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ASSESSMENT OF SERUM RETINOL LEVEL AND ITS CLINICAL ASSOCIATION IN CHILDREN

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ABSTRACT

Present study was aimed to determine the serum retinol levels in malnourished children in the age group 1 – 10yrs and to determine the relationship between the serum retinol level and clinical presentation. To compare serum retinol level in age and sex matched malnourished and apparently normal children. The study group comprised of 50 cases and 50 controls of ages between 1-10yrs. Informed consent was obtained from each child. The study was approved by ethical committee, Navodaya Medical College Hospital and Research Centre, Raichur. The nutrition was assessed according to IAP classification for children under the age of 5yrs and according to WHO classification for children between 6-10yrs. The blood sample was taken from the subjects and serum retinol level was estimated according to modified Carr Price reaction. And the level was noted. The cases were compared with age and sex matched controls. Statistical analysis was done using the software SSPS. Results of the present study show that, malnourished children have low serum retinol levels. Children consuming vitamin A poor diet had low serum retinol level. The serum retinol is more reduced in children with recurrent infections, or / and who have suffered measles in past 1-3months. In malnourished children the serum albumin in reduced and children with reduced serum albumin have low serum retinol levels. Children with moderate to severe anemia have low serum retinol levels.

INTRODUCTION

Nutrition is a critical part of health and development. Better nutrition is related to improved infant, child health, stronger immune systems, lower risk of non-communicable diseases (such as diabetes and cardiovascular disease), and longevity. Malnutrition is globally the most important risk factor for illness and death, contributing to more than half of deaths in children worldwide; child malnutrition was associated with 54% of deaths in children in developing countries [1].

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Vitamins are organic substances in food which are required in small amounts but cannot be synthesized by body in adequate quantities. Thirteen vitamins have been demonstrated to have clinical effects in humans and vitamin A is one of them, which is also known as Retinol. Vitamin A deficiency has a plethora of clinical manifestations, ranging from xerophthalmia to disturbances in growth and susceptibility to severe infection [2]. Deficiency of vitamin A is associated with significant morbidity and mortality from common childhood infections and is the world's leading preventable cause of childhood blindness [3]. Vitamin A deficiency leads to night blindness and xerophthalmia in the form of Bitot's spots, xerosis, keratomalacia, and even retinopathy [4]. Vitamin A deficiency is common in children in the

poor, underdeveloped and developing countries. Much work has already been conducted to determine the social determinants that lead to vitamin A deficiency, including indicators of poverty, low education and social discrimination [5-7]. The aim of the present study was to determine the serum retinol levels in malnourished children in the age group 1 – 10yrs, and to determine the relationship between the serum retinol level and clinical presentation.

MATERIAL AND METHODS

A total of 50 cases and 50 controls were included in the study. Children in the age group from 1yr to 10yrs admitted to the pediatric medical wards of Navodaya medical college hospital and Research Centre Raichur. For each case one control is taken in the same age group of children attending pediatric OPD with minor ailments (conditions not affecting vitamin A levels).

Inclusion criteria

1. Children with protein energy malnutrition were included in the study
2. Age between 1yr to 10yrs.
3. Children with minor ailments attending to OPD and children who come for vaccination were included in the study

Exclusion criteria

1. Children who were given vitamin A before admission were excluded.
2. Children below 1yr and above 10yrs attending OPD an immunization clinic were excluded.
3. Children who were given vitamin A before admission were excluded.

A detailed history including diet history was taken and clinical examination performed as per the Proforma. An evaluation of nutritional status and signs of vitamin A deficiency was done according to the proforma. Blood samples were collected for estimation of vitamin A levels Modified Carr -Price Method[9] , serum protein levels and for other relevant investigations.

Statistical analysis

Data were expressed in mean ± SD and percentage. Comparison between control and study group was done using student's t-test and relation of serum retinol with parameters was done by using chi-square test. A p-value less than 0.05 were considered as significant. Data analysis were done by software SPSS v16.0.

RESULTS:

In the present study serum retinol levels in the age group of 1 - 5yrs was lower when compared to children in age group in both study and control group (Table 1).

Table 1: Serum retinol levels in relation to age in the study group and control group

Age in years	Serum retinol levels (mean ± S.D µg/dl)	
	Study group (n=50)	Control group (n=50)
1 – 5yrs	9.20± 3.57 (n=26)	23.65± 2.33 (n=26)
6 – 10yrs	10.61 ± 4.18 (n=24)	23.28 ± 2.78 (n=24)

In the present study serum retinol levels in males was lower when compared to females in both study and control group (Table 2).

Table 2: Serum retinol levels in relation to sex in the study group and control group

Sex	Serum retinol levels (mean ± S.D µg/dl)	
	Study group (n=50)	Control group (n=50)
Male	9.7 ± 4.16 (n=25)	23.32 ±2.54 (n=25)
Female	10.05± 3.7 (n=25)	23.62± 2.57 (n=25)

The table 3 shows that the serum retinol level in control group was higher when compared to study group. Also serum retinol level was progressively decreasing from Class I to Class V of modified B G Prasad classification for classification of socioeconomic status.

Table 3: Serum retinol levels in relation to socioeconomic status in the study group and control group

Social class (as per modified B G Prasad classification)	Serum retinol levels (mean ± S.D µg/dl)	
	Study group (n=50)	Control group (n=50)
Class I	0	23.77±2.87 (n=8)
Class II	12.06±3.883 (n= 8)	23.58±2.07 (n=25)
Class III	11.36±3.74 (n=15)	23.17±3.08 (n= 17)
Class IV	9.1±3.42 (n=16)	0
Class V	7.4±3.49 (n= 11)	0

In the study group, the mean serum retinol level among the rural children was 9.46±3.69µg/dl which is low when compared 10.44 ±4.20 µg/dl among the children from urban area. While in the control group the mean serum retinol level among the rural children was 23.51±2.69µg/dl which is minimally high when compared 23.44±2.46µg/dl among the children from urban area (Table 4).

Table 4: Serum retinol levels in relation to urban – rural pattern in the study group and control group

Habitat	Serum retinol levels (mean ± S.D µg/dl)	
	Study group	Control group
Rural	9.46± 3.69 (n=29)	23.51 ± 2.69 (n=28)
Urban (n=49)	10.44 ±4.20 (n=21)	23.44± 2.46 (n=22)

Table 5: Relation between serum retinol levels and urban rural pattern among the cases.

Habitat	Serum retinol levels		
	≥20µg/dl	10-19µg/dl	<10 µg/dl
Rural	0	11	18
Urban	0	8	13

A total of 29 rural children in the study group were from rural background among which 18 had serum retinol levels of less than 10 µg/dl and 11 had between 10-19µg/dl. The 21 children were from urban background out which 13 had serum retinol levels of less than 10 µg/dl and 8 had between 10-19µg/dl (table 5).

The table 6 shows that the serum retinol level in children consuming vitamin A rich diet was higher when compared to children consuming vitamin A poor diet in both control and study group. Vitamin A rich diet was defined as frequent consumption of meat, egg, pulses, milk and milk products and seasonal fruits (Table 6).

Table 6: Serum retinol levels in relation to dietary intake in the study group and control group

Dietary intake	Serum retinol levels (mean ± S.D µg/dl)	
	Study group (n=50)	Control group (n=50)
Vitamin A poor diet	9.73 ± 4.19 (n=31)	23.51± 2.79 (n=26)
Vitamin A rich diet	9.97 ± 3.78 (n=19)	23.43± 2.29 (n=24)

The table 7 shows that the serum retinol level in normal children was higher when compared to malnourished children. Also serum retinol level was progressively decreasing as the severity of malnutrition increased

Table 7: Serum retinol levels in relation to nutritional status in the study group and control group

Nutritional status (as per IAP grading for children between 1 – 5yrs)		No. of cases	Serum retinol levels (mean ± S.D µg/dl)
Control	Normal	26	23.65± 2.33
Cases	Grade I	1	12.32
	Grade II	3	11.16±7.85
	Grade III	13	9.83±3.12
	Grade IV	9	7.29±1.61

Nutritional status (as per WHO grading for children between 6 – 10yrs)		No. of cases	Serum retinol levels (mean ± S.D µg/dl)
Control	Normal	24	23.28 ± 2.78
Cases	Moderate (2SD – 3SD)	9	12.46±3.77
	Severe (<3SD)	15	9.50±4.12

In our study, among the cases 10 children had MAC of less than 12.5cms and all had serum retinol levels in deficient state. The remaining 16 had moderate degree of malnutrition according to MAC, out which 9 had deficient state and 7 had low stores of serum retinol. Whereas, among the controls all children had MAC of more than 13.5cms among them 25 children had normal serum retinol levels only 1 had low stores (Table 8).

Table 8: Serum retinol levels in relation to mid arm circumference (MAC) in the study and control group.

MAC of 1 -5yrs age among study and control group	Serum retinol levels					
	≥20µg/dl		10-19µg/dl		<10µg/dl	
	study	control	study	control	study	Control
Normal (>13.5cms)	0	25	0	1	0	0
Moderate (12.5-13.5)	0	0	7	0	9	0
Severe (<12.5cms)	0	0	0	0	10	0

Table 9: Serum retinol levels in relation to mid body mass index (BMI) in the study group.

BMI of 6 -10yrs age among the study group	Serum retinol levels					
	≥20µg/dl		10-19µg/dl		<10µg/dl	
	study	control	Study	Control	Study	Control
Normal	0	19	8	3	5	0
Thinness (2SD- 3SD)	0	1	1	0	3	0
Severe thinness (<3SD)	0	0	3	0	4	0

In our study, among the cases 7 children had severe thinness (classified according WHO classification for BMI for 5 -19yrs) among them 4 had deficient stores had 3 had low stores.4 children had thinness among them 3 had deficient state and only 1 had low store of serum retinol. The remaining 13 had BMI in normal range among them 5 had deficient state had and 8 had low stores of serum retinol. In our study, among the controls 22 children had BMI in normal range among them 19 had normal serum retinol levels and 3 had low stores. Only 1 child was in the category of thinness but had normal serum retinol levels (table 9)

In our present study is 20 children presented with lower respiratory tract infection among which 14 had deficiency state and 6 had low stores. 23 children presented with gastroenteritis out which 11 had deficiency state. The remaining 25 presented with complaint of poor growth among them 10 had deficiency state. And we also found that they presented with complaints involving more than 1 system (Figure 1).

Figure 1: Serum retinol levels in relation to presenting complaints in the study group.

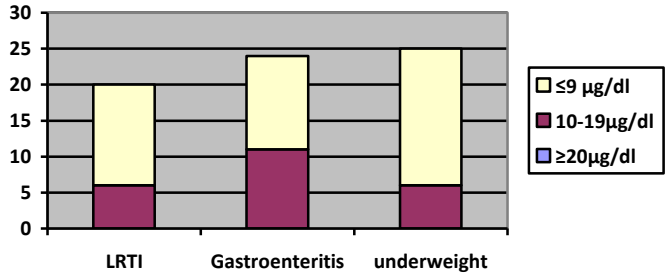

Table 10: Serum albumin levels in relation to nutritional status in the study group.

Nutritional status (as per IAP grading for children between 1 – 5yrs)	Serum albumin levels (mean ± S.D µg/dl)	No. of cases
Normal	-	0
Grade I	3.2	1
Grade II	3.06±0.75	3
Grade III	3.03±0.48	13
Grade IV	2.64±0.44	9
Nutritional status (as per WHO grading for children between 6 – 10yrs)	**Serum albumin levels (mean ± S.D µg/dl)**	**No. of cases**
Normal		
Moderate (2SD – 3SD)	3.17±0.23	9
Severe (<3SD)	2.93±0.49	15

The above table 10 shows that the serum albumin in both age group i.e. 1-5yrs and 6-10yrs the serum albumin level was progressively decreasing as the severity of malnutrition increased

DISCUSSION

In the present study, 50 cases of malnourished children were chosen between the age group of 1yr to 10yrs. Comparison of these were made with 50 age and sex matched children who are apparently normal. In the present study serum retinol levels in the age group of 1 - 5yrs was lower than in the age group of 6 – 10 yrs in both study and control group. This can be explained by a pre-existing low serum retinol levels in normal infants compared to children as seen in our control group and also the recurrent infections in younger children than the older ones.

Present study results also shows that, serum retinol levels in males were less compared to females in both study and control group. Present study observations are in accordance with earlier studies, Henrik fritis and co-workers[8], in the year 1997 reported in their study that serum retinol was lower in boys than in girls among both pre-school children and primary school children. The low levels of retinol in males can be explained by better growth in height and weight in male children, necessitating higher protein and vitamin A requirement as explained by Jain and co-workers.[9]

In present study a linear relationship between serum retinol levels and socioeconomic status was noted both in cases and controls. The serum retinol levels were progressively decreasing from class I to class V of socioeconomic status of B G Prasad classification. Study done by Ashok and co-workers[10] reported that the serum retinol levels were significantly low in socioeconomically backward children than in well nourished children.

In our present study 29 children came from village background and 21 from urban area. The mean serum retinol level among children from rural area was low when compared to the children from urban area.

Vitamin A rich diet included history of frequent intake of green leafy vegetables, yellow fruits, egg and meat[11]. In our study serum retinol level in children consuming vitamin A rich diet was higher compared to children consuming vitamin A poor diet in both study and control group.

In the study group 13 cases belonged to grade III and 9 cases belonged to grade IV of IAP classification for the age group 1-5yrs and 9 cases belonged to moderate degree and 15 cases belonged to severe degree malnutrition according to WHO classification for the age group of 6 - 10yrs. Among the cases in our study the serum retinol progressively reduced as the severity of malnutrition increased.

Study done by Ikekpeazu Ebele[12] in the year 2010 shows The mean ± SD of vitamin A, 26.7 ± 19.7iu/L were significantly decreased (P<0.05) when compared with the control 128.2 ± 56.9iu/L. The mean levels of vitamin A, of the marasmic children and those suffering from kwashiorkor were both equally significantly decreased (P<0.05) when compared to the controls.

In the present study all children who had severe grade malnutrition depending on mid arm circumference had deficient state of serum retinol levels and those moderate malnourished children 9 had deficient state and 7 had low stores. In the present among the study group 7 children had severe thinness (classified according WHO classification for BMI for 5 -19yrs) among them 4 had deficient stores had 3 had low stores. 4 children had thinness among them 3 had deficient state and only 1 had low store of serum retinol. The remaining 13 had BMI in normal range among them 5 had deficient state had and 8 had low stores of serum retinol.

In the present study 20 cases had lower respiratory tract infection at the time of presentation among which 4 had deficient state and 6 had low stores. 24 cases presented with gastroenteritis among which 13 had deficient state and 10 had low stores. And 25 cases

presented with poor growth, 19 among them had deficient state and 6 had low stores. In the present study group majority of the cases belonged to grade III and IV. In our study the serum albumin level progressively reduced as the severity of malnutrition increased. In present study 10 had pathological hypoalbuminemia (<2.5gm/dl) and all 10 children had serum retinol levels in deficient state. 30 had low serum albumin (2.5–3.5gm/dl) among them 18 had deficient state and 12 had low stores of serum retinol levels. Only 8 had normal serum albumin levels among them 3 had deficient state and 5 had low stores. Study done by Arroyave and co-workers in the year 1979[13], found that the RBP levels were significantly correlated with retinol, decreasing proportionally with infection. He also found that the serum albumin level was low in most cases.

In the present study the anemia was classified according to reference data given by WHO. In our study 27 children had severe anemia among them 18 had deficient state of serum retinol level and 9 had low stores of retinol. 34 had moderate anemia among them 13 had deficient state of serum retinol level, 10 had low stores of retinol and 11 had normal stores. 32 children dint suffer from anemia but among them 3 had deficient state of serum retinol and rest had normal stores. Rest 35 children had normal BMI and among them 19 children had normal stores of serum retinol levels, 11 had low stores and 5 had deficient state of serum retinol. Study done by Reddy and co-workers in the year 1979[14] found that in children with plasma retinol levels below 20µg/100ml, the mean levels of hemoglobin and hematocrit were lower than those in children who had retinol levels above 20µg/100ml.

To conclude, the malnourished children have low serum retinol levels, younger children (1-5yrs), male children, children from rural background, and from low socioeconomic strata have low serum retinol due to lack of intake and extra need of vitamin A for growth. Whereas, children consuming vitamin A poor diet had low serum retinol level. The serum retinol is more reduced in children with recurrent infections, or / and who have suffered measles in past 1-3months. In malnourished children the serum albumin in reduced and children with reduced serum albumin have low serum retinol levels. Children with moderate to severe anemia have low serum retinol levels.

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CONFLICT OF INTEREST:
The authors declare that they have no conflict of interest.

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