The Prevalence of Inadequate Vitamin A Nutriture in Preschool Children of North and Northeast Thailand

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Abstract

Previous surveys have suggested that preschool children in the North and Northeast of Thailand are at risk of inadequate vitamin A nutriture. Therefore, vitamin A status was assessed in 996 children aged 2-6 years in the North and Northeast Thailand during the dry (Feb.-April) and rainy (Sept.-Nov.) seasons. Approximately 1 per cent of samples during both periods exhibited serum retinol concentrations below 10 mcg/dl with means (± SD) concentration of 29±9.8 mcg/dl in the dry season and 37±15.4 mcg/dl in the rainy season. About one fifth of the studied children showed abnormal CIC and depleted liver stores (RDR > 20%). High risk areas were ranked and corresponded well by these 2 indicators. Therefore, it is concluded that the magnitude of the problem estimated by RDR and CIC are a more precise measurement of marginal vitamin A status than serum vitamin A level alone and about one-fifth of preschool children in the North and Northeast regions of Thailand experience subclinical vitamin A deficiency.

In 1960, the first large scale nutrition survey conducted by the Interdepartmental Committee on Nutrition for National Defense (ICNND) identified vitamin A deficiency as one of the major nutrition problems in Thailand[1]. A study in Chiang Mai in early 1970 showed that more than 50 per cent of children with severe PEM exhibited xerophthalmia and about 10 per cent developed keratomalacia[2]. Subsequently vitamin A deficiency was included in the Fourth National Food and Nutrition Development Plan for the period 1977-1981[3]. Later, several small scale surveys indicated that there has been a high incidence of subclinical vitamin A deficiency among preschool and school children. Moreover, a survey in 1973 revealed that the average vitamin A intake of preschool children in Ubon Ratchathani province was only one-tenth to one-half the US recommended dietary allowance (RDA)[3]. A biochemical study, measuring serum vitamin A

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concentrations in young children and lactating mothers of northeastern villages during 1977-1978, identified vitamin A deficiency as a public health pro-blem[3]. It was reported in a 1985 prevalence study conducted in Sakon Nakhon province that 12.7 per cent of rural preschool children expressed deficient serum vitamin A concentration[4]. Since it has been strongly suggestive that vitamin A deficiency even in subclinical level, shadows a significant impact upon a child's health[5-7], the extent of the problem, particularly in the high risk areas in Thailand, needs a thorough investigation. The objective of this study was to determine the prevalence of vitamin A deficiency in young children residing in the north and northeast Thailand by using clinical examination, functional and biochemical assessments.

SUBJECTS AND METHOD

Studied Samples

Population studied : 2-6 years old, pre-school children of the north and northeast regions of Thailand.

Sample size : It was assumed that the probability of finding pre-school children with vitamin A deficiency is 0.1, the accuracy of estimation is 0.05 with the alpha error of 0.05, the sample would be at least 217 per region per season. Thus, the total sample size for this project was approximately 900-1,000.

Site selection : A multi-stage sampling technique was employed using the following procedure :

1. Forty districts in each region with a high prevalence of malnutrition among pre-schoolers was the sampling frame.
2. Five districts were randomly selected from the sampling frame; 2 sub-districts were randomly selected from each district then 2 villages were randomly selected from each sub-district.
3. Ten to fifteen children in each village were randomly selected from the lists of names of all children which were reported by the provincial health office.

Time schedule :

All data were collected during two 3 month intervals in 1990:

1. February-April (dry season)
2. September-November (toward the end of the rainy season)

Parameters assessed :

1. Anthropometry : Weight : Height : Mid-arm circumference.
2. Clinical signs : Malnutrition : Xerophthalmia.
3. Biochemical indices : Serum vitamin A : Relative dose response (RDR).
4. Functional : Impression cytology.
5. Morbidity record : History of night-blindness : Acute diarrhoea : Acute respiratory tract infections.

Methodology

1. Children free of chronic or hereditary diseases received complete anthropometric measurements which included weights, heights, and mid-arm circumferences. This was conducted by well-trained field assistants.

2. Children were given a physical examination by medical teams consisting of a physician, nurse, research scientists, and trained field assistants. Special emphasis was placed upon the eye signs of vitamin A deficiency or xerophthalmia. For a history of night blindness, the response from children's mothers to a questionnaire containing descriptions of night-blindness symptoms in common local terms was obtained.

3. In both seasons, 1-1.5 ml of blood was collected from the antecubital vein. Blood samples were kept cool and covered with aluminum foil in an ice box. Blood samples were centrifuged each night at the community hospital laboratory to separated serum. All serum samples were transported in an icebox containing dry ice to the Institute of Nutrition Mahidol University (INMU). Serum vitamin A concentrations were determined by a modification of the method of Bieri et al[8] using High Performance Liquid Chromatography (HPLC). The relative dose response test (RDR) was used to assess marginal vitamin A deficiency as validated by liver reserves below a critical level.

The RDR was performed in a 20 per cent random sub-sample of all selected children or approximately 180-200 samples, following the consent of their parents.

4. A cytology examination of conjunctival epithelium (CIC) was used as another procedure to functionally detect subclinical vitamin A deficiency. This technique was performed by well-trained research scientists in a randomly selected

20 per cent (different sample from those assessed by the RDR) of all children (180-200 samples).

5. Information on illness history, diet, and socio-economic status was obtained from mothers or child caretakers.

RESULTS

From morbidity records obtained, there was 3.1 per cent of night blindness in the dry season compared to 2.2 per cent in the rainy season. Specific symptoms of acute respiratory tract infection and acute diarrhoea occurred in the past 2 weeks revealed 10.8 per cent and 49.5 per cent morbidity rate in the dry season compared to 6.7 per cent and 53.7 per cent in the rainy season respectively.

The clinical examination assessed by a medical doctor with particular attention to signs and symptoms of vitamin A deficiency indicated the point prevalence of 1 per cent of suspected Bitot's spot during the dry season and 0.6 per cent of conjunctival xerosis in the rainy season.

The distribution of serum retinol concentration among subjects in both periods is shown in Fig. 1. In the rainy season the distribution curve tended to shift to the right with a mean±S.D. of serum retinol = 37±15.4 mg/dl compared to those in the dry season with a mean±S.D. of serum retinol = 29±9.8 mg/dl. During both seasons only 0.6 per cent of subjects, whose serum retinol fell in deficient level (< 10 mcg/dl). When the level of serum retinol in the same cases during both seasons was considered, there were significant increases in the serum retinol level in the rainy season as shown in Table 1 and Table 2.

Table 1. The distribution of serum retinol by season in the same subjects.

Serum Retinol (mcg/dl)	Serum retinol (mcg/dl) Feb. - Mar. No.	%	Sep. - Oct. No.	%
< 10	0	0.0	0	0.0
10.1 - 15	12	5.7	3	1.4
15.1 - 20	18	8.5	8	3.8
20.1 - 25	51	2.0	32	15.1
25.1 - 30	40	18.8	31	14.6
30.1 - 35	42	19.8	39	18.4
35.1 - 40	29	13.7	34	16.0
40.1 - 45	3	1.5	23	10.8
> 45	17	8.0	42	19.8
Mean	28.9		36.9	
SD	9.9		14.9	

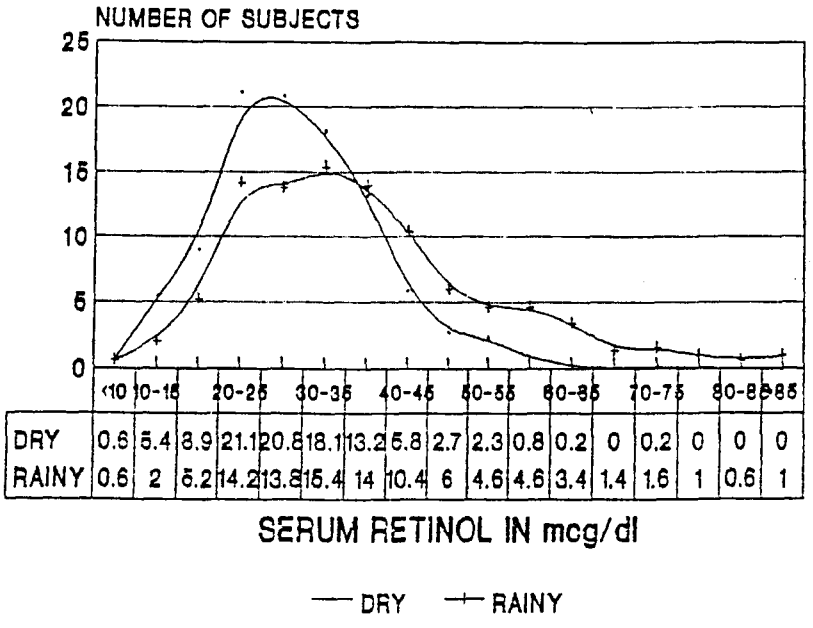

Fig. 1. Distribution of serum retinol compare the dry *vs* the rainy season.

Table 2. Distribution of serum retinol by season in the same subjects.

Serum retinol (mcg/dl)	Number of studied sample	
	Feb. - Mar.	Sep. - Oct.
< 20	30	12
20 - 30	91	63
> 30	91	138
	212	212

Chi-square = 16.56; p = 0.00

Table 3. Relationship between per cent RDR and serum retional.

	Serum retinol (mcg/dl)	
	Dry season	Rainy season
	Mean ± SD	
RDR < 20%	30.5 ± 8.9 (n = 67)	38.0 ± 12.5 (n = 66)
RDR > 20%	25.2 ± 10.9 (n = 17)	30.8 ± 11.9 (n = 18)
t-test; p-value :	2.13; 0.04	2.18; 0.03

The result of RDR and CIC assessment by provinces in each region is shown in Fig. 2.1 and Fig. 2.2. The percentage of vitamin A deficient subjects classified by RDR > 20 per cent and abnormal CIC corresponded very well in both regions. The severity of vitamin A deficiency could be ranked by these two indicators. The relationship between RDR and serum retinol is shown in Table 3. There was significant difference of means of serum retinol among the subjects whose RDR < 20 per cent compared to those whose RDR > 20 per cent during both seasons. The result of all assessments conducted in the study suggested that vitamin A status among preschool children in high risk areas was better during the rainy season than during the dry season.

DISCUSSION

To our knowledge, this study represents the first time biochemical (RDR) and functional (CIC) parameters have been conducted together. The purpose of this study was to determine the prevalence of vitamin A deficiency in young children residing in the north and northeast Thailand by different methods of assessment.

The serum retinol level less than 10 mcg/dl was found in 0.6 per cent among the studied children during both seasons compared to the study in 1988 by the Nutrition division in which 3 per cent of studied children exhibited low serum vitamin A[9]. However, 14 per cent and 7 per cent, by dry and rainy season respectively, of the subjects showed low serum retinol level (10-20 mcg/dl). By serum retinol level it was not clearly suggestive of the vitamin A deficiency status among preschool children in this study. By using RDR and CIC as the indicators, about 20 per cent or one fifth of the samples showed RDR > 20 per cent and abnormal CIC which indicated depleted stores of vitamin A in the liver and abnormal conjunctival epithelium respectively. It could be concluded that about one-fifth of pre-schoolers in the north and northeast region experienced subclinical or marginal vitamin A deficiency status which could not be detected by using serum retinol level alone. By these two parameters the level of severity in areas where the survey was done could be clearly identified. Therefore, they would be the most sensitive methods to assess vitamin A status particularly in areas where frank symptoms of deficiency were rarely detected. The significant difference of means of serum retinol among the subjects whose RDR < 20 per cent compared to those whose RDR > 20 per cent showed some relationship between serum retinol and RDR. By the history of night blindness and clinical assessment by a medical doctor the real picture of vitamin A status among the studied samples was not clearly seen. However, by history of night blindness, morbidity records of specific infectious diseases (ARI and diarrhoea), physical examination could reflect the general nutritional status which could lead to identify the risk group, risk period and risk area. For a better view it was suggestive from this study that biochemical and functional parameters must be conducted along with the conventional method to detect subclinical or marginal type of vitamin A deficiency which need to have some specific interventions for the prevention of the worse condition of deficiency. The preventive approach suggested should be in the form of vitamin A supplement by means

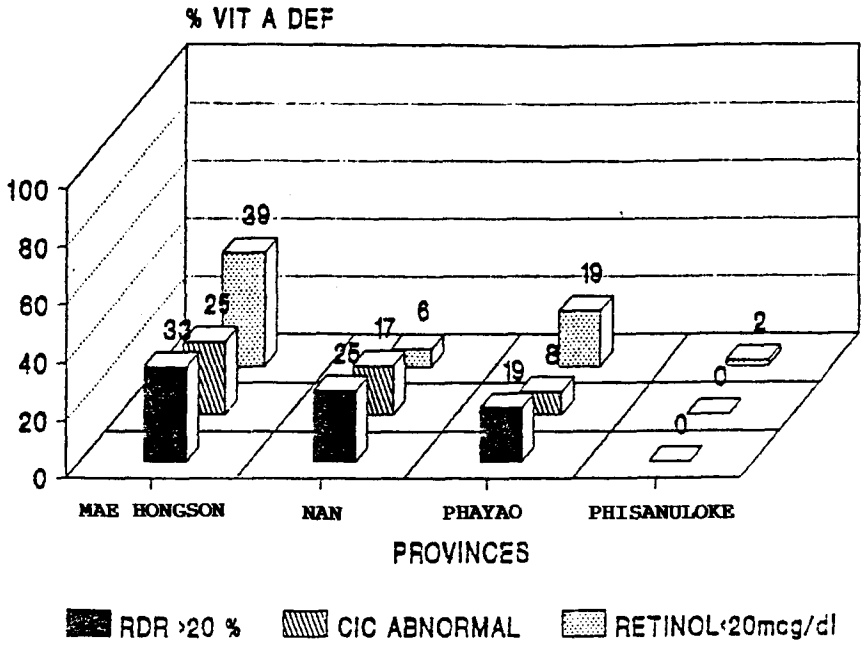

FIGURE 2.1

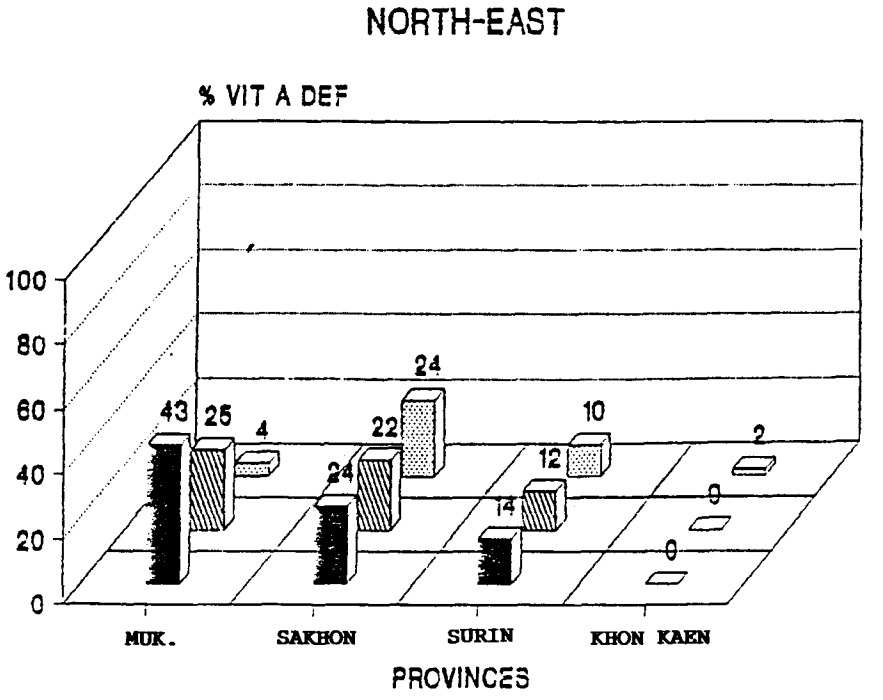

Fig. 2.1 Per cent vitamin A deficiency by provinces RDR CIC and serum retinol in the North region ; dry season.

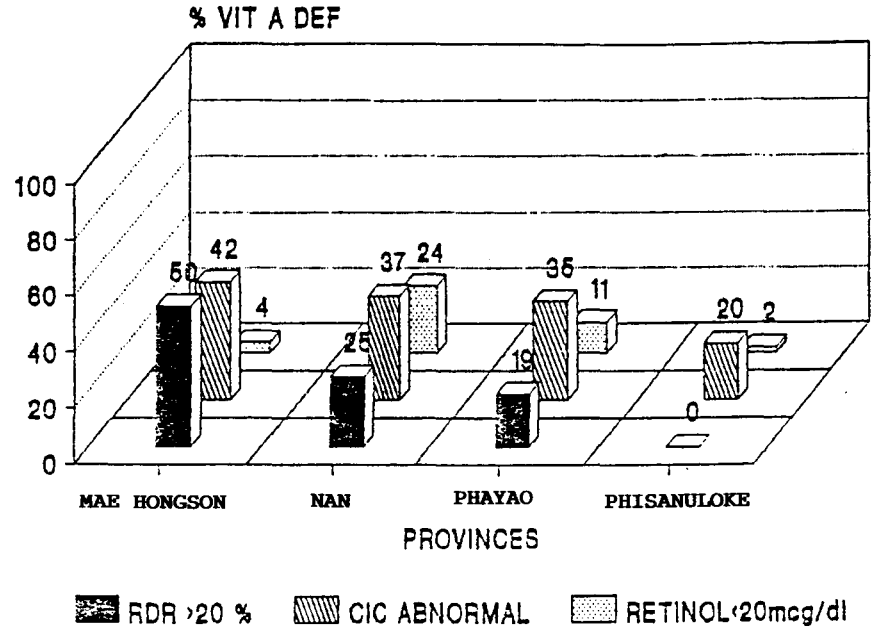

FIGURE 2.2

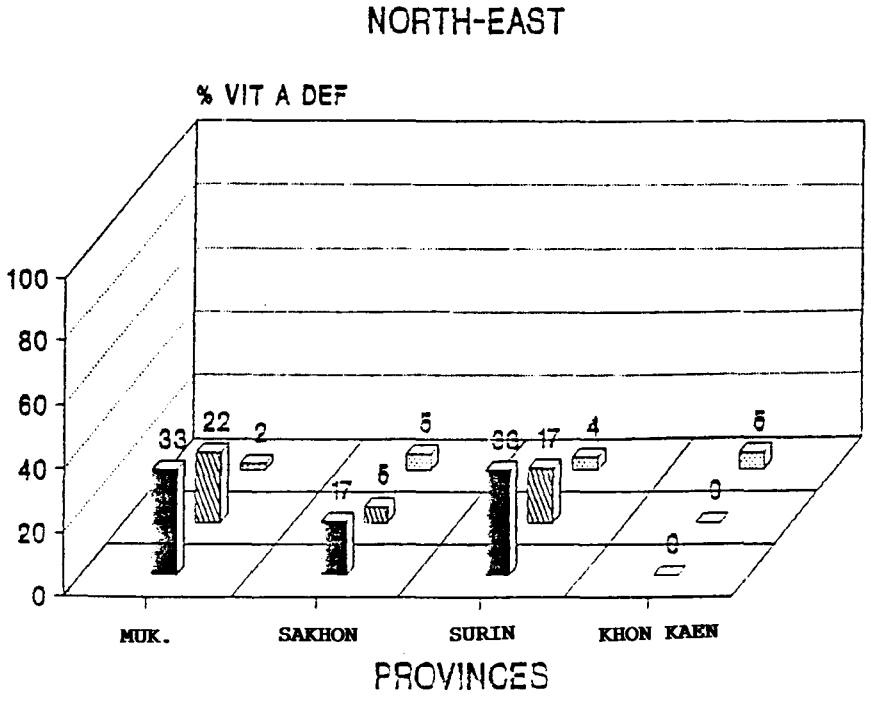

Fig. 2.2 Per cent vitamin A deficiency by provinces RDR CIC and serum retinol in the North region ; rainy season.

of improving dietary intake of vitamin A rich foods among preschool children and providing nutrition education emphasizing an increased intake of vitamin A rich diet among mothers.

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REFERENCES

1. Interdepartmental Committee on Nutrition for National Defense. The Kingdom of Thailand, Nutrition Survey (October - December 1960). 1962 Department of Defense, Washington D.C.
2. Smith FR, Suskind R, Thanangkul O, Leitzmann C, Goodman DS, Olson RE. Plasma vitamin A, Retinol Binding protein and prealbumin concentration in protein and calorie malnutrition. III. Response to varying dietary treatments. Am J Clin Nutr 1975; 28: 732-8.
3. Dhanamitta S, Stoecker B, Valyasevi A. Community Approaches to Prevention of Vitamin A deficiency, Paper present in IVACG Meeting, Jakarta, Indonesia, 11 - 13 Oct. 1980.
4. Bloem MW. Vitamin A Deficiency, Anemia and Infectious Disease in Northeast Thailand. Thesis TNO-CIVO Toxicology and Nutrition Institute, Zeist, The Netherland 1988.
5. Sommer A, Katz J, Tawrotjo I. Increased risk of respiratory disease and diarrhea in children with pre-existing milk vitamin A deficiency. Am J Clin Nutr 1984; 40: 1090-5.
6. Milton RC, Reddy V, Naidu AN. Mild vitamin A deficiency and childhood morbidity : An Indian Experience. Am J Clin Nutr 1987; 46: 827-9.
7. Barclay AJG, Foster A, Sommer A. Vitamin A supplement and mortality related to measles : A randomized clinical trial. Br Med J 1987; 47: 294-6.
8. Bieri JG, Tolliver TJ, Catignani GL. Simultaneous determination of alpha tocopherol and retinol in plasma or red cells by high pressure liquid chromatography. Am J Clin Nutr 1979; 32: 2143-9.
9. Nutrition Division, Ministry of Public Health. Report on Survey to the existence and extent of vitamin A deficiency in Thailand. Nutrition Division Report Series No. 4 1988. MOPH, Bangkok.

การสำรวจภาวะขาดวิตามินเอในเด็กก่อนวัยเรียนในภาคเหนือ และภาคตะวันออกเฉียงเหนือ

ลือชา วนรัตน์, พ.บ., ส.ม., M.C.N., แสงโสม สีนะวัฒน์, พ.บ., M.C.N.,*, เอมอร วสันตวิสุทธิ์, Ph.D.**, วัลลภ ไทยเหนือ, พ.บ., M.P.H.****

การสำรวจภาวะขาดวิตามินเอในเด็กก่อนวัยเรียนในภาคเหนือและภาคตะวันออกเฉียงเหนือได้ดำเนินการออกเป็น ระยะคือ ในฤดูร้อน (กุมภาพันธ์-มีนาคม 2533) และฤดูฝน (กันยายน-ตุลาคม 2533) ทั้งนี้ได้ทำการศึกษา 5 อำเภอ ในแต่ละภาครวม 10 อำเภอ โดยสุ่มเลือกจากอำเภอที่มีภาวะการขาดอาหารสูงจากนั้นได้สุ่มเลือก 2 ตำบล จากแต่ละอำเภอ 2 หมู่บ้านจากแต่ละตำบลรวมทั้งสิ้น 20 ตำบล 40 หมู่บ้าน เด็กก่อนวัยเรียนอายุ 2-6 ปี ได้รับการสุ่มเลือกทั้งสิ้น 996 ราย ใน 2 ภาคและ 2 ฤดู เด็กทั้งหมดได้รับการชั่งน้ำหนัก วัดส่วนสูงและวัดเส้นรอบต้นแขนตรวจร่างกายทางคลินิก เน้นการตรวจอาการทางตาของภาวะขาดวิตามินเอ เจาะเลือดเพื่อหาระดับเรตินอลในซีรั่ม นอกจากนี้ได้มีการใช้วิธีของ Relative Dose Response (RDR) และการใช้เทคนิคของเซลล์วิทยา Conjunctival Impression Cytology (CIC) โดยวิธี RDR และ CIC นี้ได้ทำการสุ่มตัวอย่างย่อย ร้อยละ 20 จากเด็กที่ทำการศึกษาทั้งหมด

ภาวะการขาดอาหารถูกประเมินโดยใช้น้ำหนักเทียบกับอายุ ส่วนสูงเทียบกับอายุ และน้ำหนักเทียบกับส่วนสูง พบว่ามีการเปลี่ยนแปลงไปในทางที่ดีขึ้นในฤดูฝน การตรวจทางคลินิกไม่พบอาการเกล็ดกระดี่ (Bitot's spot) หรือกระจกตาอ่อนนิ่ม (Keratomalacia) เลย

การศึกษาพบว่าทั้งฤดูร้อน และฤดูฝน มีจำนวนเด็กที่มีระดับซีรั่มเรตินอลต่ำกว่า 0.35 umol/L (10 ug/dl) ประมาณร้อยละ 1 ระดับซีรั่มเรตินอลที่มีอยู่ระหว่าง 0.35-0.70 umol/L (10-20 ug/dl) พบในเด็กร้อยละ 14 ในฤดูร้อน และร้อยละ 7 ในฤดูฝน

ค่าโดยประมาณของภาวะขาดวิตามินเอโดยใช้ RDR บ่งชี้ว่าประมาณร้อยละ 20 ของเด็กที่ทำการศึกษามีวิตามินเอสะสมอยู่ในตับในปริมาณไม่เพียงพอ หากใช้ CIC เป็นดัชนีชี้วัดจะพบว่ามีปริมาณร้อยละ 18 ของเด็ก มีความผิดปกติของเซลล์เยื่อบุตาขาว ซึ่งบ่งชี้ถึงภาวะขาดวิตามินเอ

ระดับความรุนแรงของการขาดวิมามินเอ เมื่อประมาณโดย RDR และ CIC มีผลสอดคล้องกัน โดยสามารถจัดเรียงลำดับขนาดและความรุนแรงของปัญหา ในจังหวัดที่ทำการศึกษาได้ผลใกล้เคียงกัน ทั้งในฤดูร้อนและฤดูฝน

โดยสรุปแล้ว การศึกษานี้แสดงให้เห็นว่า เด็กก่อนวัยเรียนประมาณ 1 ใน 5 ของภาคเหนือและภาคตะวันออกเฉียงเหนือมีภาวะขาดวิตามินเอโดยไม่มีอาการแสดงทางคลินิก (Subclinical Vitamin A Deficiency) การสำรวยครั้งนี้ทำให้เราทราบถึงพื้นที่ที่มีอัตราความเสี่ยงสูง ซึ่งจะมีประโยชน์ต่อการวางแผนงานหรือโครงการโภชนาการเพื่อเพิ่มปริมาณการบริโภควิตามินเอ ในประชาชนกลุ่มเป้าหมายต่อไปในอนาคต

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