PLASMA RETINOL AND ALPHA-TOCOPHEROL LEVEL AND GROWTH INDICES OF 7 MONTHS OLD HEALTHY THAI INFANTS IN BANGKOK

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Abstract. A cross-sectional study was conducted to measure plasma retinol and alpha-tocopherol status and the growth indices of 66 healthy Thai infants aged about 7 months old. The mean (SD) plasma retinol and alpha-tocopherol level were 1.59(0.31) and 25.40(7.01) μmol/l respectively. For their weight, height, and body mass index, the mean (SD) values were 7.96(0.93) kg, 69.95(2.42) cm, and 16.25(1.43) respectively. There was a remarkable proportion of improper feeding. However there were no correlations between plasma retinol level, plasma alpha-tocopherol level, growth indices and duration of breast milk, formula milk, weaning food feeding except alpha-tocopherol level which positively correlated with duration of breastfeeding.

INTRODUCTION

Malnutrition is an important public health problem, especially in developing tropical countries. In addition, vitamin A deficiency has been listed as a major micronutrient deficiency by the World Health Organization (WHO, 1976). It may lead to stunted growth and visual problems such as night blindness, xerosis and xerophthalmia. For vitamin E, although no clearly defined deficiency syndrome has been recognized in humans except hemolytic anemia in premature infants (Ensminger *et al*, 1995), its antioxidant property is important to protect the integrity of cellular and intracellular structures and to prevent destruction of certain enzymes. It may also have some role in immunity (Long and Santos, 1999).

We consider 7 months old infants as an important population group whose nutritional status should be assessed for many reasons. Firstly, the infants usually change their diet from milk to weaning food during this period. Secondly, infancy is the golden period for physical and mental growth and development. Lastly, many infections such as diarrhea and measles have their peak incidence and severity during infancy. Any inadequate or improper feeding during this period may lead to a major impact on growth, development and the susceptibility to infections. An otherwise healthy infant may have a subclinical nutritional problem but is misdiagnosed and may lose the opportunity to have optimal nutrition to promote growth and development. We therefore design the study to determine whether there was any subclinical abnormality in plasma retinol and alpha-tocopherol level as well as the growth indices which may reflect nutritional problems in about 7 months old healthy Thai infants.

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MATERIALS AND METHODS

This was a cross-sectional descriptive study. It was conducted in conjunction with a study on safety and immunogenicity of diphtheria-acellular pertussis-tetanus vaccine (DaPT) in

healthy Thai infants during January 1999. One ml of blood specimen was collected from each of 66 healthy infants aged about 7 months old who were undergoing blood-sampling for detection of DaPT antibodies level. Agreement to participate this study with informed consent was obtained from the parents. The plasma was separated, kept in light-protected tubes and frozen at -70ºC as soon as possible until determination of plasma retinol and alpha-tocopherol level were performed. Plasma retinol and alpha-tocopherol were determined by using high performance liquid chromatography (HPLC) according to Speek *et al* (1986) with little modification. The excitation/emission wavelengths of the fluorometer for the determination of retinol and alpha-tocopherol were 333/470 and 296/320 nm respectively.

Data on age, birth weight, duration of breast milk and other types of feeding were collected by using a preformed questionnaire. The height at birth was not included in the study because of missing values. The body weight was measured in kg by using a digital scale that could measure up to two decimals. The height was measured in the supine position in cm with one decimal. All data were analyzed by using descriptive statistics. Comparison of quantitative variables was done by using Student's *t*-test. The relationship of variables was detected by using correlation and regression analysis. Multivariate analysis was used to detect the relation of plasma retinol and alpha-tocopherol level and the duration of breast milk, formula milk and weaning food feeding.

RESULTS

The studied infants were aged 196 to 257 (mean 224) days, 56% were male. Their mean weight was 7.96 kg, 1.87 to 3.89 times of their birth weight. Their mean height was 69.95 cm and mean body mass index (BMI) was 16.25. They gained the weight on average 0.0074 times of their birth weight per day (Table 1). Males had significantly higher weight, height, and BMI than females whereas their birth weight was similar (Table 2).

Forty-five infants (68.2%) were breast-fed for at least 3 months and 18 infants (27.3%) were still being breast-fed at the time of the study. Thirteen infants (19.7%) were not breast-fed at all. Formula milk feeding was started soon after birth in 24 infants (36.4%) and its percentage gradually increased afterward. Weaning food was fed since birth to one infant (1.5%) and most of the parents (77.3%) started to feed their infants with weaning food after the age of 3 months (Fig 1).

Table 1
General characters and plasma retinol and alpha-tocopherol level of the infants.

Character	Minimum	Maximum	Mean(SD)
Age (day)	196	257	223.61(9.97)
Birth weight (kg)	2.00	3.95	3.05(0.41)
Weight (kg)	6.30	10.90	7.96(0.93)
Height (cm)	64.5	74.0	69.95(2.42)
Body mass index (BMI)	13.89	20.74	16.25(1.43)
Weight/birth weight	1.87	3.89	2.65(0.44)
Weight gain/birth weight (per day)[a]	0.0039	0.0135	0.0074(0.0020)
Duration of breastfeeding (month)	0	7	3.58(2.64)
Duration of formula milk feeding (month)	0	7	4.48(2.46)
Duration of weaning food feeding (month)	1	7	4.11(0.93)
Plasma retinol (μmol/l)	0.97	2.40	1.59(0.31)
Plasma alpha-tocopherol (μmol/l)	10.40	54.50	25.40(7.01)

[a](Weight - Birth weight)/(Birth weight)(age)

Table 2
Mean (SD) value of birth weight, body weight, height, body mass index and plasma retinol and alpha-tocopherol level according to gender.

Variable	Gender	
	Male (n=37)	Female (n=29)
Birth weight (kg)	3.04 (0.41)	3.06 (0.41)
Body weight[a] (kg)	8.36 (0.93)	7.45 (0.64)
Height[a] (cm)	71.03 (1.91)	68.59 (2.35)
Body mass index[a] (BMI)	16.57 (1.56)	15.84 (1.16)
Plasma retinol (μmol/l)	1.62 (0.29)	1.56 (0.34)
Plasma alpha-tocopherol (μmol/l)	24.56 (6.73)	26.47 (7.35)

[a]Significantly higher in male than in female infant ($p<0.05$)

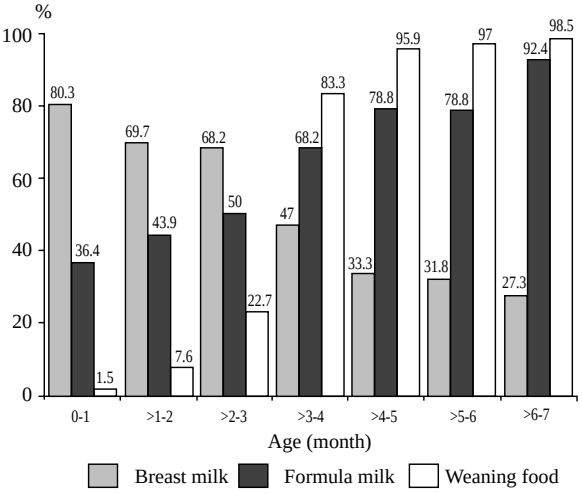

Fig 1–Percentage of infants who were fed with breast milk, formula milk and weaning food at different age.

The mean plasma retinol level was 1.59 μmol/l. Forty-five infants (68.2%) had plasma retinol level in the normal range (0.7-1.75 μmol/l) and 21 infants (31.8%) had high plasma retinol level (>1.75 μmol/l) according to WHO criteria (1976). There was no infant who had a deficient plasma retinol level. For plasma alpha-tocopherol, the mean level was 25.40 μmol/l. Sixty-one infants (92.4%) had normal plasma alpha-tocopherol levels (15-40 μmol/l) while three (4.5%) and two (3.0%) infants had deficient (<15 μmol/l) and high (>40 μmol/l) levels respectively according to the definition used by Sies *et al* (1992). There was no significant difference in plasma retinol and alpha-tocopherol level between male and female infants (Table 2).

We did not find any correlation between plasma retinol or alpha-tocopherol level and growth indices such as weight, height, BMI, and weight gain after birth ($p>0.05$). There was also no correlation between plasma retinol and alpha-tocopherol level.

In analysis of the effect of the duration of breastfeeding, formula milk feeding, and weaning food feeding on growth indices and plasma retinol and alpha-tocopherol level, we did not find any relationship between these variables when we used correlation and regression statistics. However, when multivariate analysis was used, we found that the plasma alpha-tocopherol level was higher if the infants were longer breast-fed ($p<0.05$).

DISCUSSION

All of the infants in this study had normal weight and height when compared to the study of Chavalittamrong and Tantiwongse (1987). Our male infants had higher weight and height than female infants, which was somewhat similar to the growth pattern of infants in the United States (Needlman, 2000). Chavalittamrong and Tantiwongse (1987), however, reported higher weight and height in female than male infants, different from this study. We do not

know the reason for this finding but it might be population selection bias that was the cause.

Although 68% of infants were breast-fed for at least 3 months, nearly 20% of them were not breast-fed at all despite the breast-feeding campaign in our country. In addition, 23% of infants were fed with weaning food before the age of 3 months. All these findings suggest that improper feeding practice is still a problem in our population, even in otherwise normal infants.

Thailand has been classified by WHO as a country where sporadic cases of vitamin A deficiency is prevalent but the magnitude was not considered as a significant public health problem (WHO, 1988). The highest prevalence occurred in the northern and northeastern parts of Thailand (Ministry of Public Health, 1992; Udomkesmalee *et al*, 1990). Efforts to prevent vitamin A deficiency were then implemented including addition of vitamin A in the formula milk, nutritional education to the mothers and the vitamin supplementation in pregnant women. A recent study on vitamin A content in breast milk and maternal serum conducted in Bangkok during April and May 1998 (Witte, 1998) found that the vitamin A values in both serum and breast milk were very high and well beyond the range of the standard value. Therefore the finding of high plasma retinol levels in our infants is not surprising. This finding suggests that there is no necessity for a supplementation or treatment with vitamin A in infants to reduce mortality and morbidity from diarrheal diseases, acute lower respiratory tract infection, and measles as suggested by some studies (Hussey and Klein, 1990; Glasziou and Mackerras 1993; Barreto *et al*, 1994; Hossain *et al*, 1998; Julien *et al*, 1999). However, as we know that plasma retinol level does not accurately reflect the total vitamin A storage in the body, some children may be still at risk of vitamin A deficiency if there is any aggravating factor. Adequate and well balanced diet should be recommended for all infants even if their plasma retinol level is normal.

In this study, there was no correlation between plasma retinol and growth indices. Infants who had plasma retinol levels above the normal range did not show higher growth than those who had normal plasma retinol levels. This finding should mean that vitamin A in the normal range is adequate for the optimal growth of the body and excessive vitamin A will not have additive effect on growth.

Although vitamin E seems to be less important in infant growth, it may be essential in cellular homeostasis as well as the immune response (Ensminger *et al*, 1995; Long and Santos, 1999). Deficiency of vitamin E in children with protein-energy malnutrition may associate with neurological deficits (Kalra *et al*, 1998). In addition, plasma alpha-tocopherol level may reflect overall nutritional adequacy of the infants. There are very few data on the plasma alpha-tocopherol level of infants less than one-year-old that can be compare with our study. However, if we accept that the plasma alpha-tocopherol is comparable in all age groups of children, the mean plasma alpha-tocopherol in our infants is higher than those reported by other studies (Spannaus-Martin *et al*, 1997; Karr *et al*, 1997).

In multivariate analysis model, the plasma alpha-tocopherol level was significantly higher in infants who were longer breast-fed. It may be due to the fact that vitamin E content in cow milk is only 1/10 to 1/2 of that of human milk, varying with the food consumed by the cow and this will affect the vitamin E content in formula milk (Ensminger *et al*, 1995). In addition, weaning food that does not contain vegetable oil, legumes and egg will provide inadequate vitamin E. Therefore breastfeeding should be promoted in all infants especially in low birth weight or premature infants who are at risk of vitamin E deficiency. Weaning food should also contain vegetable oil and plant materials that are rich sources of vitamin E.

In conclusion, this study in healthy Thai infant showed that there was a remarkable proportion of infant's caretakers who performed improper practice in feeding. Although no

obvious nutritional and anthropometric abnormalities were detected in these infants, this improper practice should be corrected. This study also suggests that vitamin A supplementation is not necessary for healthy Thai infants in Bangkok.

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