

VITAMIN A STATUS AND PERSISTENT DIARRHEA IN CHILDREN UNDER FIVE

NADEEM KHAWAR AND MUHAMMAD YOUNAS

*Department of Paediatrics,
Hayat Shaheed Teaching Hospital,
Peshawar.*

SUMMARY

Persistent diarrhea is a significant health problem in children under five and is associated with high morbidity and mortality. Based on current knowledge of subnormal vitamin A association with persistent diarrhea we have attempted to assess vitamin A status of children under five. 50 consecutive hospitalised children under five with persistent diarrhea, along with 50 control children without diarrhea were studied for serum vitamin A level, clinical nutritional status and eye signs. Serum vitamin A level was interpreted as subnormal < 20 mcg/dl, low 10-20 mcg/dl and deficient < 10mcg/dl. 72% (36/50) of children with persistent diarrhea and 34% (17/50) of control group had subnormal vitamin A level. The number of children with low and deficient level in the above groups were 20/36, 16/36 and 16/17, 1/17 respectively. In children with mild and moderate malnutrition with persistent diarrhea, subnormal vitamin A was found in 56.3% and 75% as compared to control group 37.5% and 55.6% respectively. Xerophthalmia was found in only 6 cases. We conclude that there is a significant association between vitamin A deficiency and persistent diarrhea, irrespective of nutritional status. Early supplementation of vitamin A to high risk children is strongly recommended.

INTRODUCTION

Persistent diarrhea has multi factorial etiology and is a significant child health problem; in terms of increase morbidity and mortality. Nearly 3–23% of all diarrheal episodes become persistent¹. World Health Organisation estimates that globally 35% of all diarrheal deaths in children under five years of age are related to persistent diarrhea².

It is mainly the problem of developing countries and is complicated further by lack of availability of standard health care. Over reliance on antibiotics³ and less attention to nutritional aspects⁴ both on the parts of health care workers and care givers (deep rooted practice of parhez) initiates the vicious cycle of persistent diarrhea and

malnutrition which often ends in a case fatality.

Recently the role of vitamin A and Zinc has become increasingly important in the causation of persistent diarrhea^{5,6}. Vitamin A accelerates epithelial healing and enhances both humoral and cell mediated immune responses⁷. Zinc is required for the maintenance of processes involved in cell division and maturation⁶. It has been shown that vitamin A is necessary for Zinc absorption from ileum in the small intestine. Thus there can be little doubt that vitamin A status can inversely influence the persistence of diarrheal episode.

A large prospective study of 28,753 Sudanese children found a strong and

TABLE - 1
NUMBER OF CHILDREN WITH SUBNORMAL VITAMIN A LEVEL IN PERSISTENT
DIARRHEA AND CONTROL GROUP.

Group	No.	Vitamin A Level		Subnormal Vitamin A Level Total (%)
		Low 10 – 20 mcg/dl	Deficient < 10 mcg/dl	
Persistent	50	20	16	36 (72)
Control	50	16	1	17 (34)

inverse relationship between total dietary vitamin A intake and the risk of diarrhea⁸.

This study was conducted to assess serum vitamin A levels in children with persistent diarrhea and to compare it with age and weight matched control group of children with no history of diarrhea in the last six months.

We hypothesised that persistent diarrhea was associated with low serum vitamin A level in our population of children under five as well.

MATERIAL AND METHODS

50 consecutive, hospitalised, children with persistent diarrhea below 5 years of age were studied along with an equal number of age, sex and weight matched controls with no history of diarrhea in the last six months. Case selection was based on WHO's clinical definition of persistent diarrhea. Children with chronic diarrhea due to organic basis were excluded. Nutritional status based on Gomez classification and eye signs of vitamin A deficiency, according to World Health Organisation classification of xerophthalmia, were carefully documented in all cases. Serum vitamin A level was checked in all 100 cases, as follows: 5ml of blood drawn from antecubital vein by using plastic, sterile, aluminum foil wrapped syringe. Sample was put in an aluminum foil wrapped tube, placed on ice and immediately transferred to the laboratory in a thermos. Sera was separated and dried under

a gentle stream of nitrogen and stored at -70 until vitamin A estimation was done in January 1998. The high performance liquid chromatography (HPLC) technique was used for vitamin A level estimation. The results of serum vitamin A were interpreted as follows: Normal level > 20 mcg/dl, Subnormal level < 20 mcg/dl, Low 10 – 20 mcg/dl, Deficient < 10 mcg/dl. The children records were then analyzed for the results.

RESULTS

Subnormal vitamin A level was found in 72% (36/50) of children with persistent diarrhea, with 20 having low (10–20 mcg/dl) and 16 deficient (< 10 mcg/dl) vitamin A level. In the control group only 34% (17/50) had subnormal level with only 1 being in the deficient range (Table 1). The mean value of vitamin A in persistent diarrhea

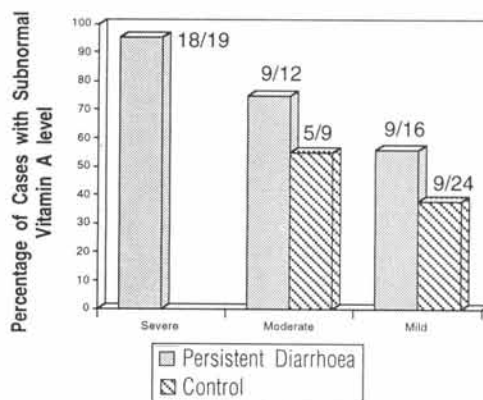


Fig. 1: Number of Cases with subnormal Vitamin A level in various degrees of malnutrition in persistent diarrhoea and control group.

TABLE - 2
AGE DISTRIBUTION OF CHILDREN WITH SUBNORMAL VITAMIN A LEVEL IN PERSISTENT DIARRHEA AND CONTROL GROUP.

Age Range (months)	Persistent Diarrhea n = 36 (%)	Control Group n = 17 (%)
1 - 12	21 (58.3)	1 (6)
13 - 24	9 (25)	3 (17)
25 - 36	2 (5.4)	5 (30)
37 - 48	3 (8.3)	5 (30)
49 - 60	1 (3)	3 (17)

group was 14.42 0.77 as compared to 23.46 0.84 in control group ($P < 0.001$). The age and sex distribution of children with subnormal vitamin A level in persistent diarrhea and control group is given in table 2 & 3 respectively.

The nutritional status of all the 100 children studied is shown in table 4. Figure 1 shows the correlation of low vitamin A level with malnutrition and persistent diarrhea. In children with mild malnutrition, subnormal vitamin A level was found in 56.3% of those with persistent diarrhea as compared to 37.5% in control group. The corresponding figure for moderate malnutrition were 75% and 55.6% respectively. It is interesting to note that in children with severe malnutrition, no weight matched control could be included during the study period.

The highest rate of exclusive breast feeding was found in control group with normal vitamin A level i.e. 85% (28/33). The corresponding figures for control group with subnormal vitamin A level and persistent diarrhea group were 53% (9/17) and 16.7% (6/36) respectively (Figure 2). Xerophthalmia was found in 6 cases only and all except 1 had vitamin A level of < 10 mcg/dl (Table 5).

DISCUSSION

72% of children with persistent diarrhea had subnormal vitamin A level (10 - 20 mcg/dl) which is significantly higher than the 34% in control group. More striking difference is observed in the deficient (< 10 mcg/dl) vitamin A range - 44% vs 6% in the persistent diarrhea and control group respectively. As expected subnormal vitamin A level is directly related to the degree of malnutrition. Yet in both mild and moderate malnutrition cases significantly higher rates of subnormal vitamin A level were observed in diarrhea group 56.3% and 75% as against 37.5% and 55.6% in control group respectively. In severe malnutrition, subnormal vitamin A level was found in 94.7% cases. Its invariable association with diarrhea and inability to select a control without diarrhea speaks for it self and lends

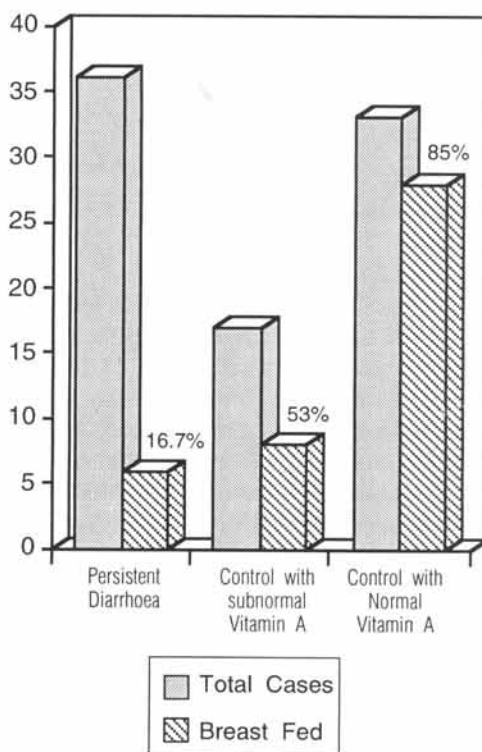


Fig. 2: Number of cases with breast feeding in different groups.

TABLE - 3
SEX DISTRIBUTION OF CHILDREN
WITH SUBNORMAL VITAMIN A
LEVEL IN PERSISTENT DIARRHEA
AND CONTROL GROUP.

Sex	Persistent Diarrhea n = 36 (%)	Control Group n = 17 (%)
Male	15 (41.6)	8 (47)
Female	21 (58.4)	9 (53)

credence to the fact that persistent diarrhoea has a symbiotic relationship with severe malnutrition. One of the important underlying factor may be vitamin A deficiency. We conclude that low vitamin A level has a strong association with the persistence of diarrheal episodes. These results are in accordance with other studies in the literature where upto 64%⁹ and 74%¹⁰ rates of subnormal vitamin A level in persistent diarrhea were reported.

Interestingly, 34% of apparently healthy children in control group were found to have subnormal vitamin A level. This phenomenon of subclinical vitamin A deficiency has been well documented^{11,12}. Most of the signs of early vitamin A deficiency are non specific e.g. anorexian, failure to thrive, diarrhea and recurrent respiratory infections. If unrecognised these children contribute to the unfortunate pool of under five mortality in developing countries¹³. As early as 1983 Sommer et al were of a view that mild vitamin A deficiency in a community justifies vigorous intervention measures to reduce childhood morbidity and mortality¹⁴. More recently two meta analyses have attempted to synthesize the results from studies carried out in Nepal, India and Sudan. Both concluded that vitamin A supplementation is associated with one-third reduction in diarrhea related childhood mortality^{5,15}.

In the long run sound nutritional practices are required to prevent vitamin A deficiency in the community. The two most important measures are optimal breast feeding¹⁶ and weaning practices. Our results show that breast feeding is associated with protection from vitamin A deficiency 85% rate of exclusive breast feeding observed in control group with normal vitamin A level as compared to 53% and 16.5% in control with subnormal vitamin A and persistent diarrhea groups.

Xerophthalmia was found in 31% of children with vitamin A level < 10 mcg/dl where as only are child with vitamin A level of 10 – 20 mcg/dl had mild eye changes. It must be noted that young children can not complain about night blindness hence its actual extent may be unknown.

The risk of persistent diarrhea with subnormal vitamin A level is highest in the first 2 years of life^{1,17,18}. We found 83 % of children in persistent diarrhea group were below 2 years of age as compared to 23.5% in control group with subnormal vitamin A level.

The above findings suggest that like most other developing countries vitamin A status in majority of our children is subnormal. Especially noteworthy is the fact

TABLE - 4
NUTRITIONAL STATUS OF CHILDREN
IN PERSISTENT DIARRHOEA AND
CONTROL GROUP.

Nutritional status*	Persistent diarrhoea n = 50 (%)	Control Group n = 50 (%)
Severe (< 60)	19 (38)	0
Moderate (60-74)	12 (24)	9 (18)
Mild (75-89)	16 (32)	24 (48)
Normal (90)	03 (06)	17 (34)

*Gomez Classification (Percentage of expected weight for age)

TABLE – 5
EYE CHANGES IN CHILDREN WITH
SUBNORMAL VITAMIN A LEVEL IN
PERSISTENT DIARRHOEA.

Xerophthalmia		Persistent diarrhoea n = 6
XN	Night Blindness	0
X1A/ X1B	Congectival Xerosis/ Bitot's Spots	4
X2/X3A/X3B	Corneal Xerosis Keratomalacia	2
XS	Corneal Scar	0
XF	Xeroophthalmic fundus	0

that majority of apparently healthy children have subclinical vitamin A deficiency. There is ample evidence that improving vitamin A status reduces childhood morbidity and mortality. Therefore, early supplementation of vitamin A to high risk children is strongly recommended.

RECOMMENDATIONS

1. Encourage breast feeding for 2 years.
2. Proper weaning diet from age 6 months onward.
3. Vitamin A supplementation of children linked to Measles immunization.
4. Maternal vitamin A supplementation linked to BCG immunization of new born.
5. Vitamin A supplementation to high risk children:
 - a). Protein energy malnutrition.
 - b). Recurrent diarrheal and respiratory infections.

REFERENCES

1. Black RE. Persistent diarrhea in children of developing countries. *Pediatr Infect Dis J* 1993; 12: 751.

2. World Health Organisation – Persistent diarrhea in children in developing countries. Memorandum from a WHO meeting, Geneva. WHO. Bull WHO 1988; 66: 709.
3. Sagaro, et al. Risk factors for persistent diarrhea. *Rev Gastroenerol Peru* 1995; 15 (3): 231.
4. Khalidi, et al. Characteristics of persistent diarrhea in pediatric services in Tunis. *Arch Pediatr* 1995; 2 (3): 227.
5. Fawzi, et al. Vitamin A supplementation and child mortality; a meta analysis. *JAMA* 1993; 269: 898.
6. Chaudhary, et al. Plasma vitamin A, zinc and selenium concentrations in children with acute and persistent diarrhea. *J. Diarrheal Dis Res* 1996; 14(3): 190.
7. Rahman, et al. Effect of early vitamin A supplementation on cell mediated immunity in infants younger than 6 months. *Am J Clin Nutr* 1997; 65: 144.
8. Fawzi, et al. Dietary vitamin A intake and the incidence of diarrhea and respiratory infection among Sudanese children. *J Nutr* 1995; 125 : 1211.
9. Buyukgebiz, et al. Investigation of serum vitamin A levels of children who had a history of recurrent diarrhea and acute respiratory infections in Ankara. *J Trop Pediatr* 1990; 36(5) : 251.
10. Usha, et al. Assessment of preclinical vitamin A deficiency in children with persistent diarrhea *J Pediatr Gastroenterol Nutr* 1991; 13 (2): 168.
11. Ibrahim, et al. Plasma vitamin A and carotene levels in Karachi population. *J Pak Med Assoc* 1987; 37: 117.
12. Molla, et al. Vitamin A status of children in the Urban slums of Karachi, Pakistan; assessed by clinical, dietary and biochemical methods. *Am J Trop Hyg* 1993; 48 (1): 89.
13. Rahmatullah, et al. Reduced mortality among children in southern India receiving a small weekly dose of vitamin A. *N Eng J Med* 1990; 323: 929..

14. Sommer, et al. Increased mortality in children with mild vitamin A deficiency Lancet 1983; 2: 585.
15. Beaton, et al. Effectiveness of vitamin A supplementation in the control young child morbidity and mortality in developing countries. Toronto; University of Toronto - 1992; 1.
16. Vicky Newman. A comparison of data from developed and developing countries. Food and nutrition Bulletin 1994; 5(2): 161.
17. Huttly, et al. Persistent diarrhea in a rural area of Bangladesh - a community based longitudinal study. Int J Epidemiol 1989; 18: 964.
18. Cruz, et al. Epidemiology of persistent diarrhea among Guatemalan rural children. Acta Paediatr suppl 1992; 381: 22.