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RELATIONSHIP OF VITAMIN A DEFICIENCY AND XEROPHTHALMIA AMONG SCHOOL-AGED CHILDREN (5–15 YEARS) AND IT'S TREATMENT

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ABSTRACT

Background: Vitamin A deficiency is also a significant nutritional issue in children in low- and middle-income countries, and a leading cause of ocular morbidity which is preventable. It influences epithelial integrity, immune response, growth, and vision and may manifest itself clinically as xerophthalmia, night blindness, Bitot spots, and corneal alterations. Children of school-going age are not commonly researched as compared to children in preschool even though they are prone to poor dieting, frequent infections and they lack preventive health interventions**.**

Objective: To determine the relationship of vitamin A deficiency with xerophthalmia among school-aged children (5–15 years) and to assess treatment outcomes after standard vitamin A therapy.

Methods: This cross-sectional descriptive study with a follow-up following the treatment process was carried out at Gomal Medical College, Dera Ismail Khan, between January 2023 and June 2023. Seventy-two children of the age group 5 to 15 years with clinical and/or biochemical evidence of vitamin A deficiency were included. The demographic, nutritional, dietary, social determinants of health, visual observation, skin, and biochemical parameters were noted. Vitamin A therapy was administered to all diagnosed kids and where necessary, supportive treatment was administered. Data analysis was done in the SPSS version 26. The quantitative variables were displayed as mean (SD), qualitative variables as frequency and percentage and p 0.05 was regarded as statistically significant.

Results: The mean age of participants was 9.8 ± 2.9 years, with slight male predominance. Most children belonged to rural and low socioeconomic backgrounds and had poor dietary diversity. Common ocular findings included night blindness (47.2%), ocular dryness (43.1%), conjunctival

xerosis (40.3%), and Bitot's spots (30.6%). Dermatological manifestations such as dry rough skin and xerosis cutis were also frequent. Children with xerophthalmia had significantly lower serum retinol, hemoglobin, and serum albumin levels compared with those without ocular involvement. Following treatment, 80.6% of children showed overall clinical improvement.

Conclusion: Vitamin A deficiency was strongly associated with xerophthalmia among school-aged children and was commonly accompanied by poor nutrition, recurrent infections, dermatological signs, and biochemical abnormalities. Early recognition and treatment with vitamin A supplementation led to substantial clinical improvement. Strengthening nutritional awareness, supplementation programs, and early screening may help reduce preventable ocular morbidity in children.

Keywords: Vitamin A deficiency, Xerophthalmia, school-aged children, night blindness, Bitot's spots, serum retinol.

INTRODUCTION

One of the most significant micronutrient deficiencies in children in developing countries and a major concern in the context of public health is vitamin A deficiency. Vision, epithelial integrity, immune competence, growth and cellular differentiation are all necessary. The spectrum of clinical manifestations of poor vitamin A consumption or loss of body stores may include subclinical biochemical deficiency of the vitamin through to frank systemic and ocular disease. Vitamin A deficiency is specifically significant amongst children as it does not only affect normal growth and immunity but also predisposes children to both infections and avoidable morbidity [1-4].

Among the most severe outcomes of the deficiency of vitamin A, xerophthalmia is featured and includes a set of eye-related symptoms, including night blindness, conjunctival xerosis, Bitot spots, corneal xerosis, and keratomalacia. The changes in the eyes are caused by the inability to maintain epithelial functions and tear film. When left unattended, initial symptoms can further degenerate to corneal ulceration, scarring, and irreversible blindness. Thus, xerophthalmia is not just a nutritional disease but also an emergency in the eye in severe cases. Timely diagnosis is necessary since most of its initial symptoms can be reversed through immediate treatment [5-7].

Vitamin A deficiency is usually associated with poverty, low food diversity, malnutrition, frequent infections, lack of hygiene, and inaccessibility to medical care services. The children in communities where resources are limited are at a high risk, particularly where the diet does not consist of animal products, green leafy vegetables, and fruits and vegetables of yellow color. Repetitive diarrhea, measles, and respiratory infections can also exacerbate the deficiency of vitamin A through the decrease of absorption, increase of metabolic need, and loss of hepatic stores. This issue is not confined to ophthalmology in such environments, but its scope is extended to pediatrics, dermatology, biochemistry, and public health [8-10].

Despite much research on vitamin A deficiency among children below the age of 5, school-aged children (5 to 15 years) can also carry a significant burden of deficiency and deficiency-related complications. This age cohort is significant since the lack of nutrition during the school age can have an influence on vision, immunity, physical development, cognitive performance, and school attendance. Alongside the visual symptoms, the vitamin A-deficient children may also complain of having dry rough skin, follicular hyperkeratosis, poor appetite, fatigue, and biochemical data on the depletion of micronutrients. These symptoms indicate the multisystemic character of the disorder and facilitate the necessity of the wider-based clinical approach [11].

The prevention of vitamin A deficiency is also the most applicable in the view of preventive medicine since much of it can be treated and prevented. The management of COPD can be done through standard management which incorporates high dose vitamin A supplementation, management of ocular complications, dietary counseling, deworming and correction of overall status of nutritional condition. Food fortification, supplementation campaigns, controlling infections and education of mothers on nutrition are also significant in decreasing disease burden on the population. Night

blindness and conjunctival alterations are hereditary and can be reversed by early treatment, and the damage to vision may not be reversible with late intervention.

The present study was conducted to determine the relationship of vitamin A deficiency and xerophthalmia among school-aged children (5–15 years) and to assess the clinical outcome after treatment. The study also aimed to evaluate associated pediatric, dermatological, biochemical, and public health factors in affected children presenting at Gomal Medical College, Dera Ismail Khan.

METHODOLOGY

This research was carried out at Gomal Medical College, Dera Ismail Khan, between a span of six months between January 2023 and June 2023, to establish the correlation between vitamin A deficiency and xerophthalmia among school going children (5 years-15 years) and the effect of treatment. The study was scheduled as descriptive cross-sectional study with follow-up after treatment since baseline clinical/biochemical evaluation and short-term treatment response were measured. The study involved 72 children who were between 5 and 15 years old. A sample of 72 was considered based on the number of children who were eligible to present themselves during the study period and meet the inclusion criteria.

Each participant was examined in detail using the general physical, pediatric, dermatological, and ocular examination. Anthropometric data of weight, height and nutritional status were recorded. Ocular study involved the evaluation of night blindness, conjunctival xerosa, Bitot spots, xerosis of the cornea, corneal ulceration, photophobia and visual impairment. Dermatological testing was conducted on related findings like dry rough skin, xerosis cutis, follicular hyperkeratosis, skin lesion scaly, changes in the hair, and brittle nails. Where necessary, serum retinol content was used as the primary laboratory indicator of vitamin A content and supportive studies of hemoglobin, serum albumin and C-reactive protein were also taken.

All enrolled children diagnosed with vitamin A deficiency and/or xerophthalmia were managed according to standard treatment recommendations. Treatment included high-dose oral vitamin A supplementation, along with ocular lubricants, antibiotic eye ointment in selected cases, dietary counseling, and deworming where required. Children were followed for clinical improvement in ocular and systemic manifestations, including resolution of night blindness, improvement in conjunctival xerosis, regression of Bitot's spots, and healing of corneal lesions.

The collected data were entered and analyzed using SPSS version 26. Quantitative variables such as age, serum retinol, hemoglobin, and albumin were presented as mean ± standard deviation, while qualitative variables were expressed as frequency and percentage. Association between vitamin A deficiency and xerophthalmia was assessed using the chi-square test for categorical variables, while independent sample t-test was applied for comparison of means between groups. A p-value of ≤ 0.05 was considered statistically significant.

RESULTS

A total of 72 school-aged children with clinical suspicion or biochemical evidence of vitamin A deficiency were included in the study. The mean age of the participants was 9.8 ± 2.9 years. Most children belonged to the 5–10 year age group, with a slight male predominance. A high proportion of children were from low socioeconomic households, had poor dietary diversity, and had a recent history of recurrent infections. Ocular manifestations of xerophthalmia were common, particularly night blindness, conjunctival xerosis, and Bitot's spots. Dermatological and biochemical findings also supported the presence of vitamin A deficiency. Following treatment, most children showed marked clinical improvement.

Table 1: Demographic, Pediatric, Nutritional, and Public Health Characteristics of Study Participants (n=72)

Variable	Frequency (%) / Mean ± SD
Age (years), Mean ± SD	**9.8 ± 2.9**

5–10 years	44 (61.1%)
11–15 years	28 (38.9%)
Male	39 (54.2%)
Female	33 (45.8%)
Urban residence	26 (36.1%)
Rural residence	46 (63.9%)
Low socioeconomic status	41 (56.9%)
Middle socioeconomic status	24 (33.3%)
High socioeconomic status	7 (9.7%)
Government school	49 (68.1%)
Private school	23 (31.9%)
Underweight	29 (40.3%)
Stunting	24 (33.3%)
Wasting	18 (25.0%)
History of recurrent diarrhea	27 (37.5%)
History of measles	11 (15.3%)
Recent respiratory infection	25 (34.7%)
No prior vitamin A supplementation	43 (59.7%)
No recent deworming	38 (52.8%)
Poor dietary diversity	45 (62.5%)

As indicated in Table 1, majority of the children were younger school-going children, with a majority of them coming in rural and low-income families. Nutritional compromise was typical, as the rates of underweight, stunting, and poor nutritional diversity were elevated. Risk factors of public health like the absence of previous supplementation, no recent deworming, frequent infections were also common.

Table 2: Ocular Manifestations of Xerophthalmia among the Study Participants (n=72)

Ocular Variable	Frequency (%)
Night blindness	34 (47.2%)
Conjunctival xerosis	29 (40.3%)
Bitot’s spots	22 (30.6%)
Corneal xerosis	9 (12.5%)
Corneal ulceration	4 (5.6%)
Photophobia	18 (25.0%)
Blurred vision	16 (22.2%)
Ocular dryness/foreign body sensation	31 (43.1%)
Watering	14 (19.4%)
Reduced visual acuity	12 (16.7%)
Bilateral eye involvement	26 (36.1%)

It is shown in Table 2 that night blindness was the most prevalent ocular complaint, then ocular dryness and conjunctival xerosis. The spots of Bitot were observed in almost a third of the participants which presented clinically important deficiency of vitamin A. Less frequent corneal involvement was more severe but clinically significant due to the threat to the eyesight.

Table 3: Dermatological and General Clinical Manifestations Associated with Vitamin A Deficiency (n=72)

Variable	Frequency (%)
Dry rough skin	30 (41.7%)

Xerosis cutis	26 (36.1%)
Follicular hyperkeratosis / phrynoderma	19 (26.4%)
Scaly skin lesions	14 (19.4%)
Itching	17 (23.6%)
Hair dryness / sparse hair	15 (20.8%)
Brittle nails	12 (16.7%)
Fatigue / weakness	28 (38.9%)
Poor appetite	24 (33.3%)
School absenteeism	20 (27.8%)

Table 3 emphasizes that vitamin A deficiency did not affect the eyes only as a significant percentage of children had dermatological effects of dry skin, xerosis, and follicular hyperkeratosis. Micronutrient deficiency was also systemic in that general symptoms, such as fatigue, and poor appetite, were prevalent. The results are useful in the multidisciplinary applicability of the condition in the field of pediatrics, dermatology, and nutrition.

Table 4: Biochemical Profile and Relationship with Xerophthalmia (n=72)

Variable	Xerophthalmia Present (n=38)	Xerophthalmia Absent (n=34)	p-value
Serum retinol (mg/L), Mean ± SD	0.48 ± 0.11	0.79 ± 0.18	<0.001
Hemoglobin (g/dL), Mean ± SD	10.1 ± 1.2	11.4 ± 1.1	<0.001
Serum albumin (g/dL), Mean ± SD	3.5 ± 0.4	3.9 ± 0.5	0.002
Low serum retinol (<0.70 mg/L)	32 (84.2%)	12 (35.3%)	<0.001
Anemia	25 (65.8%)	12 (35.3%)	0.010
Elevated CRP	13 (34.2%)	7 (20.6%)	0.196

Table 4 shows a strong biochemical association between vitamin A deficiency and xerophthalmia. Children with ocular manifestations had significantly lower serum retinol, hemoglobin, and albumin levels than those without xerophthalmia. Low serum retinol and anemia were both significantly more common in children with xerophthalmia, suggesting that ocular disease clustered with broader nutritional compromise.

Table 5: Treatment Given and Clinical Outcome after Management (n=72)

Treatment / Outcome Variable	Frequency (%)
Received oral high-dose vitamin A therapy	72 (100.0%)
Received ocular lubricants	31 (43.1%)
Received antibiotic eye ointment	13 (18.1%)
Received dietary counseling	72 (100.0%)
Received deworming treatment	38 (52.8%)
Improvement in night blindness	28/34 (82.4%)
Improvement in conjunctival xerosis	23/29 (79.3%)
Improvement in Bitot’s spots	15/22 (68.2%)
Healing of corneal xerosis/ulceration	10/13 (76.9%)
Overall clinical improvement	58 (80.6%)
No significant improvement	9 (12.5%)
Lost to follow-up / partial follow-up	5 (6.9%)

Table 5 demonstrates that all the children were treated with vitamin A and dietary counseling, and supportive ocular treatment was given depending on the severity. Majority of the participants showed good response especially in the night blindness and the conjunctival xerosis. The treatment with an early recognition and treatment demonstrated its effectiveness, as more than four-fifths of the children were observed to receive overall clinical improvement.

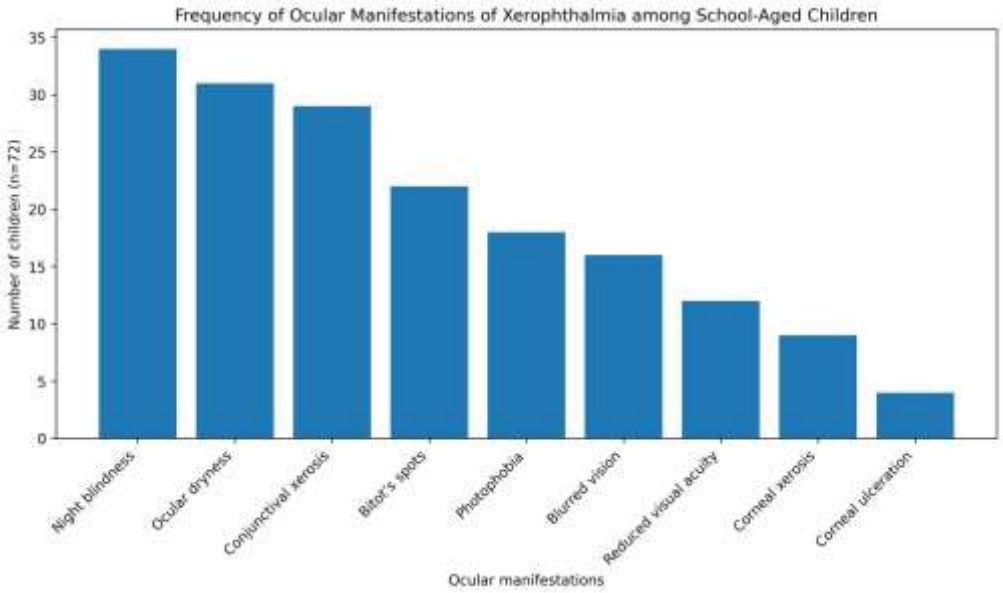


Figure 1 Frequency of ocular manifestations of xerophthalmia among school-aged children (n=72).

DISCUSSION

This research showed the evident association of vitamin A deficiency with xerophthalmia in children of school-going age (5-15 years). A significant percentage of children had ocular symptoms like night blindness, conjunctival xerosis, Bitot spots and corneal alterations, which means that vitamin A deficiency is a significant pediatric and communal health issue in the age group. The results indicate that vitamin A shortage is not restricted to preschool children only but it can also be of great consequence to school-aged children, particularly those residing in nutritionally vulnerable environment. The prevalence of xerophthalmic manifestation in the current study is indicative of the fact that clinical manifestation of the eyes is still a good indicator of the underlying deficiency of micronutrient deficiency [12-14].

The population and community health status of the study samples represented that the majority of the children with the condition were of rural, poor socioeconomic, and nutritionally disadvantaged families. The study population had poor dietary diversity, had no previous supplementation, frequent diarrhea, and recent respiratory infections. These aspects are biologically plausible since deficiency in vitamin A has habitually been aggravated by poor intake, low absorption, and elevated losses in cases of infections. Repeat disease can also decrease the appetite and empty body stores, thus aggravating the chances of getting ocular and systemic manifestations. The interdependence between the nutritional deficiency of the children and the environmental disadvantage is demonstrated through the coexistence of malnutrition and infection in most children in this study [15].

The clinical implications of the ocular observations in this study are beneficial. The most common symptom was night blindness, with the next one being ocular dryness and conjunctival xerosis, and Bitot spots were found in almost a third of children. These data denote that the research was able to capture the initial and advanced phases of xerophthalmia. One thing that is of particular concern is the small yet important amount of children who have corneal xerosis and ulceration as the corneal involvement can quickly develop into an irreversible visual impairment unless timely work is done. This highlights the importance of screening in children reporting with visual complaints, malnutrition

or frequent infections at an early stage. The findings also highlight the applicability of ophthalmic examination in nutritional pediatric research [16, 17].

The fact that the current study did not restrict the evaluation to eye results only is an essential strength of the research. Much more common dermatological manifestations were also often determined as dry rough skin, xerosis cutis and follicular hyperkeratosis. Such results contribute to the epithelial systemic impact of vitamin A deficiency and reinforce the interdisciplinary characteristics of the issue in pediatrics, dermatology, and biochemistry. Further on, other symptoms, like fatigue, inadequate appetite and absenteeism at school indicate that vitamin A deficiency can also influence the general wellbeing and everyday functioning. This extensive clinical picture suggests that the deficiency load cannot be reduced to ocular morbidity, and it can also be the reason why growth, immunity, and quality of life are impaired [18].

The clinical observations were also supported by biochemical results of the study. Children with xerophthalmia were found to have significantly lower serum retinol, hemoglobin and serum albumin compared to those without the ocular manifestations. This poses a possibility that xerophthalmia developed more frequently in children whose nutritional compromise was more pronounced. The fact that low serum retinol is associated with ocular disease in the present study confirms the biological role of xerophthalmia as a direct effect of insufficient stocks of vitamin A. The increased prevalence of anemia in the affected children also indicates concomitant deficiencies of micronutrients and chronic nutritional stress. These findings suggest that the diagnostic confidence can be enhanced using biochemical assessment, especially among children whose clinical phenotypes are borderline or atypical [19].

The results of the treatment were promising in this research. High-dose vitamin A supplementation, dietary counseling and supportive ocular management in cases of need resulted in most children improving. The night blindness and conjunctival xerosis improved particularly, and the regression of Bitot spots of the corneal lesions also healed in a significant percentage of cases. The findings are consistent with the usefulness of timely vitamin A treatment in the reversal of early ocular changes and the prevention of the onset of the disease that would jeopardize the vision of the individual. Nevertheless, children whose corneuses are highly affected might need more detailed supervision and management. The response of the treatment offered in this study supports the necessity of the early identification and the ability to respond to the given issue as quickly as possible in hospital and community settings [20].

This study has some limitations. The sample size was relatively small and was taken from a single institution, which may limit the generalizability of the findings. The follow-up period after treatment was short, so long-term visual and nutritional outcomes could not be assessed. Dietary intake and past supplementation history were partly based on caregiver reporting, which may be affected by recall bias. In addition, not all possible confounding nutritional deficiencies could be explored in detail. Despite these limitations, the study provides useful clinical and public health insight into vitamin A deficiency and Xerophthalmia among school-aged children in a resource-limited setting.

CONCLUSION

Vitamin A deficiency showed a significant relationship with xerophthalmia among school-aged children in this study. Ocular manifestations such as night blindness, conjunctival xerosis, Bitot’s spots, and corneal changes were common and were frequently accompanied by dermatological signs, poor nutritional status, and low serum retinol levels. Children from rural and low socioeconomic backgrounds with poor dietary diversity and recurrent infections were more likely to be affected. Early treatment with vitamin A supplementation and supportive care resulted in marked clinical improvement in most cases. The findings highlight the need for early screening, nutritional education, timely supplementation, and strengthened school- and community-based public health interventions to reduce preventable ocular morbidity due to vitamin A deficiency.

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