

Breast milk thiamine level of mothers with infants, clinically diagnosed as beri beri

**Than Nu Shwe, *Thein Thein Myint, *Aye Maung Han, *Aye Thaug, **Theingi Thwin,
**Phyu Phyu Aung, **Moh Moh Hlaing, **Moe Thida Kyaw & **Khin Myat Tun*

**Child Health Department, Institute of Medicine (I)*

***Department of Medical Research (Lower Myanmar)*

The study aimed to determine the breast milk thiamine level of mothers of cases (clinically diagnosed beri beri infants), to compare with those of control mothers (infants with other diseases other than beri beri) and to investigate the factors favouring thiamine deficiency. A hospital-based, cross-sectional comparative study was carried out in Yangon Children's Hospital from February, 2001 to February, 2002. A total of 204 mothers (102 mothers of infants who were diagnosed as beri beri and 102 control mothers) were included. Questionnaire was constructed to include identification of subjects, socio-economic status, food intake and eating habits with special emphasis on thiamine intake, presenting complaints, treatment received and response to treatment. The mean breast milk thiamine level of mothers of cases (8.60 ± 4.40 µg/dl) was significantly lower than that of controls (10.35 ± 6.26 µg/dl) ($p < 0.05$). Percent of mothers of cases (43.1%) who had habit of food avoidance, especially thiamine rich food were significantly higher than that of control mothers (10.8%) ($p < 0.05$). Regarding cooking rice without discarding rice-boiled water, a significantly higher percentage of control mothers (10.8%) had the habit than mothers of cases (2.0%) ($p < 0.05$).

INTRODUCTION

Beri beri is a disease condition due to vitamin B1 (thiamine) deficiency. Infantile beri beri occurs commonly and typically in infants receiving milk from mothers who had thiamine deficiency. Thiamine is rich in foods like whole grain cereals, organ meats, nuts, lean cut pork etc. Myanmar people had traditionally faulty food preparation of washing rice repeatedly before boiling and throwing away of rice-boiled water, especially among illiterates and low income families. This reduces the thiamine content of rice to almost nil. Since meat/fish intakes of low income families are often low, vitamin B1 from animal source is again negligible. In lactating mothers, there is unnecessary food avoidance due to food taboos resulting in lower thiamine intake and thus the babies become high risk for vitamin B1 deficiency.

Pediatricians of our country are under the impression that beri beri is not uncommon among the infants, especially if they are breast-fed and if their mothers have thiamine deficiency. In many occasions, as the babies were very ill, a possibility of septicemia, besides beri beri, was taken into account and broad spectrum antibiotics were given simultaneously with thiamine injection. Some of the babies recovered promptly after receiving injection thiamine, although it still lacks biochemical proof for the definitive diagnosis of beri beri. As infants suffering from beri beri presenting with heart failure and/or shock is a medical emergency, providing injection thiamine could not wait for the time required to take blood samples of the infants. Thus the situation prompted to study the breast milk thiamine content of mothers as an indirect confirmatory evidence. The study thus aimed to determine the breast milk thiamine content of mothers

with clinically diagnosed beri beri infants and to compare with those of control mothers and to investigate the factors, especially on the maternal food habits favoring thiamine deficiency.

MATERIALS AND METHODS

A hospital-based, cross-sectional comparative study was carried out in Yangon Children's Hospital from February 2001 to February 2002. Study group consisted of 102 mothers whose babies were clinically diagnosed as beri beri. One hundred and two mothers, matched in socio-economic status and infant's age, who were attending their sick infants (other than having beri beri) served as controls.

Diagnostic criteria

Infants fulfilling the following criteria were diagnosed as beri beri.

1. Infant with severe dyspnoea/ aphonia/ cyanosis/fits
2. Hepatomegaly responding to injection B1 within 30-45 minutes

The mothers who were given vitamin B complex tablets or injection by the on-duty medical officer after admission of their infants were excluded from the study.

After taking informed consents, the selected mothers were interviewed employing the structured questionnaire. Questions included were: personal characteristics (age, parity, occupation, pattern of feeding), food habit (type of rice consumed, frequency of washing rice before cooking, way of cooking rice (whether discarding of rice-boiled water or not), habit of drinking rice water and presence of food avoidance, especially on thiamine rich food such as pork lean meat, organ meat, peas and beans during lactation). Samples of milk (20 ml) were collected from the mothers in the mornings using manual expression method and placed in the bottles containing three millilitres of acetic acid. Breast milk thiamine contents were measured with "Thiochrome method" by using flurospectrophotometer [1]. The principle of

this method depends on the oxidation of thiamine to thiochrome, which fluorescence in the ultra-violet light. Under standard conditions and in the absence of other fluorescing substances, the fluorescence is proportional to the thiochrome present, and hence to the thiamine originally present in solution.

Statistical analysis

Statistical analysis was performed with Epi Info 6. Age, parity, occupation of mothers, and pattern of feeding were presented descriptively. Percent of cases and controls according to the type of rice consumed, habits of frequency of washing rice before cooking, discarding of rice-boiled water, drinking rice-boiled water and avoidance of thiamine rich food were compared by employing Chi square Test. Mean breast milk thiamine levels between cases and controls were compared by using Student 't' test. All statistical tests were considered to be significant at the $p < 0.05$ level.

RESULTS

Characteristics of mothers are presented in Table 1.

Table 1. Characteristics of cases and control mothers

Characteristics	Mothers of cases no. (%)	Control mothers no. (%)	P value
Parity			
≤3	81 (79.4)	78 (76.5)	0.61
>3	21 (20.6)	24 (23.5)	
Age			
≤ 35 years	88 (86.3)	87 (85.3)	0.84
>35 years	14 (13.7)	15 (14.7)	
Occupation			
Dependent	81 (79.4)	62 (60.8)	0.004*
Working	21 (20.6)	40 (39.2)	
Types of feeding			
Breast milk and water	83 (89.2)	83 (83.0)	0.21
Breast milk and supplementary food	10 (10.8)	17 (17.0)	

*Significant difference between mothers with cases and control mothers

Age and parity of mothers of two groups were comparable. Regarding the occupation

of mothers, significantly more mothers with beri beri cases were dependents than controls ($p < 0.05$). None of the mothers of both groups was exclusively breast fed, and majority of mothers in both categories fed their infants with breast milk and water. Only 10% of mothers of cases and 17% of control mothers had given supplementary foods of home made boiled rice or various brands of commercially available cereal powder.

Table 2. Food habits of mothers with infantile beri beri cases and those of control mothers

Food habits	Mothers of cases no. (%)	Control mothers no. (%)	P value
<i>Frequencies of rice washing</i>			
≤two times	57 (55.9)	59 (57.8)	0.78
>two times	45 (44.1)	43 (42.2)	
<i>Ways of rice cooking</i>			
Discarding rice-boiled water	100 (98.0)	91 (89.2)	0.01*
Without discarding	2 (2.0)	11 (10.8)	
<i>Habit of drinking rice-boiled water</i>			
Presence	15 (15.0)	20 (22.0)	0.21
Absence	85 (85.0)	71 (78.0)	
<i>Food avoidance habit</i>			
Absence and avoid only one type of thiamine rich food	58 (56.9)	91 (89.2)	0.001*
Presence (avoid all types of thiamine rich food)	44 (43.1)	11 (10.8)	

*Significant difference between mothers with cases and control mothers

Table 2 shows the food habits of mothers. There was no difference in type of rice consumed and frequency of washing before rice cooking between the two groups. However, ways of rice cooking and habits of food avoidance especially with regards to vitamin B1 rich food were significantly different in mothers of two groups. Higher percent of mothers of cases discarded rice boiled water than the controls (98% vs 89%) ($p < 0.05$). Significantly higher percent of mothers of cases (43.1%) had habits of food avoidance especially thiamine rich food than control mothers (10.8%) ($p < 0.05$).

Table 3. Numbers of mothers of cases and control mothers by WHO cut-off point of breast milk thiamine level

Groups of breast milk thiamine level	Mothers of cases no. (%)	Control mothers no. (%)	P value
<5 µg/dl (Severely deficient)	25 (24.7)	19 (18.6)	0.12
5-9.9 µg/dl (Marginally deficient)	41 (40.2)	36 (35.3)	
≥0.01 µg/dl (Normal)	36 (35.3)	47 (46.1)	

Odd ratios: Marginally deficient = 1.49
Severely deficient = 1.72

The mean±SE breast milk thiamine contents of mothers with beri beri cases (8.60 ± 0.44 µg/dl) were significantly lower than those of control mothers (10.35 ± 0.62 µg/dl) ($p < 0.05$). According to the WHO, breast milk thiamine level is classified into three groups: severely deficient group is below 5 µg/dl, marginally deficient group is between 5 to 9.9 µg/dl and normal group is between 10 to 20 µg/dl [2]. In mothers of cases, 24.5% and 40.2% of the subjects had severely deficient and marginally deficient breast milk thiamine levels, respectively, compared to 18.6% and 35.3% in control mothers. Lower percent of mothers of cases had normal breast milk thiamine level than that of control mothers (35.3% vs 46.1%), although the differences were not statistically significant ($p > 0.05$) (Table 3).

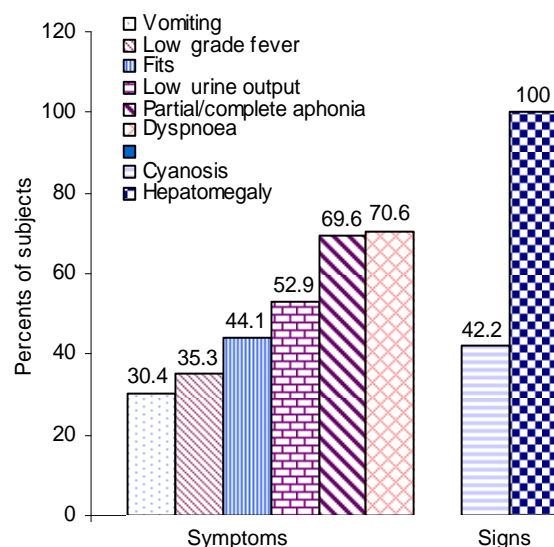


Fig 1. Clinical manifestations of beri beri cases

The age range of clinically diagnosed beri beri infants was found to be from 13 days to eight months. Majority 97.3% (99 out of 102) of the infantile beri beri cases were between the age of one and four months, The highest age frequency (49 out of 102, 48%) was found in the second month of life.

The clinical manifestations of beri beri cases are shown in Fig 1. The presenting symptoms were dyspnoea (70.6%), partial or complete aphonia (69.6%), vomiting (30.4%), low urine output (52.9%) and convulsion (44.1%). The commonest sign was hepatomegaly (100%) and the second was cyanosis (42.2%).

DISCUSSION

Thiamine is one of the vitamin B group micronutrient, which is essential in the body. It acts as a coenzyme and is involved in energy utilizing processes of the body. It is rich in whole grain cereals, lean cut pork, leafy vegetables etc. Severe deficiency of thiamine can lead to beri beri (Singalese language - too ill to move). Beri beri is especially common in breast fed infants of mothers who are thiamine deficient [3]. In our study, higher percent of mothers with beri beri infants fed breast milk alone. By occupation also, it was found that mothers of beri beri cases were mostly dependents and did not work outside, having more time to breast feed their babies. Moreover, it can be assumed that working mothers commonly introduce supplementary food earlier than dependent mothers did. The groups (cases vs controls) in the present study were comparable in age and parity.

In our study, it was found that significantly higher percent of mothers with cases had the habit of cooking rice by discarding rice-boiled water and avoiding thiamine rich foods than those of control mothers. This can be explained by the fact that thiamine is rich in whole grain cereals especially in the outer husk of rice. Therefore, if a person cooked rice by discarding rice-boiled water, a

significant thiamine content of rice would have been lost. Moreover, a lactating mother who has a habit of avoidance of thiamine rich foods, such as, lean cut pork, pulses and beans, etc, can cause thiamine deficiency which in turn lead to low thiamine content in her breast milk.

Significantly higher percent of lower mean thiamine level of mothers with cases than that of control mothers (64.7% vs 53.9%) indicates that thiamine deficiency in lactating mothers favors the occurrence of beri beri in infants. This finding is in accord with the previous comparative study on breast milk thiamine level of mothers of beri beri cases and that of mothers of non-beri beri cases in Rangoon. They showed that there was a significant relationship between the level of thiamine in the mother's milk and occurrence of beri beri, i.e 10.1 ± 4.7 $\mu\text{g}/\text{dl}$ in mothers of cases vs 12.1 ± 4.5 $\mu\text{g}/\text{dl}$ in control mothers, $p < 0.05$ [4].

Not all mothers with deficient thiamine levels lead to beri beri infants (55% of control mothers had thiamine deficiency in breast milk). This finding can be due to the fact that thiamine level of breast milk must be considerably low to occur infantile beri beri, so that it would be less than Recommended Daily Allowance (RDA), i.e., 0.17 mg/day. According to Williams (1961), mean levels of breast milk thiamine from 5-6 $\mu\text{g}/\text{dl}$ are perilous and 10 $\mu\text{g}/\text{dl}$ may be fairly safe in preventing infantile beri beri. He also reported that 0.085 mg/day could prevent infantile beri beri [5]. In this study, the mean thiamine content of breast milk of cases is 8.60 $\mu\text{g}/\text{dl}$ and those of controls is 10.35 $\mu\text{g}/\text{dl}$. If an average breast milk output by Myanmar mothers during one to four months was taken as 855 ml, as carried out by Nutrition Research Division, Department of Medical Research Division (1976), daily thiamine intake of infants from breast milk alone would be 0.076 mg/day in infants of cases and 0.092 mg/day in infants of control mothers. Thus, 0.092 mg/day thiamine in breast milk might be not low enough to cause beri beri.

The mean breast milk thiamine levels of mothers of cases and control mothers of present study were lower than those of other findings of a comparative study where breast milk thiamine levels of mothers with infantile beri beri and control mothers were 9.1 ± 4.7 $\mu\text{g}/\text{dl}$ and 12.1 ± 4.1 $\mu\text{g}/\text{dl}$, respectively [6]. In that study, the breast milk samples were taken from mothers with beri beri cases attending the Yangon Children's Hospital in 1968 but mothers from community served as controls. Higher level of thiamine levels in them might probably be due to supplementation of vitamin B complex during those days. However, in a study on thiamine nutritional status of Khayan Township (1999), the mean value of 31 lactating mothers was 6.7 ± 4.3 $\mu\text{g}/\text{dl}$ [7]. The mean thiamine level of control mothers was comparable with those of mothers from Asian countries, i.e., 10.51 $\mu\text{g}/\text{dl}$ in Philippines and 10.15 in China where rice is the main staple food [8,9]. However, the thiamine level of breast milk of Myanmar mothers was significantly lower than that of the thiamine levels of American and British mothers, i.e., 14.9 $\mu\text{g}/\text{dl}$ and 14 $\mu\text{g}/\text{dl}$, respectively [10, 11].

The age of onset of infantile beri beri is of considerable interest, as it almost exclusively occurs in the first year of life and most commonly between the first and fourth months of life [3]. This also true with our study, as the majority of the cases were between second and third month of the age. Finding of higher prevalence of beri beri in the first few months of life can be partly explained by the fact that the maternal requirement for thiamine is increased during the later months of pregnancy. Secondly, the thiamine levels of colostrum and the early lactating milk are much lower than those in the later months [3]. Finding less cases in infants of first month of life than in second or third months can be explained by the fact that the babies have sufficient reserve of thiamine in the first month of life [12].

Regarding the clinical manifestations of infantile beri beri, most of the cases had

more than one symptom or overlapping of several symptoms. The usual conditions for seeking medical treatment were dyspnoea (70.6%) and partial or complete aphonia (69.6%). Infantile beri beri may often be ushered in by an infection, even a mild one. Therefore, some of our cases (35.5%) had a low grade fever on admission and some cases were difficult to differentiate from other causes of heart failure/shock. In most of the cases, the onset of the disease was acute. The treatment given to the cases were injection thiamine only (70.6%), thiamine and antibiotics (28.4%) and thiamine and anti-convulsants treatment (1%).

From this study, it can be stated that most of the beri beri infants had mothers whose breast milk thiamine levels were lower than the cut-off point of 9.9 $\mu\text{g}/\text{dl}$. However, not all the mothers with low thiamine levels led to beri beri infants. Therefore, the results of this study pointed out that beri beri is still existing in this country and it is a characteristic disease of rice-eating countries, particularly when polished rice is consumed. It is rarely seen in communities where rice is parboiled or undermilled. Beri beri has tended to disappear when knowledge, attitude and practice of lactating mothers will improve and they become to have various foods. Another suggestion is to give health education to the pregnant mothers to take vitamin tablets containing B1 starting from late months of pregnancy until early months of lactation.

ACKNOWLEDGEMENT

First, our grateful acknowledgement must go to the mothers of the sick infants for their friendly and willing help, for without their co-operation this study would have been impossible. We also thank Professor Dr. Paing Soe, Director-General, Department of Medical Research (Lower Myanmar), for kindly allowing to do this study. Our thanks also go to the Medical Superintendent of Yangon Children's Hospital, medical officers, and nurses of that hospital for their valuable help.

REFERENCES

1. Simpson IA & Chow AY. The thiamine content of human milk in Malaya. *Journal of Tropical Pediatrics* 1956; 2(2): 69-76.
2. WHO, Geneva, 2000. The management of nutrition in major emergencies.
3. Kon SK & Mawson EH. "Human Milk", *Medical Research Council Special Report Series No. 269 (HMSO, London)*, 1950.
4. Kywe Thein, Thein Toe, Tin Tin Oo & Khin Khin Htwe. A study of infantile beri beri in Rangoon. *Union of Burma Life Science Journal* 1968; 1: 62-65.
5. Williams RR. Conquest of beri beri. Harvard University press, Cambridge, 1961; 262-283.
6. Kywe Thein, Khin Khin Tway, Tin Tin Oo & Khin Maung Naing. Studies on the thiamine level of breast milk of some Burmese mothers. *Union of Burma Life Science Journal* 1970; 3: 151-154.
7. Khin Maung Maung, Theingi Thwin, Thandar Shwe, Yin Yin Moe, Aye Aye Than & Soe Thein. A study on thiamine nutritional status of Khayan Township. *Myanmar Medical Journal* 1999; 43: 58-61.
8. Alejo G, Leon IC, Ortiliza RD, Salus EM *et al.* Studies on milk of some Filipino mothers: Normal milk thiamine levels. *The Philippine Journal of Food Science* 1965; 94 (2): 153-159.
9. Simpson IA & Chow AY. *Journal of Tropical Pediatrics* 1956; 2: 3.
10. Kon SK & Mawson EH. Wartime studies of certain vitamins and other constituents. *Medical Research Council Special Report Series No. 269*, 1950.
11. National Research Council. The composition of milks. *Bulletin of National Research Council, Washington, No. 254*, 1953.
12. Fehily L. Infantile beri beri in Hong Kong. *Caduceus* 1940; 19: 78-93.