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Original Research Article

A Study on the Vitamin a Deficiency and its Ocular Manifestation on School Children in District Muzaffarpur, Bihar, India.

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Abstract:

Objectives: The present study was to evaluate the Vitamin A deficiency and its Ocular manifestation on school Children in district Muzaffarpur, Bihar, India.

Methods: All subjects underwent eye examinations, which included observation of scotopic vision (luxometer reading) and ophthalmologic examination (including posterior segment, if indicated). Anterior segment examination was done with a pen torch and magnifying loupe (1.5×). The clinical signs of xerophthalmia were recorded and graded according to WHO criteria. The history of night blindness was reassessed using a luxometer reading and severity of night blindness was graded using WHO criteria. All children confirmed as having night blindness were subjected to posterior segment examination by direct and indirect ophthalmoscope to rule out other fundus pathology.

Results: Out of the 200 children examined, 116(58%) had normal ocular appearance while 84(42%) had ocular manifestation of vitamin A deficiency. Which included 17(8.5%) history of night blindness (XN), 51(25.5%) conjunctiva xerosis (XIA), 5(2.5%) bitot's spot (XIB), 1(0.5%) corneal scar (XS) and 10(5%) corneal xerosis (X2). None of the children were found to have xerophthalmic fundus (XF). only 77 had luxometer readings available. Out of 18 children, 17 had night blindness from history and luxometer reading. Among 38 children 28 had positive luxometer reading but there was no history of night blindness.

Conclusions: Ocular manifestations with vitamin A deficiency are mostly seen in older age children. Most common manifestations are conjunctiva xerosis, night blindness and Bitot's spot. Luxometer reading is one of the best choices for the objective assessment of night blindness. Hence, we should organize a free eye check-up camp in different school for the prevention of ocular manifestation with vitamin A deficiency. We should also aware the children along with their parents regarding nutrition like regular intake of plant foods rich in carotene such as green leafy vegetables, yellow fruits, carrots and animal foods containing retinol like fish liver oil, fish, liver, egg, meat, milk, butter, cheese, and use of fortified food like vanaspati, margarine, dried skimmed milk. Other measures like promotion of breast feeding, supply of safe drinking water, maintaining proper sanitation and hygiene, prevention of diarrhoea, measles, acute respiratory infections and access to basic health services should also be educated.

Key words: Children, Ocular Manifestations, Luxometer Reading.

Introduction

Vitamins are the essential constituents of natural food and play a key role in metabolism, cellular integrity and maintenance of homeostasis [1]. Ocular manifestations of vitamin deficiencies is an evolving field as more disease entities are being elucidated by studying the underlying pathophysiology of vitamin level irregularities [2].

The prevalence of vitamin A deficiency (VAD) has been recognized as a public-health nutritional problem in developing countries [3], which could be attributed to limited access to foods containing pre-formed vitamin A (Retinol) from animal-based food sources and poor consumption of foods containing beta-carotene due to poverty and food choices [4].

As per the World Health Organization (WHO) estimates, approximately one third of the world's pre-school children are vitamin A deficient and most of them live in South East Asia (91.5million) with highest proportion of the world's VAD children are from India [5,6,7]. Similarly, West Jr also reported that the largest number of sub-clinical vitamin A deficient children lives in India and 40% of all preschool children with xerophthalmia

(pathologic dryness of the conjunctiva and cornea) in the developing world live in India [8].

Xerophthalmia is a term referring to the spectrum of ocular presentations in the setting of hypovitaminosis A. The World Health Organization released a grading system to characterize the grading of the xerophthalmia spectrum of diseases [3]. The earliest and most benign presentation is conjunctival xerosis, which is characterized by conjunctival wrinkling and ocular surface dryness due to loss of mucin-secreting goblet cells. The next disease in the spectrum is bitot spots, which are triangular patches of white, opaque deposits classically on the temporal bulbar conjunctiva. Bitot spots are keratinized, desquamated conjunctival epithelial cells with overlying Corynebacterium xerosis bacteria which produce gas that leads to the typical opaque, rough contour. Corneal xerosis can closely follow, characterized by corneal haze, punctate epithelial erosions, pannus, and neovascularization. With the cornea now affected, patients complain of a decrease in visual acuity. The World Health Organization noted that the corneal xerosis stage is the last where high-dose vitamin A treatment will preserve baseline vision. If left untreated, corneal xerosis can progress to corneal ulceration and keratomalacia secondary to necrosis of limbal stem cells and corneal stroma. Scarring of the cornea is the final stage and would require transplantation for visual recovery [2].

Vitamin A is very essential nutrient for vision as an important component of rhodopsin, that absorbs light in the retinal receptors, and for the differentiation and functioning of the conjunctival membranes and cornea [9]. The ocular manifestations of VAD is called Xerophthalmia, which includes milder forms of Night blindness, Conjunctival Xerosis, and Bitot's Spots and severe forms of Corneal Xerosis, Corneal Ulceration and Keratomalacia [10].

Several studies have identified important predictors of Vitamin A Deficiency (VAD) in Ethiopia, including maternal education, family size, droughts, respiratory or diarrheal illnesses, dietary diversity status, availability of latrines, income status, sex of the child, and stunted growth [11, 12]. Vitamin A-rich food consumption in the country is seasonal, poor, and geographically clustered [13], and despite periodic high-potency vitamin A supplementation programs, clinical VAD remains a major public health problem [14,15]. Access to and consumption of vitamin A-rich foods are low, particularly in southern regions [13] and affordability is decreasing [16]. These challenges highlight the need for updated epidemiological evidence and the evaluation of existing interventions to address VAD effectively. Objectives of our study was to evaluate the Vitamin A deficiency and its Ocular manifestation on school Children in district Muzaffarpur, Bihar, India.

Material & Methods

The present study was conducted in the Department of Ophthalmology, Sri Krishna Medical College & Hospital, Muzaffarpur, Bihar during a period from January 2023 to July 2023. An ophthalmic examination of children with age group 5 to 15 years was conducted in six different school of Muzaffarpur, Bihar. A total of 200 school children were participated to eye checkup.

All the children were interviewed for information on any history of night blindness or any significant ophthalmic problems. All subjects underwent eye examinations, which included observation of scotopic vision (luxometer reading) and ophthalmologic examination (including posterior segment, if indicated). Anterior segment examination was done with a pen torch and magnifying loupe (1.5×). The clinical signs of xerophthalmia were recorded and graded according to WHO criteria. The history of night blindness was reassessed using a luxometer reading and severity of night blindness was graded using WHO criteria. All children confirmed as having night blindness were subjected to posterior segment examination by direct and indirect ophthalmoscope to rule out other fundus pathology.

Results

A total of 200 children were interviewed. Out Of these, 118 were boys (59%) and the remaining 82 were girls (41%). The age range was 5–15 years. Out of the 200 children examined, 116(58%) had normal ocular appearance while 84(42%) had ocular manifestation of vitamin A deficiency. Which included 17(8.5%) history of night blindness (XN), 51(25.5%) conjunctiva xerosis (XIA), 5(2.5%) bitot's spot (XIB), 1(0.5%) corneal scar (XS) and 10(5%) corneal xerosis (X2). None of the children were found to have xerophthalmic fundus (XF).

Table 1: Distribution of ocular manifestation of vitamin A deficiency among school children.

Ocular manifestation	No. of children	Percentage
Normal findings	116	58%
History of night blindness (XN)	17	8.5%
Conjunctiva xerosis (XIA)	51	25.5%
Bitot's spot (XIB)	5	2.5%

Corneal scar (XS)	1	0.5%
Corneal xerosis (X2)	10	5%
Total	200	100%

In the present study, Ocular manifestation of vitamin A deficiency were seen in 47(39.83%) school children in age group of 5-10 years. The percentage was significantly higher (p=0.0018) in this school age children (5-10 years).

37(45.12%) ocular manifestation was seen in 11-16 years age group children. But the percentage was not significantly higher(p=0.2127) as compared to normal. Out of total 200 school age children, ocular manifestation was extreme significantly higher (p=0.0014) as compared to normal findings.

Table 2: Age wise distribution of school children with ocular manifestation of vitamin A deficiency

Age group (Years)	Normal findings		Ocular manifestations		Total	p-value
	Frequency	Percentage	Frequency	Percentage		
5-10	71	60.17%	47	39.83%	118(59%)	0.0018
11-16	45	54.88%	37	45.12%	82(41%)	0.2127
Total	116	58%	84	42%	200	0.0014

In the present study, out of 84 children of ocular manifestation, 55 were males and 29 were females. When we compared the ocular manifestations with normal children, we were found that 55(44.72%) males were not significantly (p=0.0984) associated with normal male children. But 29(37.67%) females were significantly (p=0.0023) associated with normal female children. Ocular manifestation between gender (male and female) was not significantly difference (p=0.4709).

Table 3: Showing the gender wise distribution of school children with ocular manifestation of vitamin A deficiency

Gender	Normal findings		XIA-XS		Total	p-value
	Frequency	Percentage	Frequency	Percentage		
Male	68	55.28%	55	44.72%	123	0.0984
Female	48	62.33%	29	37.67%	77	0.0023
Total	116	58%	84	42%	200	0.0014

In the present study, only 77 had luxometer readings available. Out of 18 children, 17 had night blindness from history and luxometer reading. Among 38 children 28 had positive luxometer reading but there was no history of night blindness.

Sensitivity, specificity, positive predictive value and negative predictive was 44.73%, 97.44%, 94.44% and 35.59% respectively according to the diagnosis of night blindness from the history and luxometer reading.

Table 4: Showing the comparison of diagnosis of night blindness from the history and luxometer reading among school children

History of night blindness	Luxometer reading						
	XN+	Sensitivity (%)	XN-	Specificity (%)	Total	Positive predictive value	Negative predictive value
XN+ (night blindness present)	17	17/38 X 100=44.73%	1	38/39 X 100= 97.44%	18	17/18 X 100 = 94.44%	21/59 X 100 = 35.59%
XN– (no night blindness)	21		38		59		
Total	38		39		77`		

Discussions

Vitamin A constitutes a group of biochemical compounds, including retinol, retinaldehyde, retinoic acid, and beta-carotene [17]. Most pertinent for vision, 11-cis retinaldehyde (or retinal) combines with opsin in the photoreceptor outer segments to create rhodopsin. Once light strikes rhodopsin, 11-cis retinal isomerizes to alltrans retinal, leading to hyperpolarization of the photoreceptor and ultimately, initiation of the visual pathway. 11-cis retinal is regenerated in the retinal pigment epithelium (RPE), to allow the visual cycle to continue. Outside of the retinal photoreceptors, vitamin A maintains corneal and conjunctival epithelial cell integrity. If vitamin A deficiency occurs, these cells undergo metaplasia and keratinization, reducing the amount of mucous secreting epithelial cells on the ocular surface [17].

Vitamin A deficiency disorder has identified as a serious and preventable nutritional disease. It also contributes significantly, even at sub-clinical levels, to morbidity and mortality from common childhood infection. Studies suggest that ill health and risk of death from some infections are also increased even in children who are not clinically deficient but, whose vitamin A body store is depleted [18,19]. Though one of the main causes of xerophthalmia is poor intake of vitamin A rich foods, it is also associated with poverty, ignorance, faulty feeding habits among the entire population but young children in particular [20].

In the present study, a total of 200 children were selected for the ophthalmic examination. Among them, 84(42%) had specific signs of ocular manifestation of vitamin A deficiency. Night blindness was found in 8.5% of the children, conjunctiva xerosis in 25.5%, Bitot's spot in 2.5%, corneal xerosis in 5% and corneal scars in 0.5%. None of these, however, had xerophthalmia fundus. Prevalence of ocular manifestation was 42%.

Our findings showed that the prevalence of ocular manifestation of vitamin A deficiency is relatively high, compared to those from other studies. Studies in Western Yemen, Thailand, Bangladesh, Nepal and India found a very low prevalence of ocular manifestation of vitamin A deficiency [21,22,23]. Ocular manifestation, particularly night blindness, is usually the earliest clinical manifestation of vitamin A deficiency. In our study, a history of night blindness was found in 8.5% of the children. In Thailand, the prevalence of night blindness in the rural area was 1.3% in children aged 1–5 years.8 A study in Western Yemen showed only 0.5% of the children studied had a history of night blindness [21].

In the present study, Bitot's spots were seen in 2.5% of the children, compared with 1.7 and 0.4% in Western Yemen and Thailand, respectively [21,22]. In the present study, conjunctiva xerosis was seen in 25.5% children. In general, the overall prevalence of xerophthalmia among children in India was reported as 1.7% [24] and approximately 0.8% of all children suffer from Bitot's spots [25]. While, the sub-clinical VAD is even more prevalent; with recent estimates (31–57%) placing India among the highest in the world [26,25]. Similarly, a study carried out in northern India State of Uttar Pradesh reported the high prevalence of xerophthalmia (9.1%) and Bitot's Spot (5.4 %) among pre-school children. This study even reported the severe forms of VAD such as corneal ulceration and corneal scar as 0.2% and 0.5%, respectively [27]. Likewise, a higher prevalence of clinical VAD has been reported even among urban children of North Indian state of Gujarat (Bitot's Spot 2.1%).

In the present study, the prevalence of ocular manifestation of vitamin A deficiency was high in the school age group (11–16-year-olds) compared to age 5-10 years children, and the difference was statistically significant. Further stratification of the data by age confirmed that the prevalence was lower in younger children and increased with age. Several possible reasons could explain this finding. Firstly, almost 90% of the school age group were staying at a hostel where canned foods formed the staple diet. On the other hand, the younger school age group children consumed food similar to that of the adults at home.

In the present study, the prevalence of VAD was slightly higher among boys as compared to girls but the difference was not statistically significant (p=0.4709). Similar trends have been reported by Chauhan et al and Bhattacharya et al [28,29]. A study in the Philippines showed that xerophthalmia was more common in 4–6-year-old children and vitamin A deficiency was more prevalent in boys than girls [30].

In the present study, history of night blindness had sensitivity, specificity and positive predictive values of 44.73%, 97.44% and 94.44%, respectively, as compared with standard diagnosis using luxometer readings. The validity of night blindness history obtained from patients in the screening of vitamin A deficiency has been questioned. Cultural diversity, socioeconomic and educational status and awareness levels of a population are likely to affect the validity of results. A finding in Indonesia showed that night blindness ceased to be an accurate reflection of xerophthalmia impact when the prevalence was low [31].

Xerophthalmia can be treated with the help of vitamin A supplement (VAS). The supplements are either prescribed to be consumed orally or administered via injections. Furthermore, the examiner prescribes antibiotics to prevent any infections from developing in the optical structures. If cornea is already damaged then the examiner advises the patient to also keep the area covered and protected, to prevent it from pathogens, pollutants and detrimental toxins in the environment. In order to maintain healthy vision VAS is fundamental to consume in adequate amount as it is instant treatment of Xerophthalmia [32].

Conclusions

The present study concluded that the ocular manifestations with vitamin A deficiency are mostly seen in older age children. Most common manifestations are conjunctiva xerosis, night blindness and Bitot's spot. Luxometer reading is one of the best choices for the objective assessment of night blindness. Hence, we should organize a

free eye check-up camp in different school for the prevention of ocular manifestation with vitamin A deficiency. We should also aware the children along with their parents regarding nutrition like regular intake of plant foods rich in carotene such as green leafy vegetables, yellow fruits, carrots and animal foods containing retinol like fish liver oil, fish, liver, egg, meat, milk, butter, cheese, and use of fortified food like vanaspati, margarine, dried skimmed milk. Other measures like promotion of breast feeding, supply of safe drinking water, maintaining proper sanitation and hygiene, prevention of diarrhoea, measles, acute respiratory infections and access to basic health services should also be educated.

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