ISSN: 2684-1320
Journal of Pain Management & Medicine

OPEN ACCESS Freely available online

Short Communication

Is Thiamine Consumption in Body Affected by Calorie Intake?

Daisuke Harada[1*], Mitsuo Nakayama[2]

[1]Research and Development Center, Otsuka Pharmaceutical Factory, Inc., 115 Kuguhara, Tateiwa, Muya-cho, Naruto, Tokushima 772-8601, Japan; [2]International Division, Otsuka Pharmaceutical Factory, Inc., 115 Kuguhara, Tateiwa, Muya-cho, Naruto, Tokushima 772-8601, Japan

DESCRIPTION

Thiamine (vitamin B1) is a vitamin that is essential in energy-producing metabolic pathways, such as the glycolysis-tricarboxylic acid cycle. Thiamine deficiencies can lead to serious outcomes, including Wernicke's encephalopathy and beriberi with lactic acidosis. Since the publication of the WHO Report in 1965 [1], the practice has been to express thiamine requirements as amounts per energy intake. For example, the reference nutrient intake in the UK is 0.4 mg/1000 kcal [2]. The rationale studies for that practice show that more thiamine is needed to keep urinary thiamin excretion when humans consume more calories. However, that studies were conducted under the caloric range of moderately to excess [3], or extremely low range [4,5]. As far as we know, no studies have conducted to reveal the relationship between caloric intake and thiamine consumption in more usual caloric range.

Thus, we performed Parenteral Nutrition (PN) with different caloric content to rats and determined the amount of thiamine in the body [6]. Vitamin-free infusions with differing amounts of glucose were administered to normal or thiamine-deficient rats for 5 days. The total energy dosage was set at three levels (98, 140, and 196 kcal/kg). This corresponds to 14, 20 and 28 kcal/kg in human. As a result, urinary thiamine excretions on Day 5 decreased with increasing caloric dosage in the infusions. In normal rats, the amount of thiamine in the blood and organs (liver, brain, skeletal muscle) decreased during infusion; however, no significant differences were found among the infusion groups (Figure 1: Upper figures). In thiamine-deficient rats, on the other hand, the amount of thiamine in the liver and skeletal muscles did not differ significantly among infusion groups; however, the amount of thiamine in the brain and blood decreased with increasing glucose dosage (Figure 1: Lower figures).

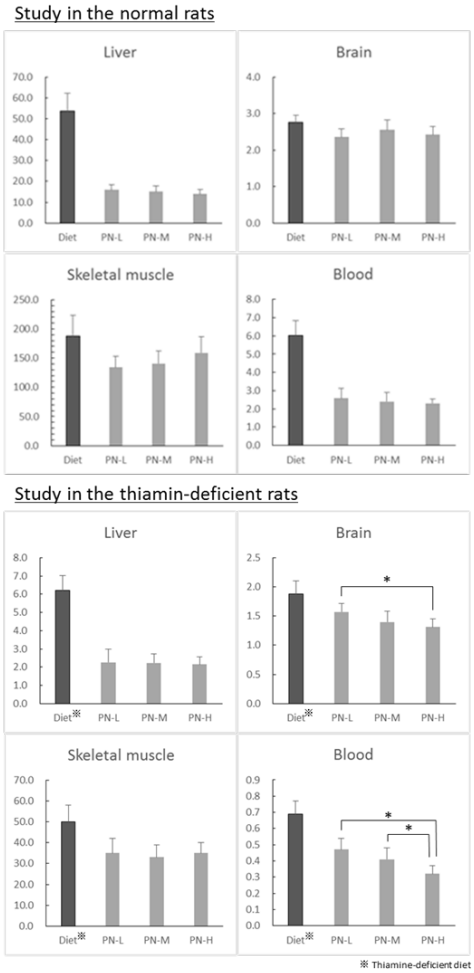

Figure 1: Amounts of thiamine on PN-Day 5 are shown as mean ± SD. The total energy dosage of PN-L, PN-M, and PN-H was 98, 140 and 196 kcal/kg respectively. Values in the diet group represent thiamine amounts at the start of PN in each experiment. **Note:** *P<0.05 among the three infusion groups (Tukey's test).

Correspondence to: Daisuke Harada, Research and Development Center, Otsuka Pharmaceutical Factory, Inc., 115 Kuguhara, Tateiwa, Muya-cho, Naruto, Tokushima 772-8601, Japan, E-mail: Harada.Daisuke@otsuka.jp.

Received: 13-Jan-2022, Manuscript No. JPMME-22-15448; **Editor assigned:** 18-Jan-2022, PreQC No JPMME-22-15448 (PQ); **Reviewed:** 01-Feb-2022, QC No JPMME-22-15448; **Revised:** 08-Feb-2022, Manuscript No. JPMME-22-15448 (R); **Published:** 15-Feb-2022, DOI: 10.35248/2684-1320.22.8.165.

Citation: Harada D, Nakayama N (2022) Is Thiamine Consumption in Body Affected by Calorie Intake? J Pain Manage Med. 8:165.

The results of this study supports the traditional practice concerning to thiamine requirement, but the relationship between caloric intake and thiamine consumption could be not simple but be the tissue and nutritional state-specific manner. Although we could not elucidate the mechanism why such specificity was observed, we speculate as follows. McCourt et al. showed that during the catalytic reaction of acetohydroxy acid synthase with Thiamine Diphosphate (ThDP) as a cofactor, the ThDP became instable, decomposed, and disappeared, and that pyruvate decarboxylase caused a similar phenomenon [7]. McCourt et al. stated that although these enzymes are not found in mammals, a similar phenomenon occurs during the catalytic reaction of pyruvate dehydrogenase and oxoglutarate dehydrogenase involved in human glycometabolism, which represents a biochemical background for the increased thiamine requirements with carbohydrate ingestion. In addition, intracellular thiamine is known to be mostly present as ThDP bound to apoenzymes in the brain [8] and erythrocyte [9] unlike other tissues and little free thiamine may be present in cells in the thiamine-deficient state. Therefore, the relationship between the metabolic load on apoenzymes with increased glucose dosage and the resulting thiamine decomposition may manifest clearly in the brain and blood.

Thiamine is the most important vitamin used in PN that contains glucose as the major source of energy. The results of our study could lead to two recommendations concerning thiamine replenishment during nutritional management. One recommendation is that, when performing high-energy management like total parenteral nutrition (TPN) for patients with suspected thiamine deficiency, thiamine replenishment and blood concentration monitoring must be planned more carefully by taking the fact that brain thiamine may be lost quickly under high-glucose loaded conditions into account. The other recommendation is that thiamine content in the body as a whole is for the most part present in the liver and skeletal muscles, for which a certain amount is lost even in a short period of time irrespective of the dosage of glucose; therefore, it is necessary to constantly replenish the amount of thiamine to maintain the required sufficient amount even in hypocaloric nutritional management like peripheral parenteral nutrition (PPN).

In Japan, the attending physician is obliged to administer thiamine with TPN as mentioned in a Dear Doctor Letter (Urgent Safety Information No. 97-2) from the Ministry of Health and Welfare (currently the Ministry of Health, Labour and Welfare). On the other hand, with regard to PPN, although no notifications like those for TPN have been issued by the administrative authorities, the guideline from the Japanese Society for Parenteral and Enteral Nutrition emphasizes the necessity of administration of thiamine and the physician can use the thiamine (or water-soluble vitamins) pre-mixed PPN formulations.

COMPETING INTERESTS

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. The authors declare no conflict of interest.

REFERENCES

1. World Health Organization and Food and Agriculture Organization of the United Nations. Requirements of vitamin A, thiamine, riboflavin and niacin: Report of a joint FAO/WHO expert group. Geneva: World Health Organization; 1967.
2. Dietary reference values for food energy and nutrients for the United Kingdom: Report of the Panel on Dietary Reference Values of the Committee on Medical Aspects of Food Policy. Rep Health Soc Subj (Lond). 1991;41:1-210.
3. Sauberlich HE, Herman YF, Stevens CO, Herman RH. Thiamin requirement of the adult human. Am J Clin Nutr. 1979;32(11):2237-2248.
4. Drenick EJ, Joven CB, Swendseid ME. Occurrence of acute Wernicke's encephalopathy during prolonged starvation for the treatment of obesity. N Engl J Med. 1966;274(17):937-939.
5. Consolazio CF, Johnson HL, Krzywicki HJ, Daws TA, Barnhart RA. Thiamin, riboflavin, and pyridoxine excretion during acute starvation and calorie restriction. Am J Clin Nutr. 1971;24(9):1060-1067.
6. Harada D, Nakayama M. Influence of glucose dosage in parenteral nutrition on body thiamine levels in rats. Int J Med Sci. 2019;16(1):1-7.
7. McCourt JA, Nixon PF, Duggleby RG. Thiamin nutrition and catalysis-induced instability of thiamin diphosphate. Br J Nutr. 2006;96(4):636-638.
8. Bettendorff L. Thiamine. In: Erdman JW Jr, Macdonald IA, Zeisel SH (10th ed) Present knowledge in nutrition. ILSI Press, Washington, United States, 2012;pp:261-279.
9. Mancinelli R, Ceccanti M, Guiducci MS, Sasso GF, Sebastiani G, Attilia ML et al. Simultaneous liquid chromatographic assessment of thiamine, thiamine monophosphate and thiamine diphosphate in human erythrocytes: a study on alcoholics. J Chromatgr B. 2003;789(2):355-363.