VITAMIN B₁ DEFICIENCY IN INFANCY

A CRITICAL REVIEW

BY

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Whether vitamin B₁ is deficient or not in normal diets in this country is open to doubt. It is probable that at times when added amounts of B₁ are required, as for instance in childhood, adolescence and during pregnancy and lactation, many persons would benefit from additional B₁ and some ill health might be preventable by addition of this vitamin to the diet. It has been calculated by Cowgill that B₁ requirements are proportional to metabolism. The amounts required daily by an adult weighing ten stone have been variously stated. They are thought to be in the region of four hundred and fifty to one thousand five hundred international units rather than two hundred as was previously suggested. The pregnant and lactating woman seem to require something in the region of one thousand international units daily for optimal well-being. The amount required by an infant has not been ascertained, but a child appears to require relatively more than an adult for each pound of body weight; four hundred international units has been suggested for a child of four and six hundred and eighty for a child of eleven years. Increase of weight would seem to need increase of vitamin B₁. A diet of high caloric value requires this vitamin for its utilization. Vogt-Müller¹ states that the more carbohydrates a diet contains the greater the requirements of B₁ and this agrees with experimental work on animals.

Recent literature

A study of the recent American literature on vitamin B₁ brings out clearly how large a measure of agreement there is among various investigators concerning the prevalence of minor degrees of B₁ deficiency especially in children. This view is now supported in England by Peters² and Pritchard³. Addition of substances rich in B₁ is advocated in the section on normal diets in a recent text book of paediatrics⁴. In the Medical Research Council's Report on Vitamins it is suggested that as a safeguard against possible deficiency a rich source of B₁ should be given to all children. With regard to infants there have been constant references in the American literature⁵ since 1929 to the fact that infants receive less than the optimal amount of vitamin B₁. Sure, Macy, Lemester and Bloxom^{6, 7} have carried out experiments on infants and young children and show that those receiving a supplement of vitamin B₁ to their normal good quality diet thrive

better than the control subjects. Sure goes so far as to say that 'Perhaps millions of lives may be saved by employing vitamin B₁ as routine to the extent that orange juice and cod-liver oil are used'⁸. Bray found marked benefit from giving added B₁ to infants in the Pacific Isles.

Amounts required

Adequate amounts of vitamins are recognized as being essential to health and the B group is thought to be the one most likely to be supplied in deficient amount⁹. Vitamins A, D, and C are prescribed for most bottle-fed babies but of B₁ the infant receives only the small amount present in the milk formula after the cow's milk, which is not a rich source of this vitamin when raw, has been dried or evaporated: and a further fraction from the orange juice given for its vitamin C content. The optimal amount of vitamin B₁ has not been ascertained for the infant. A child of four is thought to require four hundred international units daily. Since the metabolism of the infant is greater it is possible that it requires relatively more of this vitamin. An infant receiving only a milk mixture is likely to require about two hundred international units a day for optimal well-being. Increased carbohydrate in the diet necessitates a greater intake of vitamin B₁. The diet of an infant less than six months old contains a greater proportion of carbohydrate than does that of a child aged one year. This figure of two hundred international units is twice that suggested by Pritchard for children under one year. He does not state, however, by what means he arrived at his estimate of one hundred international units daily¹⁰.

The amounts required at different ages and under various conditions fluctuate widely. Thus it has been estimated that pregnant and lactating animals (rats) need five times as much vitamin B₁ as they require when not in this condition. This is found also to apply to the human¹¹; pregnant and nursing women have a greatly increased need of B₁.

Symptoms of deficiency

It has recently been suggested that B₁ deficiency may be a major factor in the causation of the symptoms of pregnancy toxæmia. The amount calculated as adequate for both mother and child when the latter is breast fed is in the neighbourhood of one thousand five hundred units¹². As extremely few nursing mothers receive even half this amount, it is not surprising to find that breast milk contains considerably less vitamin B₁ than does cow's milk and the assumption that breast-fed infants are at least as short of this element as bottle-fed babies has therefore much to support it.

Although symptoms of gross deficiency are not seen in this country, a large number of symptoms have been attributed to minor degrees of vitamin B₁ shortage. This varied symptomatology leads to widely differing clinical pictures from the well-defined syndrome such as pink disease and

the indefinite but frequently met with condition called debility or 'failure to gain weight.' The description given by Hoobler, of Detroit, of a case of infantile beri-beri has suggestive points of similarity with the infant who is just 'not getting on' as will be seen from the following tables:—

INFANTILE BERI-BERI.	THE INFANT FAILING TO THRIVE.
Vomiting and constipation.	Vomiting and constipation.
Fretfulness.	Fretfulness.
Restlessness.	Restlessness.
Waxy look.	Pale.
Whining cry.	Cries pitifully.
Colic, 'blue turns.'	Colic.
Convulsions.	

Symptoms of minor degrees of deficiency in animals vary considerably according to the kind used. Thus in rats anorexia, a staring coat, failure to gain weight and finally death from inanition are described, even though at post mortem the stomach may be full of curds. In monkeys diarrhoea is a frequent early symptom and dehydration may become marked¹³. In this respect some work done on dogs is of interest, as it is found that in animals suffering from mild avitaminosis (B₁) the symptoms are increased by giving water freely without food¹⁴. If it is true that many infants at the present time are receiving sub-optimal amounts, these results may have some bearing on the symptoms and treatment of gastro-enteritis in infancy. Rats reared on a diet deficient in B₁ are said to be inferior in 'maze learning' to those fed on a diet containing in addition adequate amounts of this vitamin¹⁵.

The actions of the B₁ fraction of the vitamin B complex have not been fully determined but the following have been attributed to this substance by several independent workers.

1. Muscle tonus especially of the intestinal tract is increased; vitamin B₁ is thought to correct anorexia and constipation through this action, as 'hunger contractions' of the stomach are absent in animals on a B₁ deficient diet¹⁶.

2. Carbohydrate metabolism is dependent on the presence of B₁ for its completion of the oxidation process. The vitamin is thought to act as a catalyst. In deficiency states the lactic acid produced by muscular activity accumulates there and is only very slowly oxidized and removed, thus leading to fatigue, atony and possibly to the accumulation of toxic end-products of metabolism¹⁷. The bradycardia of rats on a B₁ deficient diet used as a method of standardization is thought to be due to this accumulation of lactic acid in the heart muscle.

3. Vitamin B₁ has some essential part in the well-being of the lymphoid tissues. In animals fed on diets deficient in B₁ the lymphoid tissue throughout the body atrophies leading (a) in the bowel to impaired assimilation of food, (b) to generalized lymphopenia¹⁸.

From a consideration of the above actions it is reasonable to suppose that the result of adding vitamin B₁ to the diet of infants and children would be an increase in appetite, and in assimilation and utilization of food, thus producing an increase in weight and height. Many large scale experiments have been carried out in America and show quite conclusively that the

expected result is indeed a fact¹⁹. Infants and children up to two years of age, gain seventy per cent. more if supplied with additional vitamin B₁. Since in each case the diet appeared to be of good quantity and quality before the addition of vitamin B₁ it is reasonable to suppose that in this country also many children and infants are receiving less than optimal amounts of this substance.

It seems desirable to put this suggestion to the test by adding vitamin B₁ to the food of a group of nurslings and comparing their progress with a control group. These observations are now being made.

Summary

From a survey of the literature it would appear that:—

1. The amount of vitamin B₁ required by a nursling is about two hundred units a day.
2. Many nursing mothers do not have sufficient vitamin B₁ in their food to pass on an adequate supply to their babies.
3. By analogy from animal experiments some common infantile ailments may arise from deficiency of vitamin B₁.
4. There is sufficient evidence to make feeding experiments on young infants desirable.

REFERENCES

1. Vogt-Müller, P., *Lancet*, London, 1935, i, 275.
2. Peters, R. A., *Proc. Roy. Soc. Med.*, London, 1934, XXVII, 481.
3. Pritchard, E., *Practitioner*, London, 1935, CXXXIV, 433; *Mother and Child*, London, 1936, V, 469.
4. Parsons, L. G., & Barling, S., *Diseases of Infancy and Childhood*, London, 1933, I, 151.
5. Harris, J., & Leong, P. C., *Lancet*, London, 1936, i, 893.
6. Gaynor, M. F., & Dennett, R. H., *J. Pediat.*, St. Louis, 1934, IV, 507.
7. Bloxom, A. P., *Am. J. Dis. Child.*, Chicago, 1929, XXXVII, 1165.
8. Sure, B., *Vitamins*, London, 1933, 65.
9. Friend, G. E., *Brit. Med. J.*, London, 1936, ii, 276.
10. Pritchard, E., *Mother and Child.*, London, 1936, V, 276.
11. Aykroyd, W. R., *Vitamins*, London, 1936, 73.
12. Peters, R. A., *Proc. Roy. Soc. Med.*, London, 1934, XXVII, 481.
13. Browning, E., *Vitamins*, London, 1931, 260.
14. Cowgill, G. R., *J. Am. Med. Ass.*, Chicago, 1932, XCVIII, 2285.
15. Kruse, H. D., & McCollum, E. V., *J. Am. Med. Ass.*, Chicago, 1932, XCVIII, 2205.
16. Sure, B., *Vitamins*, London, 1933, 40.
17. Peters, R. A., *Lancet*, London, 1936, i, 1161.
18. Browning, E., *Vitamins*, London, 1931, 16.
19. Bloxom, A. P., *Am. J. Dis. Child.*, Chicago, 1929, XXXVII, 1167.