SCI. MED. J. CAI. MED. SYND. VOL. 8, NO. 1, Jan., 1996.

# THIAMINE STATUS IN PROTEIN ENERGY MALNUTRITION

**Hamed A. Elkhayat*, Sanaa A.R. Mahmoud*, Ahmed S. Hafez** and Osama Nour-Eldeen***

*(Department of Pediatrics* and Community Medicine**, Faculty of Medicine, Ain Shams University).*

## ABSTRACT

*Serum thiamine was studied in 51 malnourished infants and children and in the sera of 17 apparently healthy infants and children serving as a control group for a possible role of thiamine deficiency in nutritional edemagenesis.*

*Patients were categoirzed according to Wellcome's classification into kwashiorkor, marasmus and marasmic kwashiorkor groups. The mean serum thiamine levels of patient groups were significantly lower than that of the control group with lower values in kwashiorkor gropus than in the marasmic group. The mean serum pyruvic acid levels, a substrate for thiamine pyrophosphate coenzyme, were significantly higher in the patient groups than in the control group. There was a significant positive correaltion between serum thiamine and albumin levels among the malnourished gropus. We concluded that serum thiamine deficiency and consequently the accumulation of pruvic acid besides hypoalbuminemia may play a role in the pathogenesis of edema in protein energy malnutrition.*

## INTRODUCTION

Edema usually develops early in protein energy malnutrition. Some researches suggested that hypoalbuminemia is a major cause of edema in kwashiorkor (1), while others believe that hypoalbuminhemia plays an insignificant role (2). Kidney malfunction due to potassium deficiency (3) and increased mineralocorticoids, renin and antidiuretic hormone activities were also suggested factors responsible for edemagenesis (4).

Malnutrition in rats fed different diets containing variable amounts of proteins led to functional thiamine deficiency (5), oxidative decarboxylation of of ketoacids and transketolation with accumulation of the substrates of the reactions e.g. pyruvate and the ketocarboxylate derivatives of the branched chain amino acids (6).

This work aims at studying the role played by thiamine in the pathogenesis of edema as a contributing factor to other etiological agents in cases of protein energy malnutrition.

## SUBJECTS & METHODS

The study was conducted on 68 subjects (36 males & 32 females) attending the nutrition out-patient clinic and the inpatient ward of the Children Hospital of Ain Shams University. Their age ranged from 3 to 42 months with a median age of 13 months. Detailed history was taken, thorough physical examination, and anthropometric measurements were performed.

Patients were classified according to Wellcome's classification of protein energy malnutrition into four groups:

**Group I :** Comprised 17 kwashiorkor pateints (kwo); 12 males and 5 females.

**Group II :** comprised 17 marasmus patients; 7 males and 10 females.

**Group III :** Comprised 17 marasmic kwashiorkor patients (marasmic kwo); 6 males and 11 females.

**Group IV :** comprised 17 healthy infants and children (11 males and 6 females) of a similar socioeconomic status of the patient groups serving as a control group.

The following biochemical analyses were performed:

1- Serum albumin using drupt technique (1974) (8).

2- Estimation of total serum proteins as determined by Peters, 1968 (9).

3- Estimation of serum thiamine using thiochrome method (10).

4- Estimation of serum pyruvic was performed by Friedman & Haugan, 1943 (11).

All clinical and laboratory data were analyzed using t-test and correlation coefficient (R) test (12). Significant level was considered when $P < 0.05$.

## RESULTS

The age of the studied patient groups ranged from 3 to 42 months. The mean age of the four studied groups was 13.7 ± 8.8, 9.8 ± 6.3, 13.5 ± 1 and 16.8 ± 10.3 months for groups I, II, III & IV respectively.

Their mean weights were 6.3 _ 1.7, 4.2 ± 1.1, 5.2 ± 1.5 and 10 ± 2.4 kg respectively. **Table (1)** shows that the mean weight for age values of kwo, marasmus and marasmic kwo groups are significantly lower than that of the kwo group ($p < 0.001$). The mean weight for age values for marasmic and marasmic kwo groups are significantly lower than that of the kwo group ($p < 0.001$).

The mean length for age values of kwo, marasmic and marasmic kwo groups are significantly lower than that of the control group ($p < 0.001$). The mean length for age values of the marasmic kwo group is significantly lower than that of the kwo group ($p < 0.001$). The mean weight for length values of the kwo,

marasmic and marasmic kwo groups are significantly lower than that of the control group ($p < 0.001$) while there is no statistically significant difference among the kwo, marasmic and marasmic kwo groups.

**Table (2)** shows the mean serum thiamine level (mg/dl) and the mean serum pyruvic acid level (mg/dl).

The mean serum thiamine levels of the kwo, marasmus and marasmic kwo groups ($1.1 \pm 0.3$, 0.4 and $1.3 \pm 0.3$ mg/dl respectively) are significantly lower than that of the control group ($2 \pm 0.5$ mg/dl). The mean serum thiamine level of the kwo group is significantly lower than that of the marasmic group, and the mean serum thiamine level of the marasmic group is significantly higher than that of the marasmic kwo group ($p < 0.001$).

The mean serum pyruvic levels of the 3 patients groups are significantly higher than that of the control group.

the mean serum levels of the marasmic and the marasmic kwo gropus are significantly lower than that of the kwo group ($p < 0.05$). There is a negative correlation between the mean serum thiamine and pyruvic acid levels, however statistically insignificant ($p > 0.05$). There is a positvie correlation between the mean serum thiamine and albumin levels which is statistically significant ($p < 0.001$) (Figures 1 & 2). There is no correlation between thiamine and weight for age or weight for length.

## *DISCUSSION*

The causal relationship between edema of malnutrition and hypoalbuminemia is proved in the present study as albumin level was low in the sera of the malnurourished groups. This notion is as well more emphasized by the finding that serum albumin was significantly lower in kwo and marasmic kwo groups than in the marasmic group. This result agrees with that obtained in 1984 by Laditan (13) who found a significant negative correlation between edema and serum albumin.

Since serum albumin was low in both edematous (kwo & marasmic kwo) and non edematous malnourished group (marasmic) and since serum albumin level was normal in 3 patients of our studied kwo group despite the presence of edema, thus hypoalbuminemia per se could not be the sole factor for the development of edema in malnourished infants. This finding is consistent with Landman and Jackson (1980) who found that kwo is not always assocaited with protein deficient diet (14). In addition Golden in 1982 stated that the rate of dedma resolution is strongly correlated with dietary energy intake rather than protein intake (15). Thus other factors besides hypoalbuminemia have contributed to the pathogenesis, sustenance and regresdsion of nutritional edema (13).

The relationship between edema in wet beriberi and thiamine deficiency is a fact stated by Vichai et al., in 1970 (16). The important biochemical features of

**Table (1) : Mean and SD of Weight for age (%) and Weight for length in all groups.**

| | Control (No = 17) | Kwo (No = 17) | Marasmus (No = 17) | Marasmic Kwo (No = 17) |
|---|---|---|---|---|
| *Mean weight for age %* | 90.9 ± 8.1 | 63.6 ± 5.8 | 51.1 ± 6.8 | 53.3 ± 7.6 |
| *Mean length for age %* | 95.9 ± 5.4 | 89.7 ± 5.5 | 84.3 ± 6.8 | 82.7 ± 6.2 |
| *Mean weigh for length* | 92.9 ± 5.7 | 63.3 ± 16.1 | 68 ± 9.3 | 70.3 ± 10.8 |

**Table (2) : Mean and SD of serum albumin, serum thiamine and serum pyruvate in all groups.**

| | Control (No = 17) | Kwo (No = 17) | Marasmus (No = 17) | Marasmic Kwo (No = 17) |
|---|---|---|---|---|
| Mean serum albumin (gm %) | 3.5 ± 0.5 | 2 ± 0.5 | 2.6 ± 0.7 | 2.2 ± 0.5 |
| Mean serum thiamine (mg %) | 2 ± 0.5 | 1.1 ± 0.3 | 1.5 ± 0.4 | 1.3 ± 0.3 |
| Mean serum pyruvate (mg %) | 1.31 ± 0.3 | 1.9 ± 0.2 | 1.7 ± 0.2 | 1.6 ± 0.3 |

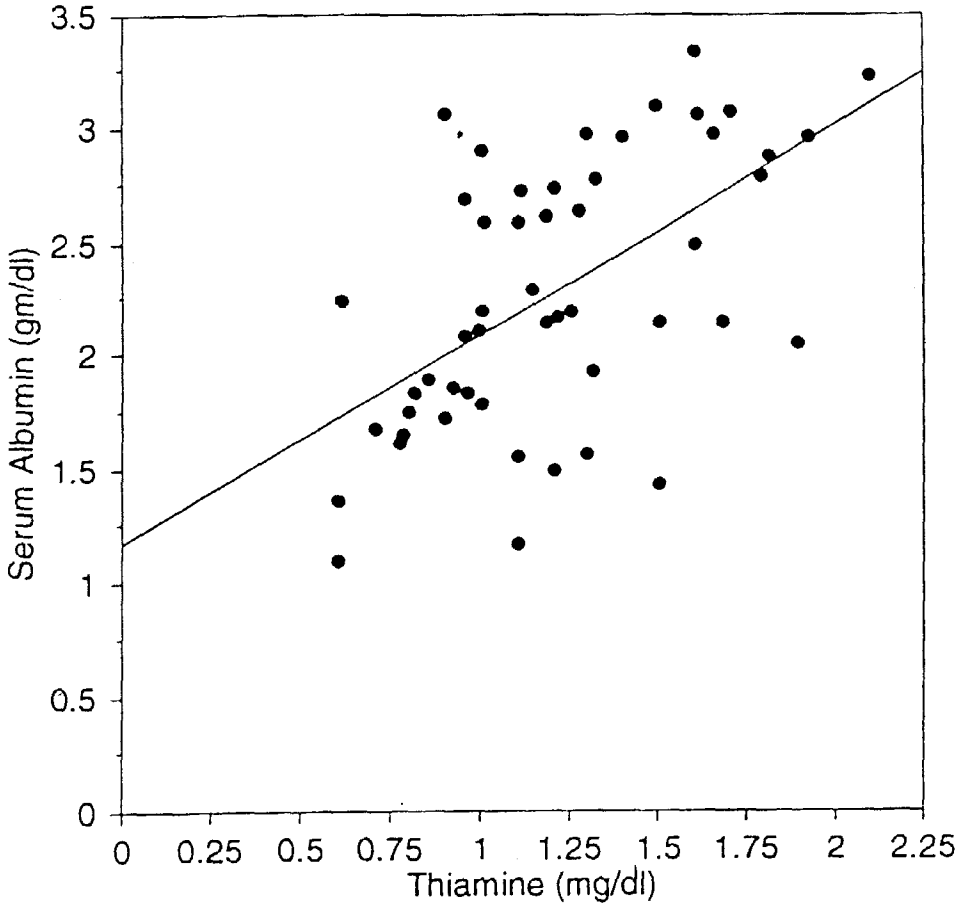


**Fig. (1) : Correlation between thiamine and serum albumin.**

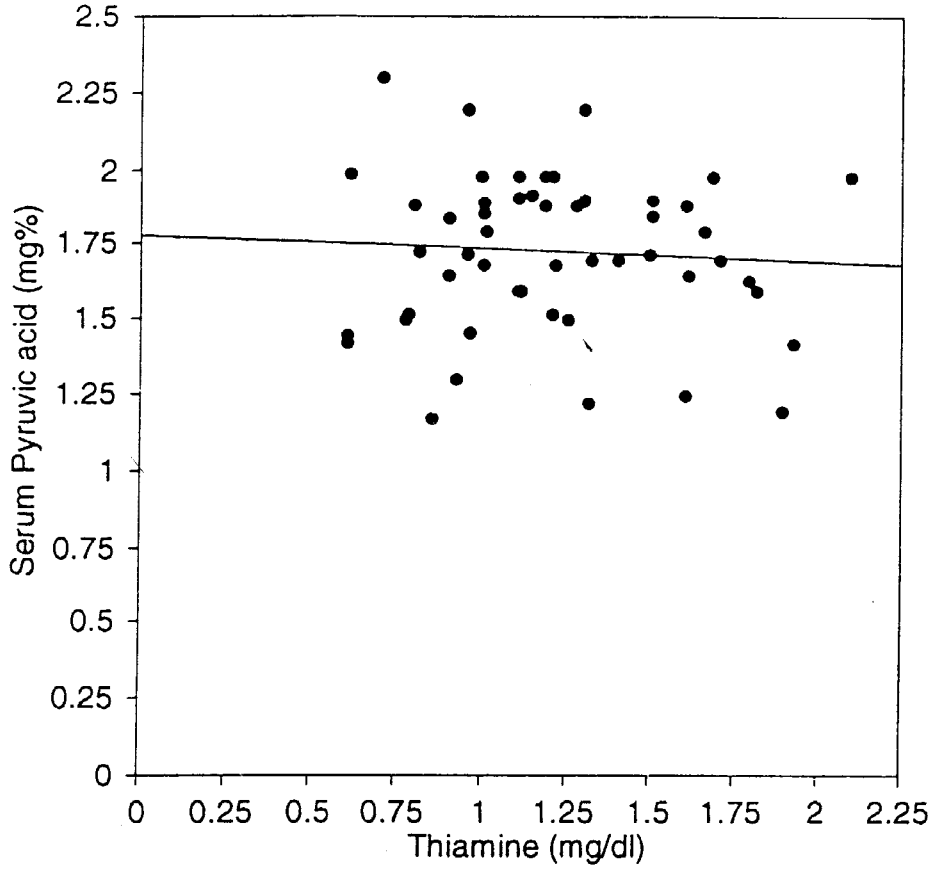


**Fig. (2) : Correlation between thiamine and serum pyruvic acid.**

thiamine deficiency include increased concentrations of pyruvic and lactic acid in blood (17). This fact was evident in our study, however Suberlich in 1967 (18) found that fasting pyruvate level was normal in thiamine deficiency and only rises following a glucose load.

Despite their biochemical thiamine deficiency, our studied subjects did not show classical features of beriberi. Although it is possible that the mental dullness and apathy seen in some of the edematous malnourished subjects were aggravated by thiamine deficiency.

The significant positive correlation between serum albumin and thiamine could prove that deficiency of both albumin and thiamine contribute to the development of edema in the studied patients, however the exact relationship awaits further investigations.

## *REFERNCES*

1- *Coward WA and Fiorotto M: The pathogenesis of edema in Kwashiorkor, the role of plasma proteins. Proc Nutr Soc 38:51, 1971.*

2- *Golden MHN: Skin breakdwon in kwashiorkor responds to zinc. Lancet 1:1256, 1980.*

3- *Mann MD, Bowie, MD and Hanson HDL: Potassium in protein energy malnutrition. South Afr Med J 49:2026, 1972.*

4- *Srikantia SG and Mohanram M: Antidiuretic hormone values in plasma and urine of malnourished children. J Clin Endocrinol 31:312, 1970.*

5- *Ahmed SM, Kimura M and Itokwa Y: Determination of thiamine status during protein caloric malnutrition in rats. J Am Coll Nutr 7 (3): 215, 1988.*

6- *Martin DW: Water soluble vitamins, in: Harper's Textbook of Biochemistry, P 97:113, 1981*

7- *Wellcome trust working party: Classification of infantile malnutrition. Lancet 11:302, 1970.*

8- *Drupt F: Determination of albumin level. Pharm Biol 9:777, 1974.*

9- *Peters T: Chem 14:1147, 1968.*

10- *Kircdh ER and Bergein O: JBC 43:575, 1942.*

11- *Freidman TE and Haugan GE: JBC 44:23, 1943.*

12- *Understanind medical statistics, London, William Heinmann Medical Book Limited, 1982.*

13- *Laditan AA: Nutritional edema and serum albumin concentration. East Afr Med J 61 (11): 812, 1984.*

14- *Landman J and Jackson AA: The role of protein deficiency in the etiology of kwashiorkor. West Afr Med J 29:229, 1980.*

15- *Golden MHN: Protein deficiency, energy deficiency and the edema of malnutrtion. Lancet 1: 1261, 1982.*

16- *Vichai T, Vimokesant SL, Dhanamitta S and Valyasevi A: Clinical and biochemical study of beriberi. Am J Clin Nutr 23 (8): 1017, 1970.*

17- *Cantarow A and Schepartz B: Vitamins, W.B. Saunders Co., Philadelphia, 4th ed., Chap 7, P 174:1967.*

## دراسة مستوى فيتامين ب ١ فى الأطفال المصابين بسوء التغذية

حامد الخياط . سناء عبد الرحمن محمود . أحمد شريف حافظ* . أسامة نور الدين كريم
أقسام طب الأطفال . وطب المجتمع* - كلية الطب - جامعة عين شمس

تم دراسة فيتامين ب١ فى ٥١ طفل من المصابين بسوء التغذية بالإضافة إلى ١٧ طفل من الأصحاء تم دراستهم كمجموعة ضابطة ، وقد أجريت هذه الدراسة لاستبيان الدور الذى قد يلعبه فيتامين ب١ فى حدوث التورم فى حالات سوء التغذية .

تم تقسيم مجموعة المرضى تبعا لتصنيف « ويلكوم » إلى ثلاث مجموعات هى مجموعة كواشيور كور ومجموعة الهزال ومجموعة الهزال المصاحب بكواشيور كور .

أثبتت النتائج أن متوط مستوى فيتامين ب١ فى مجموعة المرضى أقل منه فى المجموعة الضابطة وذو دلالة إحصائية وقد كان هذا النقص فى مجموعة الكواشيور كور أكثر وضوحا منه فى مجموعة الهزال . كما أظهرت الدراسة إرتفاعا فى نسبة حمض البيروفيك فى مجموعة المرضى أكثر منه فى المجموعة الضابطة وتبين من الدراسة أنه توجد علاقة طردية ذات دلالة إحصائية بين مستوى فيتامين ب١ والزلال بالدم فى مجموعة الأطفال المصابين بسوء التغذية .

وعلى هذا يخلص هذا البحث إلى أن نقص فيتامين ب١ والذى ينتج عنه ارتفاع فى مستوى حمض البيروفيك فى الدم بالإضافة إلى نقص الزلال يعد من الأسباب التى تلعب دورا هاما فى حدوث التورم فى حالات سوء التغذية عند الأطفال .