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Original Research Article

Prevalence of Vitamin A Deficiency and Ocular Manifestation in Malnourished Children

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Conflict of interest: Nil

Abstract

Introduction: Vitamin A deficiency is a major public health problem and a leading cause of preventable blindness among malnourished children. This study assessed its prevalence and ocular manifestations.

Materials and Methods: A hospital-based cross-sectional study was conducted on 100 malnourished children aged 6 months to 5 years. Nutritional status was assessed using WHO criteria, and ocular examination was done as per WHO classification. Serum vitamin A levels were estimated in selected cases. Statistical analysis was performed with $p < 0.05$ considered significant.

Results: The prevalence of vitamin A deficiency was 38%, with 26% clinical and 12% biochemical deficiency. Ocular manifestations were seen in 26%, with conjunctival xerosis (15%) most common. Deficiency was significantly higher in severe malnutrition (60% vs 23.3%, $p < 0.001$) and in children with infections (54.5% vs 17.8%, $p < 0.001$).

Conclusion: Vitamin A deficiency is common among malnourished children and is strongly associated with severe malnutrition and infections.

Keywords: Vitamin A Deficiency, Malnutrition, Xerophthalmia, Children.

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Introduction

Vitamin A is an essential fat-soluble micronutrient required for normal vision, growth, epithelial integrity, immune function, and cellular differentiation in children.[1] It plays a crucial role in maintaining the health of the conjunctival and corneal epithelium and is necessary for the synthesis of rhodopsin, a visual pigment responsible for adaptation to dim light. Deficiency of vitamin A remains a major public health problem in developing countries, particularly among preschool-aged children and malnourished populations. Children suffering from protein-energy malnutrition are more vulnerable due to inadequate dietary intake, poor absorption, recurrent infections, and impaired hepatic storage of vitamin A [2].Vitamin A deficiency is one of the leading causes of preventable childhood blindness worldwide. According to global estimates, a significant proportion of children in low- and middle-income countries are affected, with the highest burden seen in South Asia [3]. It has been estimated that hundreds of thousands of children become blind each year due to vitamin A deficiency, with a high risk of mortality following visual loss [4]. These findings highlight the magnitude of the problem and its serious consequences in vulnerable populations. The earliest clinical manifestation of vitamin A deficiency is night blindness, resulting from impaired rhodopsin synthesis in the retina. As the deficiency progresses, ocular manifestations collectively termed xerophthalmia develop, including conjunctival xerosis, Bitot's spots, corneal xerosis, corneal ulceration, and keratomalacia, which may ultimately lead to irreversible blindness [5]. These manifestations are particularly common in malnourished children and those suffering from recurrent infections such as measles and diarrhea [6].Several community-based studies have reported a considerable prevalence of ocular manifestations of vitamin A deficiency among children from underprivileged populations. Conjunctival xerosis and Bitot's spots are among the most commonly observed clinical signs, reflecting subclinical and clinical deficiency states [2,7]. Dietary inadequacy, poor weaning practices, and low intake of vitamin A-rich foods have been identified as important contributing factors in such populations [8].Malnutrition and vitamin A deficiency often coexist and interact synergistically, forming a vicious cycle in which malnutrition predisposes to deficiency, while vitamin A deficiency further increases susceptibility to infections and growth retardation [6]. Children with severe acute malnutrition frequently present with advanced ocular manifestations, which, if not detected early, may progress to permanent visual impairment [9].

Despite the implementation of vitamin A supplementation programs and nutritional interventions, vitamin A deficiency continues to be prevalent in many regions [3]. Early identification of deficiency and its ocular manifestations is essential for timely intervention and prevention of blindness and associated morbidity. Therefore, assessing the prevalence of vitamin A deficiency and its ocular manifestations among malnourished children is of great clinical and public health importance. In this context, the present study was undertaken to evaluate the prevalence of vitamin A deficiency and its ocular manifestations in malnourished children attending a tertiary care center.

Materials and Methods

The present study was conducted as a hospital-based cross-sectional observational study in the Department of Pediatrics at a tertiary care center. The study included malnourished children aged 6 months to 5 years attending the pediatric outpatient department and those admitted to the pediatric ward during the study period. Malnutrition was assessed and classified according to the World Health Organization (WHO) child growth standards using weight-for-age, height-for-age, and weight-for-height indices.

Inclusion Criteria

- Children aged 6 months to 5 years
- Children diagnosed with malnutrition (moderate or severe) as per WHO criteria
- Children whose parents/guardians provided informed consent

Exclusion Criteria

- Children with congenital ocular abnormalities
- Children with systemic diseases affecting vitamin A metabolism (e.g., liver disorders)
- Children who had received vitamin A supplementation within the past 3 months
- Children whose caregivers did not give consent

Data Collection: After obtaining informed consent, detailed demographic and clinical information was collected using a predesigned and pretested proforma. Data regarding age, sex, socioeconomic status, dietary history, immunization status, and history of recurrent infections such as diarrhea and measles were recorded.

Anthropometric Assessment: Anthropometric measurements including weight, height/length, and mid-upper arm circumference (MUAC) were measured using standard techniques. Nutritional status was classified into moderate acute malnutrition (MAM) and severe acute malnutrition (SAM) according to WHO growth standards.

Clinical Examination: All children underwent detailed general and systemic examination. Ocular examination was performed to identify signs of vitamin A deficiency based on WHO classification of xerophthalmia, including:

- Night blindness (XN)
- Conjunctival xerosis (X1A)
- Bitot's spots (X1B)
- Corneal xerosis (X2)
- Corneal ulceration/keratomalacia (X3A/X3B)
- Corneal scar (XS)

Biochemical Assessment: Where feasible, serum vitamin A (serum retinol) levels were estimated using standard laboratory methods. Vitamin A deficiency was defined as serum retinol levels <0.70 µmol/L.

Socioeconomic Status Assessment: Socioeconomic status was assessed using the Modified BG Prasad classification.

Outcome Measures: The primary outcome was to determine the prevalence of vitamin A deficiency among malnourished children. Secondary outcomes included assessment of the prevalence and pattern of ocular manifestations associated with vitamin A deficiency.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) version 25. Descriptive statistics such as mean ± standard deviation and frequency with percentage were used. Association between categorical variables was assessed using the Chi-square test or Fisher's exact test. A p-value of <0.05 was considered statistically significant.

Results

The present study included a total of 100 malnourished children aged between 6 months and 5 years who were evaluated for the prevalence of vitamin A deficiency and its associated ocular manifestations. The demographic characteristics of the study population are summarized in Table 1. The majority of children belonged to the age group of 1–3 years, accounting for 45% of the total study population, followed by children in the age group of 3–5 years (35%) and 6–12 months (20%).

The mean age of the study participants was 2.4 ± 1.1 years, indicating that malnutrition and its associated complications were more common among toddlers and preschool-aged children. With regard to gender distribution, 58% of the children were males and 42% were females, showing a slight male predominance in the study population. Nutritional assessment based on WHO classification revealed that 60% of children had moderate acute malnutrition (MAM), while 40% were categorized as having severe acute malnutrition (SAM), highlighting a substantial burden of severe malnutrition among the study participants.

The prevalence of vitamin A deficiency and its ocular manifestations is depicted in Table 2. The overall prevalence of vitamin A deficiency among malnourished children was found to be 38%. Among these, 26% of children exhibited clinical signs of vitamin A deficiency, while an additional 12% were identified through biochemical assessment alone. Ocular manifestations of vitamin A deficiency were observed in 26% of children, indicating a significant proportion of affected individuals with visible clinical signs. Among the various ocular findings, conjunctival xerosis was the most common manifestation, observed in 15% of children, followed by Bitot's spots in 8% and night blindness in 6% of cases. More severe ocular manifestations such as corneal xerosis and keratomalacia were noted in 3% and 2% of children, respectively. These findings suggest that while early manifestations were more frequent, advanced stages of deficiency were also present in a subset of the study population. The association of vitamin A deficiency with nutritional status and recurrent infections is presented in Table 3. A significantly higher proportion of children with severe acute malnutrition were found to have vitamin A deficiency compared to those with moderate malnutrition. Specifically, 60% (24 out of 40) of children with SAM were vitamin A deficient, whereas only 23.3% (14 out of 60) of children with MAM had deficiency. This difference was statistically highly significant ($\chi^2 = 13.2$, $p < 0.001$), indicating a strong association between the severity of malnutrition and vitamin A deficiency. Similarly, a significant association was observed between recurrent infections and vitamin A deficiency. Among children with a history of recurrent infections, 54.5% (30 out of 55) were found to be vitamin A deficient, compared to only 17.8% (8 out of 45) among those without such a history. This difference was also statistically highly significant ($\chi^2 = 14.6$, $p < 0.001$), suggesting that recurrent infections play an important role in the development and progression of vitamin A deficiency.

Table 1: Demographic Characteristics of Study Population (n = 100)

Variable	Category	Frequency	Percentage
Age Group	6–12 months	20	20%
	1–3 years	45	45%
	3–5 years	35	35%
Gender	Male	58	58%
	Female	42	42%
Nutritional Status	Moderate Acute Malnutrition (MAM)	60	60%
	Severe Acute Malnutrition (SAM)	40	40%

Table 2: Prevalence of Vitamin A Deficiency and Ocular Manifestations (n = 100)

Parameter	Frequency	Percentage
Vitamin A Deficiency (Overall)	38	38%
Clinical Deficiency	26	26%
Biochemical Deficiency	12	12%
Ocular Manifestations	26	26%
Night Blindness	6	6%
Conjunctival Xerosis	15	15%
Bitot's Spots	8	8%
Corneal Xerosis	3	3%
Keratomalacia	2	2%

Table 3: Association of Vitamin A Deficiency with Nutritional Status and Infections (n = 100)

Variable	Category	Vitamin A Deficiency Present	Vitamin A Deficiency Absent	p-value
Nutritional Status	MAM (n=60)	14 (23.3%)	46 (76.7%)	<0.001*
	SAM (n=40)	24 (60%)	16 (40%)	
Recurrent Infections	Present (n=55)	30 (54.5%)	25 (45.5%)	<0.001*
	Absent (n=45)	8 (17.8%)	37 (82.2%)	

Discussion

In the present study, the majority of children were in the age group of 1–3 years (45%), followed by 3–5 years (35%) and 6–12 months (20%), with a mean age of 2.4 ± 1.1 years, indicating higher vulnerability among preschool children. Arlappa et al. (2011) [10] similarly reported vitamin A deficiency prevalence of 17–20% among rural preschool children, while Arlappa et al. (2008) [11] also documented a high burden of clinical and subclinical deficiency in this age group. Males constituted 58% and females 42% in the present study, comparable to Muliyil et al. (2019) [12], who reported no significant gender difference. Regarding nutritional status, 60% had moderate and 40% had severe malnutrition. Carlier et al. (1991) [13] reported combined malnutrition and vitamin A deficiency prevalence exceeding 30–40%, while Molla et al. (1993) [14] observed deficiency rates of 30–50% among children with poor nutritional status, supporting the present findings.

The overall prevalence of vitamin A deficiency in the present study was 38%, with 26% clinical and 12% biochemical deficiency. Jemal et al. (1999) [15] reported prevalence ranging from 16.2% to 51.8% in Ethiopia, while Jonathan et al. (2003) reported 30–40% subclinical deficiency in Nepal, both comparable to the present findings. Arlappa et al. (2011) [10] reported a lower prevalence (17–20%), likely due to inclusion of general population, whereas Meshram et al. (2020) [16] and Muliyil et al. (2019) [12] reported deficiency rates of 25–35% and 23–28%, respectively, supporting the present study trend. Ocular manifestations were seen in 26% of children, with conjunctival xerosis (15%), Bitot's spots (8%), and night blindness (6%) being the most common. Sharma et al. (1984) [17] reported xerophthalmia prevalence of 5–10%, and Rashed et al. (1996) reported 2–10%, both lower than the present study. Tarwotjo et al. (1982) [7] also observed significant ocular manifestations among nutritionally deprived children. The higher prevalence in the present study may be due to inclusion of malnourished children.A strong association was observed between vitamin A deficiency and malnutrition, with 60% of SAM children being deficient compared to 23.3% of MAM children ($p < 0.001$). Carlier et al. (1991) [13] reported deficiency rates exceeding 40% among severely malnourished children, while Molla et al. (1993) [14] reported 30–50% deficiency, supporting the present findings. Vitamin A deficiency was also significantly associated with infections, with 54.5% deficiency in children with infections compared to 17.8% without infections ($p < 0.001$). Filteau et al. (1993) [6] reported a 20–40% reduction in serum retinol during infections. These findings support the strong association observed in the present study.

Conclusion

The present study revealed a high prevalence of vitamin A deficiency (38%) among malnourished children, with conjunctival xerosis and Bitot's spots being the most common ocular manifestations. A significant association was observed between vitamin A deficiency, severity of malnutrition, and recurrent infections, indicating that severely malnourished children are at greater risk.

Limitations of the Study

The present study had certain limitations. Being a hospital-based study from a single tertiary care center, the findings may not be generalizable to the community. The sample size was relatively small (n = 100), and the cross-sectional design limited causal inference. Serum vitamin A levels were not assessed in all participants, which may have underestimated subclinical deficiency. Additionally, dietary intake was not quantitatively evaluated, and reliance on caregiver recall may have introduced bias.

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