improve; and (3) secondary center (SC)—dilated comprehensive eye examination by a trained ophthalmologist and intervention including surgery. More complex eye diseases that could not be managed at the secondary center were referred to the tertiary eye care center (Bhubaneswar).

Visual impairment (VI) was defined using the National Program for Control of Blindness and Visual Impairment (NPCB VI), India criteria.[6] In brief, early VI (EVI) was distance visual acuity between 6/12 and 6/18 in the better eye, moderate VI (MVI) was distance visual acuity between 6/18 and 6/60 in the better eye, severe VI (SVI) was distance visual acuity between 6/60 and 3/60, and blind when the visual acuity in the better eye was worse than 3/60. As we had used the Basic Eye Screening Test (BEST) protocol in our study for vision assessment (where the last target was 6/60), patients whose distance visual acuity was worse than 6/12 and better than 6/60 were considered early MVI and worse than 6/60 was considered as SVI/blindness.[5]

Anterior segment ophthalmic disorders included corneal pathology, cataract, pterygium, strabismus, and posterior segment disorders, including retina and optic nerve diseases. These have been defined by us earlier.[5]

Height, weight, and mid-upper arm circumference (MUAC) were measured using standard equipment and methods in under-five children.[7] Global acute malnutrition (GAM) was defined as the presence of both moderate acute malnutrition (MAM) for children aged 6–59 months with a MUAC between 115 and 125 mm; severe acute malnutrition (SAM) for children aged 6–59 months was defined as MUAC <115 mm.[7] The body mass index (BMI) was calculated from the height and weight of patients older than five years.

In children, vitamin A deficiency (VAD) manifested in conjunctiva and cornea was examined by external examination of the eye (flashlight or slit lamp), and the history of night blindness was elicited from the parents and neighbors.

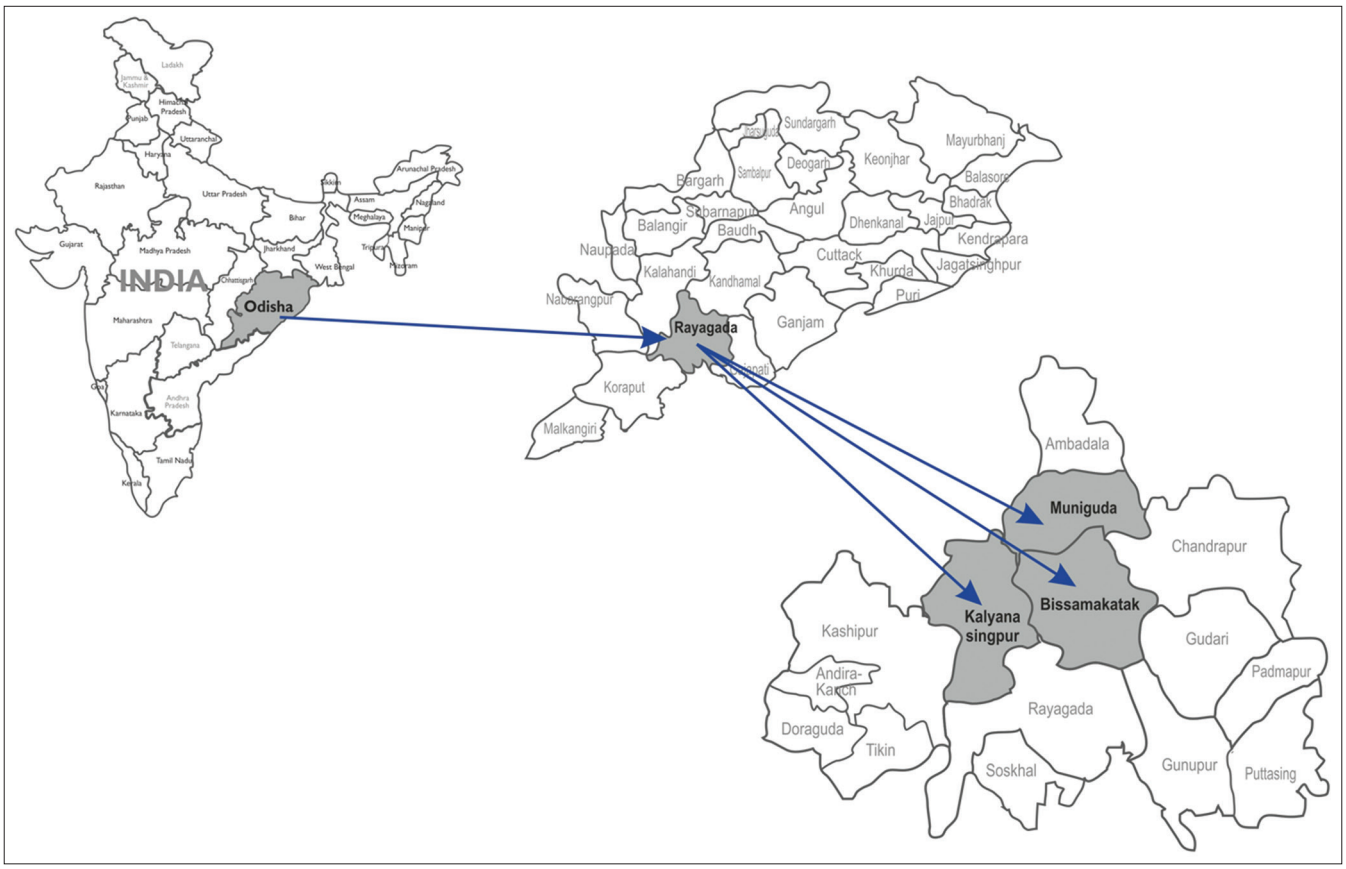

Figure 1: Geographical locations where Tribal Odisha Eye Disease (TOES) study was conducted

During this survey, people identified with diabetes, hypertension, anemia, and nutritional deficiency were referred to the nearest public health facility for further management.

Informed consent and approval

The Institutional Ethics Committee approved the study (2021-76-BHR-39). Written consent was obtained from the village head before the screening, and verbal consent was taken from all participants. The left thumb impression was taken for people who were operated in the secondary center. TOES-PVTG adhered to the tenets of the Declaration of Helsinki on human subjects' participation.

Statistical analysis

The data were entered in Microsoft Excel (Microsoft Inc., Richmond, USA) spreadsheet, and statistical analyses were performed using IBM SPSS (version 23.0; IBM Corp., Armonk, NY). *P* value < 0.05 was considered statistically significant. Categorical variables were presented in number and percentage, and continuous variables were presented as means with standard deviations and median with interquartile range (IQR). Mean, standard deviation, and percentages were calculated using descriptive statistics. The Shapiro–Wilk test tested the normality of data. Univariate and multivariate linear regression was performed to determine factors affecting moderate and severe visual impairment.

Results

The target population of the *Dongaria* PVTG community was 11, 085.[3] It consisted of 26.5% (n = 2935) adult males, 36.3% (n = 4026) females, 12.4% (n = 1373) under-five children, and 24.8% (n = 2751) children between 6 and 16 years [Table 1]. The current study achieved 89% (n = 9872) coverage of the target population spread over 88 hamlets; it was better in children than adults [Table 1].

The mean age of the screened population was 25.5 ± 18.8 years (range 1 month to 87 years). *Dongaria* females, including the girl child, were 55% (n = 5391) of the entire community; their mean age was 27.9 ± 19.8 years. Only 5.2% (n = 522) were above 61 years. Literacy was 14%; 10% of people had completed primary school, and 4% had attended secondary school or higher.

Visual impairment

Visual impairment was detected in 12.4% (n = 1227) people; early MVI- 9.9% (n = 982), and SVI/blindness- 2.5% (n = 245). Visual impairment increased with age [Table 2]. Cataract (50%; n = 491/982) and refractive error (35%; n = 343/982) were the most common causes of early MVI; cataract was the most common cause of SVI/blindness (76%; n = 187/245) [Fig. 2]. More females than males were visually impaired. Vitamin A deficiency was detected in 20% of *Dongria* children [Table 3].

Multivariate logistic regression analysis showed older age (>30 years) and female gender were strongly associated with early MVI and SVI/blindness (P < 0.0001) [Table 4].

Here is a brief description of common ophthalmic disorders.

Refractive error and presbyopia

Uncorrected refractive error (URE) was detected in 7.5% (n = 744); 96% (n = 712/744) were adults, and 64% (n = 471/744) were females [Table 3]; early MVI and SVI/blindness was seen in 46% (n = 327/712) and 1% (n = 10) people, respectively. Among those with URE, 77% (572/744) were given corrective spectacles. Before the screening, only 0.2% (n = 25/9872) of people wore spectacles.

Presbyopia was found in 41.5% (n = 924/2227) of individuals in the screened community. Of these, 486 received near vision correction on the day of screening. The remaining 438 people were dispensed with presbyopia correction after further examination at the vision and/or secondary eye center. We will describe additional details of URE and presbyopia in a subsequent manuscript.

Cataract

Senile cataract was detected in 7.6% (n = 754) of the screened people, and more than two-thirds (n = 560, 74.3%) were female [Table 3]. In the cataract group, 670 (90%) had bilateral cataract, 482 (64%) had early MVI, and 188 (25%) had SVI/blindness. All people who failed to improve vision with a pinhole at screening and had lenticular opacity on flashlight examination were referred, but only a third (n = 243) visited the secondary eye center at Rayagada. The mean age of this group was 64.0 ± 8.4 years. Forty people were pseudophakic; four had received bilateral cataract surgery, but one individual was aphakic in one eye. Of all the patients who attended the secondary center, 23 had prior cataract surgery and were pseudophakic in one eye at the time of presentation. Of these, 19 (82.6%) presented with BCVA ≥6/12 in the operated eye.

At the time of writing this report, 134/243 (55%) people had undergone cataract surgery. Among those operated on, 82/134 (61%) had early MVI, 16/134 (12%) had SVI, and 36/134 (27%) were blind before surgery. The conversion for

Table 1: Demography

Block	Target population *n*=11,085 Examined=9872 (89%)		Target adult male *n*=2,935 (26.5%) Examined=2,489 (85%)		Target adult female *n*=4,026 (36.3%) Examined=3499 (87%)		Target<5 years *n*=1,373 (12.4%) Examined=1361 (99%)		Target 6-16 years n=2,751 (24.8%) Examined=2523 (92%)	
	Total	Examined	Total	Examined	Total	Examined	Total	Examined	Total	Examined
Bishamcuttack	5332	4292 (80%)	1533	1103 (72%)	2046	1562 (76%)	438	436 (99.5%)	1315	1210 (92%)
Muniguda	3470	3401 (98%)	894	883 (99%)	1159	1158 (100%)	577	571 (99%)	840	769 (92%)
Kalyansinghpur	2283	2179 (95%)	508	503 (99%)	821	779 (95%)	358	353 (99%)	596	544 (91%)

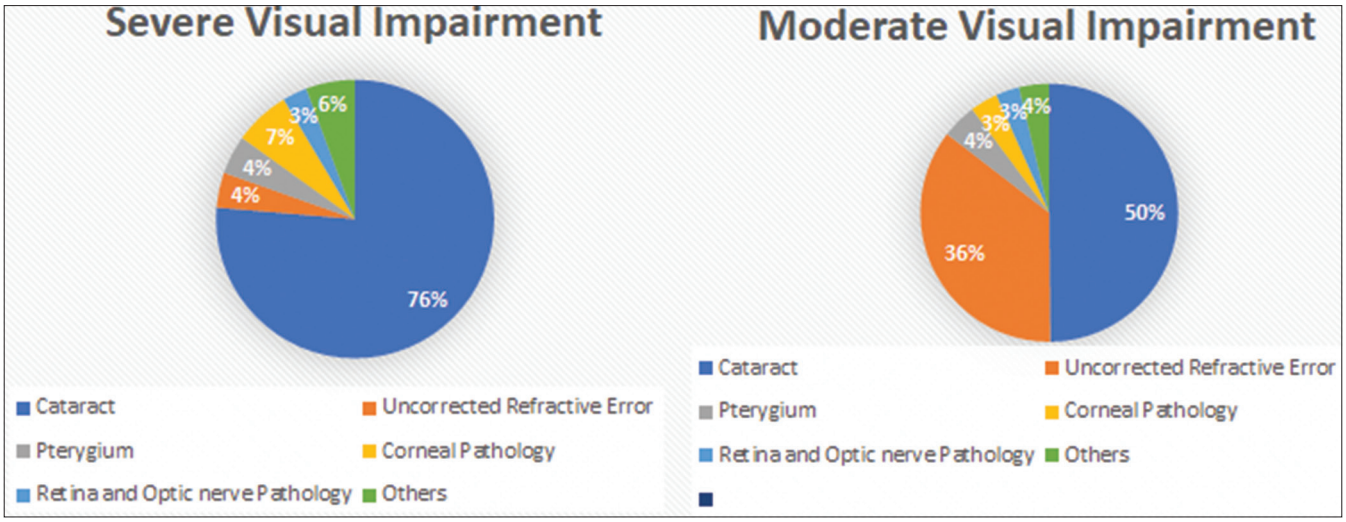

Figure 2: Causes of visual impairment, early moderate visual impairment (MVI), and severe visual impairment (SVI)/blindness

Table 2: Distribution of visual impairment in *Dongaria* community

Age group (years)	VI; *n*; 12.4%			Early MVI			SVI/Blindness		
	Total	Male	Female	Total	Male	Female	Total	Male	Female
+ 51	844	211	633	654	173	481	190	38	152
31-50	297	95	202	256	80	176	41	15	26
17-30	80	43	34	66	37	29	14	9	5
0-16	6	4	2	6	4	2	0	0	0
All ages	1227	353	871	982	294	688	245	62	183

Table 3: Clinical profile of patients

Ocular condition	Age (years)	Total	Male	Female
Cataract	All	754 (7.6%)	192 (25.5%)	560 (74.4%)
	<40	21 (3%)	10 (48%)	11 (52%)
	>40	733 (97%)	192 (26%)	541 (74%)
Refractive error	All	744 (7.5%)	273 (36.6%)	471 (63.3%)
	<16	32 (4%)	17 (53.1%)	15 (46.8%)
	>16	712 (96%)	256 (35.9%)	456 (64%)
Presbyopia	>40	924 (15%)	446 (48%)	478 (52%)
Pterygium	All	107 (1%)	33 (30%)	74 (70%)
Vitamin A deficiency	All	916 (9.2%)	473 (52%)	443 (48%)
	<16	790 (20.2%)	419 (53%)	371 (47%)
	>16	126 (2.1%)	54 (43%),	72 (57%)

cataract surgery was 17% (82/482) for people with early MVI, 8% (16/188) for people with SVI, and 81% (36/44) for people who were blind. Further details regarding the outcomes of cataract surgery will be described in the subsequent manuscript.

Eye disorders in children

In the screened population, 37.2% (n = 4124) were children (birth to 16 years), and one-third (33.3%; 1373/4124) were under-five. There were more under-five girls (54%; n = 733) and more 6–16 age group boys (54%; n = 1353) (p-value < 0.0001). Ocular signs of VAD were detected in 20% (n = 790; one-third were under 5) of children, and conjunctival xerosis (X1A) was the most common. Other disorders included strabismus (1.5%; n = 59; exotropia most common) and cataract (n = 2). GAM was detected in 17.2% (n = 234) of children, and 18% (n = 244) under five years were stunted for age.

General health and lifestyle

The mean body mass index (BMI), where height and weight were available (n = 3804), was 18.7 ± 3.8 (male 18.8 ± 3.8 and female 18.7 ± 3.9). A sizeable (42%) number of *Dongaria* people were underweight (n = 1605/3804; BMI 17.5 ± 0.5), and more than half in this group (58%; n = 945; BMI 13.7 ± 2.6) were severely underweight. Females (58%; 929/1605) were more underweight than males. Overweight and obesity were uncommon (7.4%; 280/3804; BMI: 25.8±5.7).

Essential hypertension was detected in 4% (n = 389) of people. The prevalence was higher between the fourth and sixth decade of life and more often seen in females (6 of 10). Alcohol intake was 62% (n = 6144) in this community and included 56.3% (n = 3461) females and 19% (n = 1158) under 18 years people.

Discussion

Health data, including eye health data, are essential for program planning and resource allocation. There is a severe shortage of health data for tribals because of gross poverty, poor literacy, and relegation from the mainstream.[1] PVTG community is marginalized and may remain so because policy planning and interventions are complex given the inadequate eye health data. The current study is the first (Medline search) attempt to

Table 4: Multivariable-adjusted analysis for associations of SVI/blindness and MVI with demographic variables

	Severe visual impairment/Blindness			Early moderate visual impairment		
Age group (years)	Adjusted OR	95% CI	*P*	Adjusted OR	95% CI	*P*
11-30						
31-50	4.3	1.003-3.266	<0.0001	3.5	2.724-4.606	<0.0001
51+	1.8	2.563-7.398	<0.04	2.5	1.938-4.606	<0.0001
Gender						
Male	1.8	1.401-2.416	<0.0001	0.5	0.463-0.613	<0.0001
Female*						

systematically collect eye health data from a numerically large but sequestrated PVTG community in the remote Rayagada district of Odisha. We conducted the study in the Rayagada district of Odisha for three reasons: (1) Rayagada is a tribal district with over 50% tribal population,[3] (2) it is home to the PVTG *Dongaria* indigenous community,[3] and (3) we have fixed eye health facilities in this district-one community (secondary) and nine primary (vision) centers including three of these closer to the PVTG habitats.

Our study designed to examine the people at three different locations at or close to their residence (screening), nearby vision center (primary exam), and at the secondary center (comprehensive exam) was to facilitate universal coverage through community outreach and provide the best possible care for a large spectrum of eye disorders at the secondary (community) eye center. This overarching objective was feasible because of the protocol-based task sharing between CHWs, VTs, and ophthalmologists. We believe the currently used TOES-PVTG model could be ideal implementation research in PVTG communities and help fill the know-do gap often noted in marginalized communities. Simple interventions like spectacles and/or cataract surgery at no cost to people with minimal access to eye care may transform their lives and improve their health-seeking behavior.

We have used the protocol-based tier system of eye care delivery model for three decades,[8] and recently, the World Health Organization has recommended it under the Integrated People-Centered Eye Care (IPEC) for universal health coverage (UHC) to reduce avoidable blindness.[9] Despite the rugged terrain, we screened 89% of the target population and facilitated escorted transport of 41% (384/940 referred) to VC (travel distance range 13–26 km) and 46% (453/984 referred) to SC (travel distance range 45–63 km).

The prevalence of VI among the Dongaria community was 1.3 times higher than the non-PVTG population in the same Rayagada district (12.4%, 95% CI 9.1-9.5,vs 9.4%, 95%CI 11.7-13).[10] Older age >30 years and female gender in *Dongaria* were strongly associated with moderate and severe visual impairment. Cataract and URE as the principal causes of VI among *Dongaria* were along the expected lines. We believe some of the reasons for earlier reported poor utilization of healthcare facilities could be the distance to health facilities, poor literacy, and apprehension of the interventions.[11] At the time of screening, only 0.2% of *Dongarias* wore spectacles, and 86% were illiterate. At the time of writing this report, 77% (572/744) of URE and all (924) presbyopic among *Dongarias* had received correcting spectacles. Among those *Dongarias* who visited the secondary center with cataract, more than half (134/243) had been operated on. We believe these vision-restoring interventions in the *Dongarias*, predominantly in the economically productive age group, and their direct and indirect impact on livelihood opportunities would likely make others voluntarily seek eye and health care.

Policy Implication.

1. The data showed that there were more *Dongaria* girls under five (54%), more boys (54%) in the 6–16 age group, and again more female adults (55%), suggesting poor survival of older girl children and adult males. This calls for additional operation research and required health intervention. It also calls for a greater focus on maternal and child health.
2. In the studied *Dongaria* people, 42% of them were underweight (by BMI); 17% of under-five children had malnutrition; 18% were stunted for their age; 20% of children under five years had VAD; 12% of older adults had hypertension, and two-thirds of them admitted to harmful and habitual intake of alcohol. Comparatively, data drawn from nine major non-PVTG tribal groups of India (residing in Odisha, West Bengal, and Gujarat) has shown a 40% prevalence of adult under nutrition, 12.8% obesity, and 10% hypertension, with higher affected females.[12] This calls for providing better health and well-being facilities.

A long-term strategy would be a multi-pronged approach that addresses better roads and connectivity, education and livelihood opportunities, proximally located health facilities, and persistent advocacy to improve health-seeking behavior.

Conclusion

This first population-based study of one large PVTG in Odisha has shown that there is significant health (malnutrition), eye health (cataract and uncorrected refractive error), and behavioral (alcohol use) issues in this community. What is valid for the Dongaria community could be true for other PVTGs in Odisha. A proactive, universal screening protocol used in the current TOES-PVTG may help understand their problems and make required policy changes. Simple interventions like providing spectacle and cataract surgery are likely to ease their financial burden and improve their quality of life. We believe improved livelihood opportunities and economic independence would probably change their health-seeking behavior. A pyramidal system of eye care that combines the physical and functional elements of IPEC as practiced by several organizations in India[8] and advocated by the World Health Organization[9,13] is likely to bring better health and wellness to this marginalized community. The Government of Odisha should consider a systematic eye health survey of

other PVTG communities and design a robust delivery model for good health and eye health.

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Conflicts of interest

There are no conflicts of interest.

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