

## Tribal Odisha Eye Disease Study Report # 6. Opportunistic screening of vitamin A deficiency through School Sight Program in tribal Odisha (India)

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**Purpose:** To explore the possibility of vitamin A deficiency (VAD) detection through School Sight Program (SSP) in a tribal district of Odisha, India. **Methods:** In a cross-sectional observational study, we tracked school children with ocular signs/symptoms of VAD to their villages. The ophthalmologist examined their under-5 siblings and other under-5 children in the village. Information pertaining to family belief and practices of food, water, sanitation, and the socioeconomic status of the family were collected. **Results:** The ocular features of VAD were detected in 207 of 4801 (4.3%) examined children. This included 70 children (mean age  $11 \pm 2.6$  years) detected in the school, 22 siblings (mean age  $3.2 \pm 1.2$  years) of these children detected at their home, and 115 children (mean age  $3 \pm 1.5$  years) detected in their habitat. The average family size was  $5.8 \pm 2.02$  and the birth order of the child with VAD was  $2.3 \pm 1.25$ . Most parents were farmer, living in asbestos-roofed house, depended on public underground water, and practiced open-air defecation. The distribution of VAD in 207 children was conjunctival xerosis (X1A = 207; 100% of VAD and 4.3% of all children), Bitot's spot (X1B = 169; 81.6% of VAD and 3.5% of all children), corneal scar (XS = 3; 1.4% of VAD and 0.06% of all children), and night blindness (XN = 35; 16.9% of VAD and 0.72% of all children). **Conclusion:** An opportunistic screening for detection of VAD through a SSP could be cost-effective and complement the existing strategy.

**Key words:** India, Odisha, school screening, tribal, vitamin A deficiency

Vitamin A deficiency (VAD) is an important nutritional disorder. Vitamin A is essential for vision (especially dark adaptation), immune response, bone growth, reproduction, maintenance of the surface linings of the eyes, epithelial cell growth and repair, and epithelial integrity of the respiratory, urinary, and intestinal tracts.<sup>[1]</sup> VAD is a risk factor for blindness and for mortality from measles and diarrhea in children age 6–59 months. VAD may be secondary to decreased ingestion, defective absorption, altered metabolism, and increased requirements. In humans, vitamin A, a fat-soluble vitamin, is stored in the liver. An adult liver can store up to 1 year's reserve of vitamin A, whereas a child's liver may have enough storage to last only for several weeks. Hence, children are more often susceptible to VAD. Some ocular signs of VAD denote chronic deficiency (Bitot's spot, night blindness), while other signs denote acute deficiency (corneal ulcer, keratomalacia). The World Health Organization (WHO) recommends vitamin A supplementation (VAS) annually (100,000 IU; 30 mg retinol equivalent) in children 6–11 months of age and biannually (200,000 IU; 60 mg retinol equivalent) in children 12–59 months of age.<sup>[2]</sup>

In the 1960s, the WHO conducted the first global survey of VAD with associated xerophthalmia and complicated measles.<sup>[3]</sup> In 1973, an International Vitamin A Board was set up to alleviate global malnutrition. In India, the National Prophylaxis Program against Nutritional Blindness due to

Vitamin A Deficiency (NPPNB due to VAD) was initiated in 1970 in 11 states with the specific aim to prevent nutritional blindness due to keratomalacia.<sup>[4]</sup> The National Institute of Nutrition (NIN), Hyderabad, India, evaluated the impact of this program in two participating states 6 years after starting the program. Because the impact was positive, the program was extended to all states in India.<sup>[5]</sup> At the same time, a large trial has shown benefit of supplementing VAS with deworming (albendazole 400 mg biannual), the "Deworming and Enhanced Vitamin A Supplementation (DEVTA)" in India.<sup>[6]</sup> The WHO has recommended biannual VAS in VAD-endemic countries.<sup>[7]</sup>

VAD is associated with the socioeconomic status of the people and country. In the middle- and low-income countries, the prevalence of VAD has decreased from 39% in 1991 to 29% in 2013, though this reduction in VAD has not reflected in the sub-Saharan Africa (prevalence 48%) and south Asia (prevalence 44%). In 2013, VAD accounted for 1.7% of all deaths in children younger than 5 years in the middle- and low-income countries.<sup>[8]</sup> It is reported that over the past 40 years, the clinical VAD has declined in India, but not entirely eliminated.<sup>[9]</sup> A 2001 national survey conducted by the Indian Council of Medical Research (ICMR) in 16 districts in all five

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regions of the country still showed prevalence of Bitot's spot in 3 of 16 districts.<sup>[10]</sup> The National Family Health Survey (2005–06) in India had documented that only 29.7% of children below the age of 5 years had received vitamin A in the prior 6 months.<sup>[11]</sup>

VAD is typically a disease of preschool children. Untreated, it could persist in the school-going children too. The Rayagada School Sight Program (SSP) was primarily aimed at detection and treatment of uncorrected refractive error though it also included detection of ocular anomalies using both trained schoolteachers and qualified ophthalmic technicians.<sup>[12]</sup> During this program, we detected Bitot's spot and night blindness in a few students. Guided by the accredited social health activist (ASHA) workers, a team led by an ophthalmologist visited all houses to examine younger preschool siblings and all under-5 children present at the time of examination in the neighborhood. This communication is based on these visits and underlines the value of opportunistic screening for VAD.

## Methods

The study was approved by the local district administration and by the institutional ethics committee (2016-15-CB-14). The research protocol adhered to the provision of the Declaration of Helsinki for research involving human beings. The school authorities provided consents for eye examination by optometrists in their premises and the parents provided consent for eye examination of the children in their homes. Written informed consent was obtained from the parents of the children who were referred for examination by ophthalmologist in the hospital.

The Rayagada SSP methodology and the results are already described.<sup>[12]</sup> The school children suspected by the examining teachers to have external eye manifestations of VAD (xerosis, Bitot's spot, etc.) or complained of having difficulty in dusk/night vision were examined by an optometrist as a part of the SSP and were confirmed by an ophthalmologist after a comprehensive eye examination. The VAD ocular features were classified as per the WHO classification.<sup>[13]</sup>

The comprehensive eye examination included external examination, slit-lamp biomicroscopy, refraction, and funduscopy in addition to the enquiry of night blindness. The VAD-affected children detected in the SSP were tracked to their homes for examination of their preschool siblings; the team also examined under-5 children in the same village and on the same day. In the community, all children were assembled in a central shaded location of the village usually in front of one of the houses. The basic examination was an external eye flashlight test by an ophthalmologist. The parents were asked to comment on the child's day and night vision as "good" or "bad." The accompanying healthcare professionals with the help of ASHA workers collected data on the food habit (vegetarian and nonvegetarian, consuming milk and green vegetables), vaccination status, socioeconomic condition, and the environment. All examinations were done in the presence of the parents and village head.

## Results

The Rayagada SSP was a multistage program that involved 216 trained teachers and eye health personnel; the team screened 153,107 children in 2124 schools in the district. The teachers referred 4519 children for ocular anomaly

with or without refractive error. They suspected VAD in 300 children (6.6% of referred). As reported by us earlier and the methodology described, the sensitivity of teachers detecting Bitot's spot in the school children was 6.06% [95% confidence interval (CI): 1.68–19.61] and the specificity was 95.00% (95% CI: 94.41–95.52).<sup>[12]</sup> All these children could not recollect having received VAS in preschool years, and there was no school record to capture the data. The optometrists confirmed VAD in 73 of them (24.3% of teacher's examination) and the ophthalmologist confirmed VAD in 70 (95.8% of optometrist exam). Within 3 months, an ophthalmologist-led team reached the house of 65 children located in rural habitats (family of five children had migrated) to their homes and examined 32 under-5 siblings of these 65 school children with VAD. In addition, the ophthalmologist also examined the remaining 250 under-5 children in the same village. The traveling distance from the eye care facility (Rayagada) to these habitats was from 20 to 150 km. Twenty-two siblings of VAD school students and 115 of 250 children in these habitats had ocular signs of VAD. Thus, a total of 207 vitamin A-deficient children were detected out of 4801 children examined in the school or village clusters [Fig. 1].

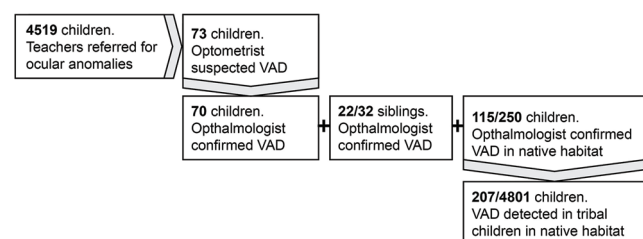
There was no documented evidence of vaccination and VAS and the parents were vague in their answer. The demography details including the vaccination status are shown in Table 1.

In this cohort, there were children with conjunctival xerosis (XIA) and Bitot's spot (XIB), corneal scar (XS), and night blindness (XN) [Table 2]. One child had general features of VAD. Only 5% of children consumed cow milk or other dairy products, 12%–38% had regular nonvegetarian food, 81% practiced open-air defecation, 90% of parents were farmers, and the majority lived in asbestos-roofed houses [Table 3].

Our term of reference by the local authority was that the government must do all interventions, from spectacles to surgery. Hence, the findings of the study were shared with the concerned district health officials so that immediate and appropriate planning and execution for VAS is done. We guess this was done as per the national guidelines.

## Discussion

Mass screening method is used to detect the ocular features of VAD in India.<sup>[14]</sup> But mass screening is both time-consuming and highly resource-intensive. This study explored the possibilities of an opportunistic detection of VAD using the lead obtained in the routine school screening in a tribal district in India (Odisha) as a complement to the existing system. We chose to conduct this study in Rayagada district in Odisha for two reasons – first, it is a predominantly tribal population



**Figure 1:** Flowchart demonstrating the stepwise detection of vitamin A-deficient children

**Table 1: Demographics of the examined population with VAD (n=207)**

Age ( $\pm$ standard deviation) of school children	11 $\pm$ 2.6 years
Age range of school children	5-6 years
Age ( $\pm$ standard deviation) of siblings	3.2 $\pm$ 1.2 years
Age ( $\pm$ standard deviation) of children in the habitat	3 $\pm$ 1.5 years
Male: female	5:4
Average no. of family members	5.8 $\pm$ 2.02 (range: 3-14)
Antenatal checkup during their pregnancy	29 (20%)
Home: hospital delivery among vitamin A-deficient children	15:1
Mean age of the mother at first child birth	16.6 $\pm$ 1.62 years (range: 15-21 years)
Average no. of family members	5.8 $\pm$ 2.2 (3-14)
Birth order of the vitamin A-deficient child in the family	2.3 $\pm$ 1.25 (1-5)
Vaccination and vitamin A supplementation status	Unknown; most children did not have any vaccination card and could not share a reliable history of vaccination

VAD=Vitamin A deficiency

**Table 2: Distribution of VAD ocular features (n=270)**

VAD features	School		Siblings		Habitat		Total n	Prevalence % n=4801
	n	%	n	%	n	%		
Conj. xerosis (X1A)	<b>70</b>	<b>100</b>	<b>22</b>	<b>100</b>	<b>115</b>	<b>100</b>	<b>207</b>	<b>4.3</b>
Age (years)								
0-5	0	0	22	100	115	100	137	2.8
5-10	31	44.2	0	0	0	0	31	0.64
10-15	39	55.7	0	0	0	0	39	0.81
Gender								
Male	39	55.7	12	54.5	64	55.6	115	2.3
Female	31	44.2	10	45.4	51	44.3	92	1.9
Bitot's spot (X1B)	<b>70</b>	<b>100</b>	<b>11</b>	<b>50</b>	<b>88</b>	<b>76.5</b>	<b>169</b>	<b>3.5</b>
Age (years)								
0-5	0	0	11	50	88	76.5	99	2
5-10	29	41.4	0	0	0	0	29	0.6
10-15	41	58.5	0	0	0	0	41	0.85
Gender								
Male	37	52.8	7	31.8	47	40.8	91	1.8
Female	33	47.1	4	18.1	41	35.6	78	1.6
Corneal scar (XS)	<b>1</b>	<b>1.4</b>	<b>1</b>	<b>4.5</b>	<b>1</b>	<b>0.86</b>	<b>3</b>	<b>0.06</b>
Age (years)								
0-5	0	0	1	4.5	1	0.86	2	0.04
5-10	1	1.4	0	0	0	0	1	0.02
10-15	0	0	0	0	0	0	0	0
Gender								
Male	0	0	0	0	0	0	0	0
Female	1	1.4	1	4.5	1	0.86	3	0.06
Night blindness (XN)	<b>9</b>	<b>12.8</b>	<b>5</b>	<b>22.7</b>	<b>21</b>	<b>18.2</b>	<b>35</b>	<b>0.72</b>
Age (years)								
0-5	<b>0</b>	<b>0</b>	<b>5</b>	<b>22.7</b>	<b>21</b>	<b>18.2</b>	<b>26</b>	<b>0.54</b>
5-10	<b>5</b>	<b>7.1</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>5</b>	<b>0.10</b>
10-15	<b>4</b>	<b>5.7</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>4</b>	<b>0.08</b>
Gender								
Male	<b>5</b>	<b>7.1</b>	<b>3</b>	<b>13.62</b>	<b>11</b>	<b>9.53</b>	<b>19</b>	<b>0.39</b>
Female	<b>4</b>	<b>5.7</b>	<b>2</b>	<b>9.08</b>	<b>10</b>	<b>8.6</b>	<b>16</b>	<b>0.33</b>

VAD=Vitamin A deficiency. The bold values denote overall value of the specific condition for all age and gender groups

**Table 3: Environment, socioeconomic status, and food habits of VAD children (n=207)**

Variables	Number (%)	Variables	Number (%)	Variables	Number (%)	Variables	Number (%)
Water		Sanitation		Occupation		Food habit	
Bore well	115 (55.6)	Uncovered latrine	39 (18.9)	Farmer	187 (90.5)	Cow milk	11 (5.3)
Public tap	6 (2.9)	Open air defecation	168 (81.0)	Driver	1 (0.5)	Egg/chichi	79 (38)
-	-	-	-	Fisherman	5 (2.3)	Fish	25 (12)
-	-	-	-	Teacher	1 (0.5)	-	-
-	-	-	-	Unemployed	10 (5)	-	-

VAD=Vitamin A deficiency

and relatively remote location,<sup>[15]</sup> and second, we, the LVPEI, have established a fixed secondary-level eye care facility in this district for delivery of appropriate and affordable eye care. Rayagada ranks 465 in 640 districts in India and the district Human Development Index (HDI) is only 0.18.<sup>[16]</sup> A 2007 report has indicated poor nutritional status of children and mothers in Rayagada district.<sup>[17]</sup> A 2013 report had observed that the poor VAS coverage in India was related to poor development of the district, rural location, children of less educated mothers, and the children born in higher birth order.<sup>[11,18]</sup>

The Indian state of Odisha has adopted the WHO recommendation of biannual VAS.<sup>[19]</sup> The VAS coverage in Odisha has increased from 61% in 2006 to 97% in 2011 though we suspect that it has not reached the most vulnerable population uniformly<sup>[20]</sup> and this includes the Rayagada district.<sup>[21]</sup> Normally, one has to conduct a massive drive to search these localities where children with VAD live. This is expensive in terms of time and other resources. While the traditional method should continue, tracking to these habitats through the lead provided by the children in the school was another modality, both opportunistic and cost-saving.

The cut-off to define VAD as a public health problem in a community is the prevalence of Bitof's spot at  $\geq 0.5\%$ .<sup>[22]</sup> The prevalence of Bitof's spot [3.5%; Table 2] in this study exceeded this limit. Thus, VAD in Rayagada (Odisha, India) is a public health problem. The large prospective study involving a million preschool children in north India has shown that the prevalence of Bitof's spot halved over the 5-year study period using the DEVTA strategy of combined deworming and VAS.<sup>[6]</sup> In the absence of a case-control study, one could attribute the reasons for this high prevalence to poor neonatal care, home delivery, questionable VAS, inadequate diet, poverty, and poor sanitation. While continuing with the biannual VAS program recommended by the WHO and others,<sup>[2,23,24]</sup> special efforts are required to improve education, mother's nutrition, and household sanitation.<sup>[11]</sup>

This study has several limitations: (1) the Rayagada SSP was not inherently designed to detect VAD. The study team only performed an opportunistic screening of reaching those habitats from where certain students were found to have clinical features of VAD. (2) All children in this tribal community may not be attending the school; it is likely that we missed visiting some habitats. (3) The SSP was not designed to identify the risk factors leading to VAD.

The strength of the study lies in the fact that the lead was obtained from a large pool of over 153,000 school-going students and the use of the opportunistic screening in the children's home and habitat. This reemphasizes our belief

that the school screening should be beyond the detection of refractive error only. This kind of opportunistic screening is cost-effective in areas where the VAS forms part of the public policy. A future study could be planned to screen all preschool children and pregnant women to detect the VAD burden and identify the risk factors of VAD in this district so that the local health authorities could design a tailored plan of care. In addition, adopting the WHO and United Nations International Children Emergency Fund recommendation of the Integrated Management of Childhood Illness<sup>[25]</sup> and delivering the child care through primary eye care<sup>[26]</sup> at the district level will help reduce the VAD disease.

## Conclusion

The results of our study suggest that an opportunistic screening for detection of VAD through a SSP could be cost-effective and complement the existing strategy.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

## References

- Ross SA, McCaffery PJ, Drager U, De Lucal M. Retinoids in embryonal development. *Physiol Rev* 2000;80:1021-54.
- World Health Organization. Guideline: Vitamin A Supplementation in Infants and Children 6–59 Months of Age. Geneva, Switzerland: WHO; 2011.
- Reddy V. History of the International Vitamin A Consultative Group 1975-2000. *J Nutr* 2002;132(9 Suppl):2852S-6S.
- Maternal and child health scheme for prophylaxis against nutritional blindness in children caused by vitamin A deficiency. Family Planning Programme, Fourth Five-Year Plan Technical Information: MCH No. 2. New Delhip. 1-22.
- Kapil U, Chaturvedi S, Nayar D. National nutrition supplementation programmes. *Indian Pediatr* 1992;29:1601-13.
- Awasthi S, Peto R, Read S, Clark S, Pande V, Bundy D, and the DEVTA (Deworming and Enhanced Vitamin A) team. Vitamin A supplementation every 6 months with retinol in 1 million pre-school children in north India: DEVTA, a cluster-randomised trial. *Lancet* 2013;381:1469-77.
- Report of the XXII International Vitamin A Consultative Group Meeting. Vitamin A and the Common Agenda for Micronutrients. Lima, Peru, 15–17 November, 2004. p. 49-59.
- Stevens GA, Bennett JE, Hennocq Q, Lu Y, De-Regil LM, Rogers L, et al. Trends and mortality effects of vitamin A deficiency in children in 138 low-income and middle-income countries between 1991 and 2013: A pooled analysis of population-based surveys.

- Lancet Global Health 2015;3:e528-36.
9. World Health Organization. Global Prevalence of Vitamin A Deficiency in Populations at Risk 1995–2005. WHO Global Database on Vitamin A Deficiency. Geneva, Switzerland: WHO; 2009.
  10. Toteja GS, Singh P, Dhillon BS, Saxena BN. Vitamin A deficiency disorders in 16 districts of India. *Indian J Pediatr* 2002;69:603-5.
  11. Semba RD, de Pee S, Sun K, Bloem MW, RajuVK. The role of expanded coverage of the national vitamin A program in preventing morbidity and mortality among preschool children in India. *J. Nutr* 2010;140:208S-12S.
  12. Panda L, Das T, Nayak S, Barik U, Mohanta BC, Williams J, *et al.* Tribla Odisha Eye Disease Study (TOES) #2. Rayagada School Screening Program – Effectiveness of multistage screening and accuracy of schoolteachers in vision screening and other ocular anomalies detection. *Clinical Ophthalmol* 2018;12 1181-7.
  13. World Health Organization. Control of Vitamin A Deficiency and Xerophthalmia. Report of a Joint WHO/UNICEF/USAID/Helen Keller International/IVACG Meeting. Technical Report Series 672. Geneva, Switzerland: World Health Organization; 1982.
  14. Aspatwar AP, Bapat MM. Methods of mass screening of vitamin A deficiency. *Indian Ped* 1996;33:223-5.
  15. Available from: [www.stsodisha.gov.in](http://www.stsodisha.gov.in). [Last accessed on 2018 Jun 15].
  16. Available from: [www.usindiapolicy.org](http://www.usindiapolicy.org). [Last accessed on 2018 Jun 15].
  17. Kar GC, Sarangi L, Nanda A. A study of food related nutritional deficiency in KBK district of Orissa. Available from: [www.planningcommission.nic.in/reports/sereport/ser/new\\_rep.pdf](http://www.planningcommission.nic.in/reports/sereport/ser/new_rep.pdf). [Last accessed on 2019 Jun 12].
  18. Agrawal S, Agrawal P. Vitamin A supplementation among children in India. Does their socioeconomic status and the economic and social development status of their state of residence make a difference? *Int J Med Public Health* 2013;31:48-54.
  19. Rah JH, Houstao R, Mohapatra BD, Kumar SS, Saiyed F, Bhattacharjee S, *et al.* A review of vitamin A supplementation program in India: reasons for success in the states of Bihar and Odisha. *Food Nutr Bull* 2014;35:203-10.
  20. Bhattacharjee S, Rah JH, Dashmohapatra B, Bhaumik S, Badgaiyan N, Aquayo VM. Is vitamin A supplementation program reaching the most vulnerable children in India? New evidence from Odisha. *Eur J Nutr Food Safety* 2015;5:742-43.
  21. Available from: [www.nhmorissa.gov.in/frmchildhealth.aspx](http://www.nhmorissa.gov.in/frmchildhealth.aspx). [Last accessed on 2018 Jun 15].
  22. UNICEF. Vitamin A Supplementation: A Decade of Progress. New York, NY: UNICEF Nutrition Section; 2007
  23. West KP, Sommer A, Palmer A, Schultink W, Habicht JP. Commentary: Vitamin A policies need rethinking. *Int J Epidemiol* 2015;44:292-4.
  24. Bhutta ZA, Baker SK. Premature abandonment of global vitamin A supplementation programmes is not prudent! *Int J Epidemiol* 2015;44:297-9.
  25. WHO, UNICEF. IMCI. Integrated Management of Childhood Illness. Switzerland: World Health Organization; 2005.
  26. Malik ANJ, Mafwiri M, Gilbert C. Integrating primary eye care into global child health policies. *Arch Dis Child* 2017;1-5.