Prevalence of Vitamin A Deficiency among 6 months to 5 years old Children

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I. Introduction

Myanmar, likewise other South-East Asian countries, vitamin A deficiency remains a public health problem. The vitamin A status of children around the world is compromised due to inadequate dietary intake and infections resulting potential risk of morbidity[1]. Serum retinol concentrations are useful indicators of vitamin A status and are influenced by inflammation and infection. This paper is to reveal the prevalence of vitamin A deficiency among 6 months to 5 years children in 13 townships across Myanmar.

II. Background

In Myanmar, universal vitamin A supplementation program had been started since 1993. In 2000, the prevalence of vitamin A deficiency was below the cut-off for public health problem[2], and since then, there is no community survey on vitamin A.

Monitoring and evaluation are essential components of vitamin A intervention programs. They enable program managers to track progress in achieving their goals. Three reasons for determining the vitamin A status in populations are: to assess the magnitude of vitamin A deficiency, to identify populations at high risk for developing vitamin A deficiency, and to monitor and evaluate the effectiveness of vitamin A supplementation programs and track progress toward elimination goals[3].

III. Methodology

Study design will be a community-based, cross-sectional study. Study places will be carried out in 15 townships from randomly selected regions of Myanmar. 6-59 months aged children in selected regions of Myanmar will be recruited as the subjects. For the sample size calculation, the following formula will be used.

$$\mathbf{n= [(z^2 \times p\ q\ )/\ d^2] \times DE \times RR}$$

p = prevalence of low serum vitamin A in children = 4.2% = 0.042

d = absolute precision = 0.015

q = 1- p = 0.958

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[1] Humphrey JH, Agoestina T, Wu L, et al. Impact of neonatal vitamin A supplementation on infant morbidity and mortality. J Pediatr 1996; 128: 489–96

[2] National Health Plan (2006-2011)

3 WHO/UNICEF. Indicators for assessing vitamin A deficiency and their application in monitoring and evaluating intervention programs. Geneva: WHO, 1994

z = 1.96 = a statistical parameter corresponding to the confidence level of 95% (an error risk of 5%)

DE = 2

RR = Respondent Rate = 15 % = 1.15

n = sample size required = 687 x 2 x 1.15 =1580

The sample size for each township is 108 children, having 36 children in each cluster, and thus, in total for 15 townships are 1620. Unfortunately study could be conducted in 13 townships covering 1410 children.

The study time was carefully chosen to conduct between 4 months and 6 months after mass Vitamin A supplementation to avoid its effect on serum level. When the study was delay and missed to meet designated time frame for some townships, Vitamin A supplementation was postponed intentionally until the study has been conducted.

Materials

A pre-tested questionnaire was administered by trained interviewers to mothers or female caregivers, in order to collect demographic factors, socio-economic condition, child's diet and breast-feeding. A local events calendar will be prepared for each site to assist in determining the age of each child. Information about breastfeeding and age for weaning of children was recorded by questioning the mothers. Last vitamin A supplementation and intake of vitamin A containing drugs were also noted.

The dietary vitamin A intake was assessed by using a semi-quantitative food frequency questionnaire to estimate the number of occurrences on which food sources of vitamin A and carotenoid are consumed during the previous month. Measuring cups and teaspoons were used to estimate the usual portion sizes of locally available food items containing vitamin A. The mothers or female caregivers were asked for vitamin A rich foods intake of children in previous month.

Regarding the breast milk amount and energy content in it, this study adopted the reference. Considering the fairness and ethical issues to the child, as the breast milk is the major nutrient for most of the children participated in this study, the interviewers were trained to ask and noted the amount of breast milk produced by the caregiver in a day as 'high/low/average amount'. Nevertheless, based on the reference, the amount of breast milk accounted in this study as 'average amount', which is in line with the literature[4]. Then, the total content of energy, protein and vitamin A was summed up that from food intake, including breast milk.

Consumption of breast milk and mean energy obtained from breast milk by children in developing countries according to age group

[4] Brown KH, Dewey KG, Allen LH. (1998). Complementary feeding of young children in developing countries: A review of current scientific knowledge. WHO/NUT/98.1. Geneva: World Health Organization

Consumption	Age group (mo)				
	0–2	3–5	6–8	9–11	12–23
No. of subjects/studies	172/3	259/5	603/16	342/13	377/9
Breastmilk (g/day)	714	784	674	616	549
Energy (kcal/day)	437	474	413	379	346

Source: Brown KH, Dewey KG, Allen LH. Complementary feeding of young children in developing countries: a review of current scientific knowledge. 1998. WHO/NUT/98.1 Geneva: World Health Organization, 1998.

The cut-off level for vitamin A deficiency was determined according to the recommended dietary allowances in Southeast Asia[5].

Recommended Dietary Allowance for South East Asia (SEA-RDA)[a]

Age	Energy (kcal/day)	Protein (g/day)*	Vitamin A (ug/day)
6-11 months	710	14	400
1-3 years	1180	23	400
4-6 years	1470	29	450

[a]Source: Corazon VC Barba & Ma Isabel Z Cabrera (2008). Recommended Dietary Allowances Harmonization in Southeast Asia. *Asia Pac J Clin Nutr;17 (S2):405-408*

*Adjusted for 70% Protein quality

Morbidity data were included in the questionnaires on the past history of diarrhea and respiratory infections in children during the 4 weeks prior to the interview and children were examined also for the ARI only during the study. Diarrhea in this study was defined as the passage of three or more loose motions a day and a respiratory infection was defined as the presence of cough with or without expectoration for at least 24 hours.

Night blindness was able to be assessed by history only as the constraint of time frame of data collection period. All children were clinically examined to detect ocular manifestations of vitamin A deficiency by trained medical officers according to the guidelines specified[6].

Anthropometric measurements of weight and height were done to a nearest precision of 0.1 kg and 0.1 cm respectively. Children were classified as underweight, stunted and wasted if the calculated weight-for-age, height-for-age and weight-for-height Z-scores respectively, using data from WHO Growth standard, 2007 for age and sex of children.

According to the World Health Organization and the United Nations Children's Fund[7], serum retinol has been used as a key indicator of vitamin A deficiency (VAD). A two ml sample of venous blood

[5] Corazon VC Barba & Ma Isabel Z Cabrera (2008). Recommended Dietary Allowances Harmonization in Southeast Asia. *Asia Pac J Clin Nutr;17 (S2):405-408*

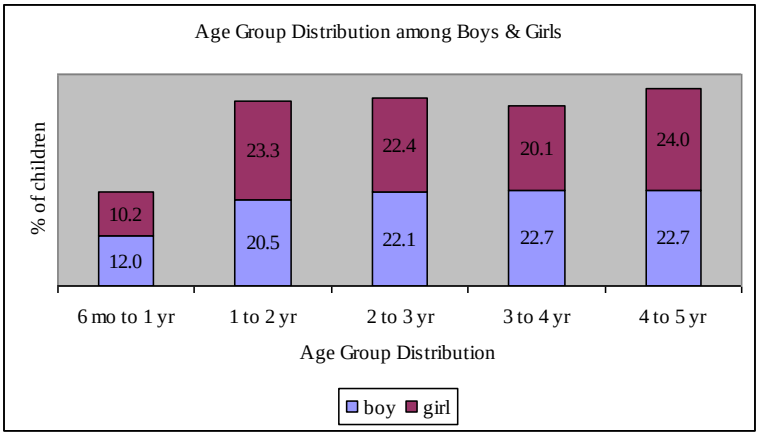
[6] World Health Organization (1995*a*)

was drawn from each child into polypropylene tubes, kept, stored and carried to the laboratory of Nutrition Research Division, Department of Medical Research (Lower Myanmar) according to the standard procedures. Samples were stored at -80°C until biochemical analysis.

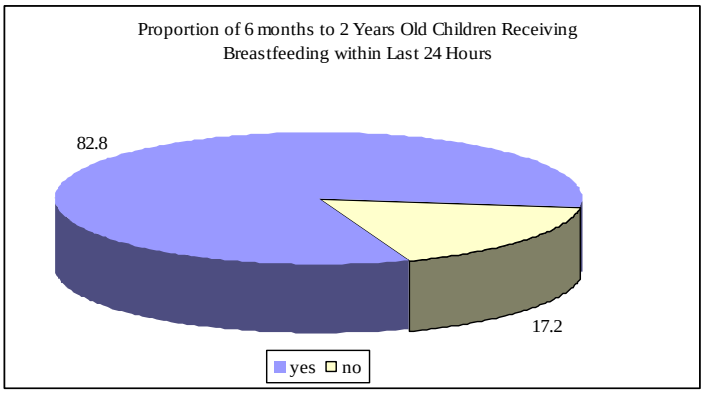
Serum retinol was analyzed by reversed phase high performance liquid chromatography (HPLC)[8]. Sub-clinical vitamin A deficiency is defined as serum retinol <0.7 μmol/L. The categorization of vitamin A deficiency as important public health problem in this study follows the WHO recommendation[9].

Findings

(1) Socio-Demography



Out of 1410 children in total, age group distribution is according to the study design which is the least in 6 month to 1 year group and similar in other 3 groups; meanwhile, the gender distribution is likely to be similar in both sexes.

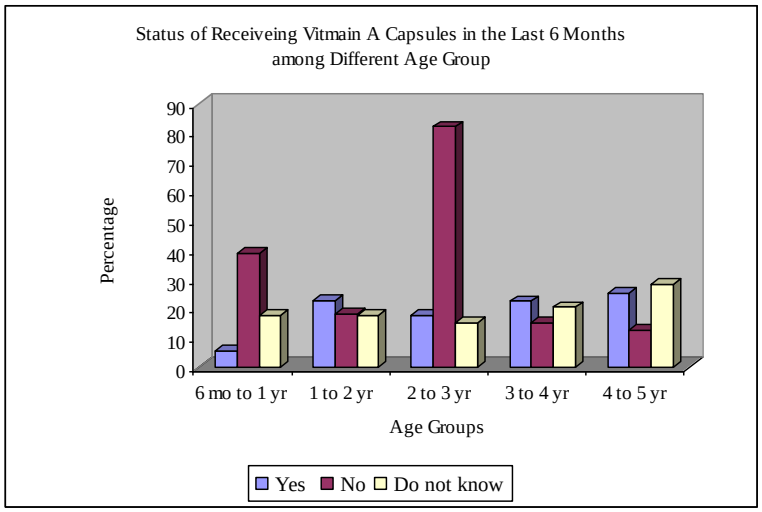


[7] WHO/UNICEF. Indicators for assessing vitamin A deficiency and their application in monitoring and evaluating intervention programs. Geneva: WHO, 1994

[8] International Vitamin A Consultative Group. Biochemical methodology for assessment of vitamin A status. The Nutrition Foundation, Washington DC, USA, 1982

[9] Serum retinol concentrations for determining the prevalence of vitamin A deficiency in populations (WHO/NMH/NHD/MNM/11.3)

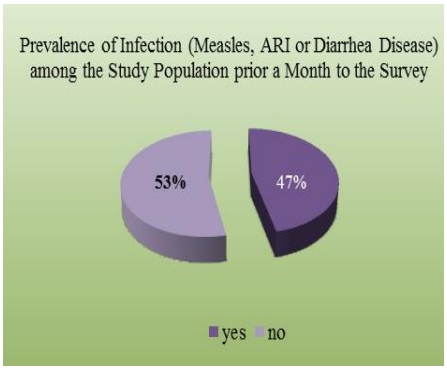
This study has included the children between 6 months and 2 years for breastfeeding information. In that group, 83% are still breastfed during the last 24 hours of interview; however, 17% are not.



In this survey, out of all the study population, the children who have not received vitamin A capsules in the last 6 months are the largest in 2 to 3 year age group. Commonly observed in all age groups, some of them who do not have knowledge about the drugs they received from the health care providers are what and the reason why they should give to their child.

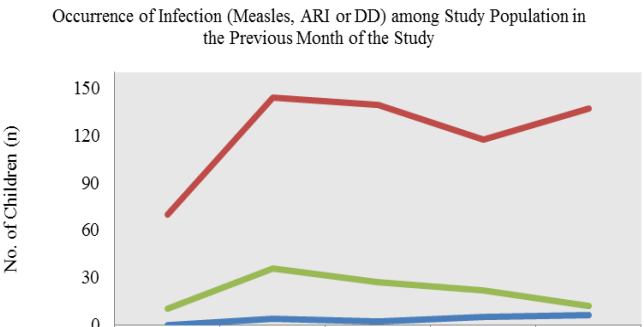
(2) Morbidity Status

A month before the survey, around half (47%) of the study children from 6 months to 5 years had any sign of infection (measles, ARI or Diarrheal disease).

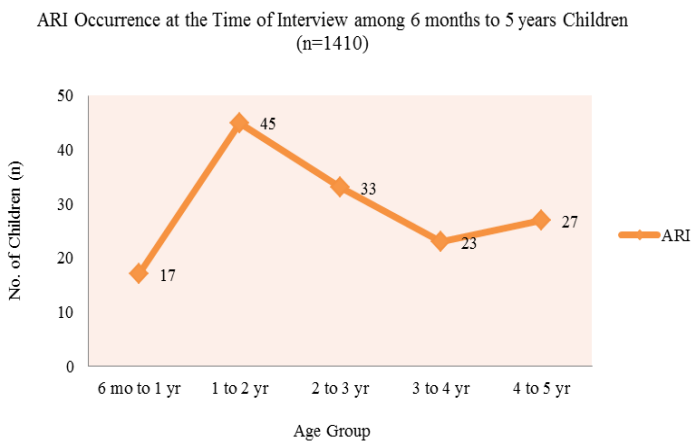


Some of the children had suffered measles except 6 month to 1 year age group. ARI seems the commonest infection in this survey, and it rises starting from 6 months until 2 years of age.

However, the incidence is likely to be dropped in the following years until 4 years of age, and it surges again afterwards. Though the incidence of Diarrhea cases is not as common as ARI, there it remarkably is. The incidence rate is sloping up like that of ARI in between 6 months to 2 years of age.



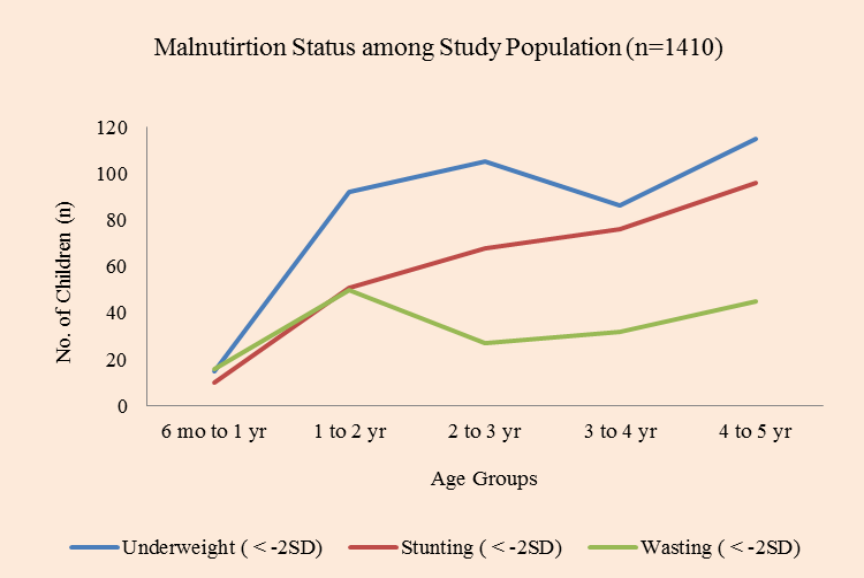
	6 mo to 1 yr	1 to 2 yr	2 to 3 yr	3 to 4 yr	4 to 5 yr
Measles	0	4	2	5	6
ARI	70	144	139	117	137
DD	10	36	27	22	12



During the interviews, around 10% of the children being interviewed were having at least a sign of ARI (n=145). The rate of incidence is more or less likely to be that of previous month; the highest in 6 month to 2 years of age children, fallen during 2 to 4 years and shot up again from 4 years of age onwards.

(3) Malnutrition Status

In this section, age of the children taken part in this study is grouped into year from year. The indicators: underweight (WAZ), stunting (HAZ) and wasting (WHZ) are used to identify the nutritional status of children. From the below figure, it is observed that the more the age getting old, the higher the prevalence of malnutrition status.



Using the WHO growth Standard, the nutritional status between boys and girls was similar; whereas, that between rural and urban was likely to be higher in former area. Underweight is the highest in Sagaing region, stunting and wasting in Ayeyarwaddy region; meanwhile severe underweight, stunting and wasting are the peak in Bago region.

Status of Malnourishment among Study Population (6-59 months children)

	Underweight (Weight for Age)		Stunting (Height for Age)		Wasting (Weight for Height)			No. of Children
	<-2SD to -3 SD	<-3SD	<-2SD to -3 SD	<-3SD	<-2SD to -3 SD	<-3SD	>+2SD	
Gender								
Boys	183	25	123	38	70	11	8	727
Girls	170	35	100	40	79	10	7	683
Area								

Rural	231	38	148	55	97	10	11	940
Urban	122	22	75	23	52	11	4	470
State/Region								
Ayeyarwaddy	53	9	43	9	31	3	3	217
Bago	62	24	32	21	30	10	3	216
Magwe	29	6	23	4	11	0	0	108
Mandalay	51	4	32	21	10	1	2	216
Mon	16	2	10	5	12	1	2	108
Sagaing	70	3	31	2	27	1	2	216
Shan (South)	24	3	23	9	6	0	1	108
Yangon	48	9	29	7	22	5	2	221
Total	353	60	223	78	149	21	15	1410

(4)Nutrient Sufficiency Status

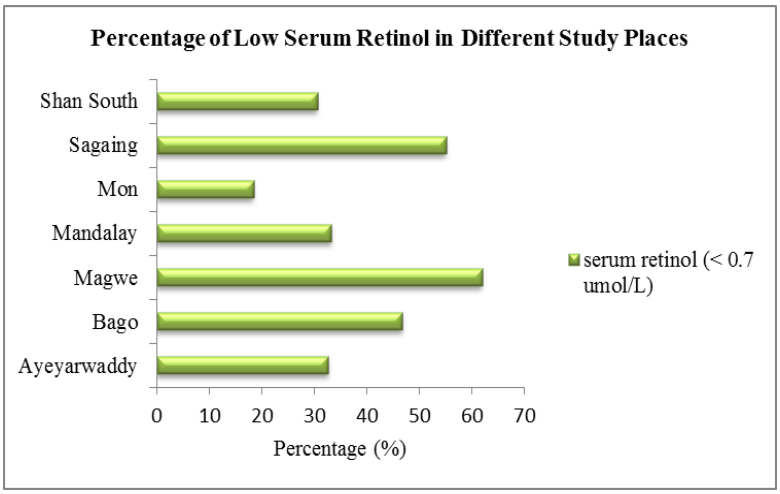
In this section, the age groups are different from the previous one since in the references, the adequacy level of energy, protein and vitamin A from their consumption including breast milk intake come from the specific age groups. Despite this study is interested in vitamin A, energy and protein amount from consumption are also analyzed. Among all three nutrients, vitamin A level said to be most sufficient than the other two: energy and protein. However, energy is observed to be the only nutrient insufficiently consumed.

By State/Region, vitamin A intake insufficiency is the highest in Ayeyarwaddy region and Shan (South) state and, the lowest in Sagaing region. Energy intake is highly insufficient in Mon state among other State/Region; meanwhile, protein intake is the most insufficient in Ayeyarwaddy region, comparing to that in other Sate/Region.

By the age group, there is no child whose vitamin A intake is lower than age-adjusted requirements in 6 months to 1 year group. The most insufficient intake is observed among children between 4 to 5 years of age.

Based on serum retinol which is the indicator of vitamin A level, the lowest serum retinol is observed among children from Magwe region, followed by that from Sagaing and Bago regions. Yangon region is seen more likely to be higher in serum retinol level than any other regions in this study. Quantitatively, vitamin A adequacy from intake including breast milk is analyzed. The following figures are explaining the number of children above and below the age adjusted vitamin A cut-off values according to their age groups. The green symbol noted that the children whose intakes are above the age-adjusted vitamin A requirement values and the red symbols are for the children whose intake are below the age-adjusted values.

In the group of children between 6 months and 1 year, there are 157 children and their intake is above the age-adjusted requirement cut-off level. Meanwhile, in the group of 1 to 3 year aged children, those who have adequate vitamin A intake are about 6 times larger than those whose intake are below age-adjusted cut-off level (536 vs. 86). In the other group of children between 4 to 5 years aged, 455 children are above the age-adjusted vitamin A requirement and 176 children are below the cut-off level.



IV. Discussion

As the influence of infection on vitamin A status is well proved from many studies, this study also had noted the occurrence of infection among under five children (measles, ARI & diarrhea) a month before the interview. The commonest infection among them was ARI than other two and steeping up in 4 to 5 years of age group. In this paper, the researchers could not mention the status of inflammation using serum indicators (CRP & AGP). Therefore, we could not differentiate the prevalence of vitamin A deficiency is due to the effects of infection or virtual decrease in vitamin A consumption.

Regarding vitamin A capsule receiving, knowledge sharing from health care providers is said to be weak among community as not knowing whether they had received vitamin A capsules is common in all age groups of children. Due to postponing Vitamin A supplementation in late study townships, it is possible to find out low Vitamin A coverage in study area.

Nutritional status of all under five children in this study (n=1410) was also detected in this study, which is relatively lower than National Data in terms of severe underweight, stunting and wasting compared to National Data (MICS, 2009-2010).

Prevalence of Nutritional Status		National Data*	Survey Data
Underweight	Moderate	17.0	25
	Severe	5.6	4.3
Stunting	Moderate	22.4	15.8
	Severe	12.7	5.5
Wasting	Moderate	5.8	10.6
	Severe	2.1	1.6

Source: MICS (2009-2010)*Using WHO Growth Standard

By now, the influence of infection on nutritional status is seen in this study. Nutritional status (underweight) and the occurrence of ARI at the time study is negatively correlate in this study ($r = -0.53$; $p < 0.05$). The ARI occurrence is also correlated with stunting, but statistically insignificant (r

= 0.04; p = 0.137). Similarly, the diarrhea occurrence in a month before the study has effect on the weight for height at the time of examination (r = -0.53; p < 0.5). In accordance with the postulation of Scrimshaw, Taylor & Gordon, infection and malnutrition were related in a vicious cycle[10].

In terms of nutrient intake, until before the inflammation indicators are come out, we would say that vitamin A deficiency is the highest in age 4 to 5 years group when the prevalence of infection is also higher in that age group. Several studies have shown that improper feeding practices including breast milk[11].

After biochemical analysis, the total subjects for serum retinol have come up with 1383, as the blood samples of 27 children from Paung Te (7 children) & Kyauktagar (9 children) Township from Bago Region, Chauk Township (13 children) from Magwe Region) and Loilin Township (8 children) from Shan-South State) were spoiled and had to be cancelled. Out of 1383 children based on serum retinol examination, vitamin A deficiency has been observed among children over 1 year of age.

V. Conclusion

Regardless of inflammation, the prevalence of vitamin A deficiency based on serum retinol level was 37.2% in National Level which is much higher than in 2000 (4.2%)[12]. By State/Region, the prevalence of vitamin A deficiency is: in Yangon (19.0%), Ayeyarwaddy (32.7%), Bago (46.8%), Sagaing (55.1%), Magwe (62.0%), Mandalay (33.3%), Shan-South (30.6%) and Mon (18.5%). Meanwhile, based on the food intake, the consumption of Vitamin A below RDA was 19% across the whole country. In conclusion, vitamin A deficiency problem is in severe degree of public health problem according to WHO recommendation.[13]

VI. Recommendations

1. Until unless the status of infection has been explored, the National Program of Vitamin A Capsule supplementation should be still there with more information sharing by the health care providers.
2. If the incidence of infection stayed high, the management for those infection should be monitored and evaluated whether according to the specific guidelines or not.
3. Vitamin A capsules supplementation program to under five children should be regularly carried out and strengthened to cover the whole community.

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[10] Schrimshaw, Taylor & Gordon. (1968). Interactions of nutrition and infection. WHO monograph series No. 57. WHO. Geneva

[11] Hoyle et al. (1980). Breast feeding and food intake among children with acute diarrheal disease. *Am. J. Clin. Nutr*.; 33:2365-2371

[12] Prevalence Survey by DOH & DMR (Lower Myanmar) in 2000

[13] Serum retinol concentrations for determining the prevalence of vitamin A deficiency in populations (WHO/NMH/ NHD/MNM/11.3)