FLUORIDE ANALYSIS OF HUMAN MILK IN REMOTE AREAS OF THAILAND

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Abstract. The objective of this study was to measure the fluoride content in human milk collected from mothers living in remote areas of Thailand and to correlate it with fluoride concentrations in drinking water and water for domestic use. Four to five ml of breast milk were sampled from mothers living in villages where schools under the jurisdiction of the Department of Border Patrol Police were located. The schools were sampled by Multiple Stratified Cluster Random Sampling. Fluoride was determined by microdiffusion method. Statistical analysis were made by ANOVA and LSD test. Correlation between fluoride content in milk and water was assessed by Kendall's tau-b. The mean fluoride concentration in breast milk was 0.017±0.02 ppm. There was no difference in breast milk fluoride concentration between regions (p=0.6). No correlation was found between breast milk fluoride content and fluoride concentrations in either drinking water or water for domestic use (r_τ = -0.09, p = 0.32, r_τ = -0.04, p = 0.65 respectively).

INTRODUCTION

Breast milk is considered to be the best nutrient for infants. It was suggested that mothers should feed their child with breast milk until one and a half years of age. In the first six months of life, milk is the main diet, and other kinds of food are considered as supplements. During the period between 6 and 12 months, the dietary importance of milk gradually changes from the main food to a supplement. After 12 months, milk becomes a supplement (Tantibhedyangkul, 1993). In remote areas, most children are fed with breast milk which is a natural human product and it is convenient to feed without any preparation. Dental caries in young children is an important dental health problem in Thailand. A survey in 1994 conducted by the Dental Health Division, Department of Health, Ministry of Public Health revealed that the prevalence of dental caries in children aged 3 years was 61.7% with dmft or decay, missing and filling (3.4 teeth per person). Most surveys conducted at the provincial level found a rising trend in the prevalence of dental caries (Prasertsom and Leelasithorn, 1999). In order to prevent caries in this age group, it was recommended that infants have an initial oral evaluation visit within 6 month of eruption of the first tooth or no later than 12 months of age. This will allow the dentist to recommend proper oral health care and perhaps prescribe a fluoride supplement if drinking water contains less than 0.3 ppm of fluoride (AAPD, 1999-2000). When prescribing a fluoride supplement, not only the fluoride content in drinking water should be considered but also that of food. Phatumvanit *et al* (1987) estimated the fluoride intake of children 4-6 months of age in Bangkok and found a value of 0.02 mg/kg body weight; fluoride content in breast milk was found to be 0.02 ppm. However, the study was conducted in Bangkok where most people used tap water which contained 0.12±0.04 ppm fluoride (Songpaisan *et al*, 1983), and this might be the cause of low fluoride in breast milk.

In remote areas near the border of Thailand, fluoride contents may vary with different geography. Mothers living in various regions may have different fluoride contents in their breast milk. Since fluoride in milk can be absorbable (Ericsson, 1958; Spak *et al*, 1982) and infants in remote areas usually consume breast milk during the first year of life, a study of the fluoride content in breast milk is thus important and can be used as baseline data for planning of fluoride supplementation in infants for the prevention of dental caries.

The objective of this study was to measure fluoride content in breast milk and correlate it with fluoride in drinking water and water for domestic use in remote areas of Thailand.

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MATERIAL AND METHOD

Breast milk sampling

We sampled 4-5 ml of breast milk from mothers living in villages where schools under the jurisdiction of the Department of Border Patrol Police are located, by Multiple Stratified Cluster Random Sampling as described in our previous study (Chuckpaiwong *et al*, 2000). The milk was collected between 19 July and 8 October 1999 and frozen at -80ºC until analyzed.

Fluoride measurement

Breast milk was thawed at room temperature and determined by the microdiffusion method of Taves (1968) by adding 1 ml of deionized water into 1 ml of milk in a 10 cm plastic dish followed by 2 ml of 5M perchloric acid saturated with hexamethyldisiloxane. One ml of 0.1 M sodium hydroxide solution was added into a 3 cm plastic dish as the trapping solution. This dish was then placed on the 10 cm dish with a cover and immediately sealed with vaseline to prevent air leakage and subsequently incubated at 40ºC with continuous shaking by rotary motion at 100 rpm for at least 12 hours. One ml of deionized distilled water was added into the trapping solution in the 3 cm dish and the pH was adjusted with TISAB III solution. Fluoride concentrations were measured with a fluoride electrode (ORION Model 96-04,96-09) which was directly attached to an ion analyzer (Expandable ionanalyzer Model EA 940, ORION, USA). Each sample was measured in triplicate. The efficiency of measurements was evaluated using reverse extraction of standard fluoride solution at a concentration of 0.1 and 1 ppm.

Statistical analysis

Mean and standard deviations were calculated. ANOVA and LSD test were used for comparing fluoride in breast milk from various regions. The correlation between fluoride content in breast milk and in drinking water and water for domestic use was determined by Kendall's tau-b.

RESULTS

Sixty-five samples of breast milk were collected from mothers aged 17 to 43 years (mean age 27.8 ± 5.9). The mean fluoride content of the breast milk ranged from 0.13 ppm (central and southern regions) to 0.21 ppm (the northern region) with a mean of 0.017 ppm and standard deviation of 0.02 ppm (Table 1). When fluoride content in breast milk from different regions was compared, there was no difference ($p = 0.6$). In addition, there was no correlation between fluoride content in breast milk and fluoride content in either drinking water or water for use ($r_\tau = -0.09$, $p = 0.32$; $r_\tau = -0.04$, $p = 0.65$ respectively).

DISCUSSION

Our study revealed a very low level of fluoride in breast milk (0.017 ± 0.02 ppm). This finding is similar to a previous report which found that breast milk contained not more than 0.02 ppm of

Table 1
Fluoride content in human milk, drinking water and water for domestic use in different regions.

Region	No.	Fluoride content (Mean±SD) (ppm)		
		Human milk	Drinking water[a]	Water for domestic use[b]
Central and East	5	0.013±0.011	0.04±0.04	0.29±0.28
Northeast	12	0.015±0.008	0.03±0.03	0.07±0.05
North	27	0.021±0.031	0.06±0.05	0.10±0.09
South	21	0.013±0.008	0.04±0.05	0.11±0.19
Total	65	0.017±0.02	0.04±0.04	0.13±0.19

[a, b]Fluoride contents of drinking water and water for domestic use are those from our previous study (Chuckpaiwong *et al*, 2000).

Table 2
Estimation of fluoride intake in infants (Average fluoride content in breast milk =0.017).

Age (months)	Weight[a] (kg)		Suggested milk intake[b] (ml)	Estimated daily F-intake (mgF/kg body weight)		Estimated daily fluoride allowances for infants[c] (mgF/kg body weight)
	Boy	Girl		Boy	Girl	
3	4.5-7.0	4.5-6.5	900	0.002-0.003	0.002-0.003	0.05-0.07
6	7.0-9.0	6.0-8.0	960	0.002-0.002	0.002-0.003	0.04-0.06
12	7.5-11.5	7.0-10	1,080	0.002-0.002	0.002-0.003	0.04-0.05

[a]Pruksananonda (1993)
[b]Silva and Reynolds (1996)
[c]Burt (1992)

fluoride (Ericsson and Ribelius, 1971; Phantumvanit *et al*, 1987). Our results also showed no correlation between breast milk fluoride and fluoride in drinking water and water for domestic use. This is in agreement with a study on the comparison of breast milk fluoride of mothers living in areas where drinking water contained 1 ppm and 0.2 ppm fluoride. The study found little difference in fluoride content in breast milk but there was a big difference in fluoride content in blood (Ekstrand, 1996). A study of Ekstrand *et al*, (1984b) also found low fluoride content in breast milk of mothers who consumed supplementary fluoride, which reflected low secretion of fluoride into breast milk.

Regarding the prevention of caries by fluoride supplementation, Burt (1992) has estimated the maximum fluoride intake each age group should receive, *ie* children aged 3 and 6 months should receive fluoride not more than 0.33 mg, and 0.43 mg for children aged 12 months. An estimated daily fluoride allowance for infants is shown in Table 2. Due to the unavailability of data on the amount of breast milk consumed by children in each age group, an estimate can be made from the amount of infant formula suggested feeding. It was recommended that the amount consumed by children aged 2-3, 3-6 and 6-12 months be 900, 960 and 1,080 ml respectively (Silva and Reynolds, 1996). The fluoride intake in children fed with breast milk was thus estimated to be about 0.02 mg, which was much less than the maximum level they should receive. In addition, the daily fluoride intake from breast milk per kg body weight was estimated as shown in Table 2. Infants who consume breast milk as the main diet receive a fluoride intake much lower than the recommendation. Since infants in remote areas consume breast milk almost exclusively, the recommended dose of fluoride supplement needs to be reconsidered. The current dose recommendation was changed from starting fluoride supplement at birth to starting at 6 months due to the higher fluoride content in infant formula than in breast milk. It was reported that baby formula fed infants received 150 times more fluoride than breast fed infants (Ekstrand *et al*, 1984a). Thus, if fluoride in drinking water is less than 0.3 ppm, the breast fed infants in remote areas may receive supplemental fluoride earlier than the recommendation since these infants are classed as having suboptimal fluoride intake.

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