International Proceedings of Chemical, Biological and Environmental Engineering, Vol. 86 (2015)
DOI: 10.7763/IPCBEE. 2015. V86. 9

Effect of Thiamine on Blood Glucose after Maximal Aerobic Exercise in Male Student

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Abstract. High-dose thiamin supplementation may be helpful in preventing fatigue or accelerating recovery from exercise-induced fatigue. In this research 36 non-athlete university students male were selected with average 22.8 ± 2.4 and 42.36 ± 1.83 for age and Vo2max respectively (three group, namely experimental group A, experimental group B and control group). They have to exercise on treadmill before and after the thiamin consumption. Blood glucose changes in subjects measured by (GOD-PAP method) after the exercise (pre-test). The subject's consumed thiamin during 10 days (EGA 30 mg /day, EGB 300 mg/day and CG just placebo). Blood glucose changes measured in three groups like as pre-test, during and the end of the exercise on treadmill after 10 days (post-test). Results indicate that there is no change in blood glucose in EGA (30 mg thiamin/day) and CG (placebo) but showed that blood glucose reduced in EGB (300 mg thiamin/day)($P>0.05$). In fact, degree of exhaustion increased in EGB that they consumed 300 mg thiamin per day, and they could to do exercise for a long time. Like the other B vitamins, thiamin is used to treat fatigue.

Keyword: blood glucose, non-athlete, maximal aerobic exercise, thiamine.

1. Introduction

[1], [2] Vitamin adjusts the energy metabolism in physical activities and is widely used as a dietary supplement to enhance exercise performance. [3] Among vitamins, thiamine (vitamin B1) is a coenzyme of the pyruvate dehydrogenase (PDH) that stimulates the conversion from the pyruvate to the acetyl CoA and Vitamin B1 (Thiamine pyrophosphate)(TPP) is an essential vitamin for glucose metabolism (Marcus et al., 2001). [4] It also plays a role as a coenzyme of the branched-chain decarboxylase that reacts to the physiochemical reaction of the oxoglutarate dehydrogenase and the branched-chain amino acids in the formation of succinyl CoA in the TCA cycle. [5] On the other hand, the regular practice of exercise increases oxygen availability to the skeletal muscle due to myoglobin formation, increased muscle capillarization, increase in the size and number of mitochondria, increase in aerobic enzyme levels and activity, etc. These adaptations increase an individual's physical capacity increases, which are often detected by decreases in muscle and blood lactate concentrations. [6] A daily recommended dose of thiamine is 0.5mg/1000Kcal for a healthy adult. Therefore, thiamine may be sufficiently taken; otherwise, the energy intake would be limited or refined food would be taken too much in daily life. [7] Also, if a person takes vitamin B (B1, B2, B6), vitamin C and other vitamins less than one third of the recommended daily requirements, it is observed that the maximum oxygen uptake and the lactate threshold significantly decrease within 4 weeks, causing problems in the exercise performance through vitamin deficiency. [8] A study also reported that the maximum oxygen uptake decreases by about 11.6% and the lactate accumulation increases by 7% as a result of deficiencies in thiamine, riboflavin and vitamin B6 for 24 healthy male adults for more than 11 weeks. However, such result is from the study involving the vitamin B complex, and for this reason it is hard to say

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that the effect is from thiamine alone, which calls for a study involving single intake of thiamine. Up to now, [9], [10] it is observed that the single supplementation of thiamine decreases fatigue in seniors and manual workers and prolongs the duration of swimming time until exhaustion while decreasing the lactate threshold and lactate concentration. [11], [12] There is evidence that the administration of thiamine (100 mg/day for 3 days) reduces serum lactate and improves resistance to fatigue. [13] The administration of thiamine has also been shown to improve ergogenic capacity, [14] although other studies concluded that thiamine is incapable of improving physical activity or the levels of serum lactate. [15] Likewise, lactic acidosis is present in situations where a deficiency of thiamine and pyruvate dehydrogenase exists. [11] Thiamin is often used to prevent fatigue, not only muscle fatigue but also feelings of fatigue. [14] The rationale for the use of thiamin as an anti-fatigue reagent has been that it can inhibit production of lactate because of increased pyruvate dehydrogenase, activity by thiamin, and the decreased production of lactate seen after ingestion of thiamin in a thiamin deficient state has been seen as evidence of this. Most of the body's cells use glucose as energy sources when Oxygen help glucose to change into energy, the aerobic energy production is called. This process is not possible unless there would be enough Vitamins. Vitamin B1 is a part of enzyme system (pyruvate dehydrogenate) which helps to moving glucose with oxygen. When B1 act as a co-factor to produce energy, it appears as Thiamin diphosphate (TDP). For analyzing carbohydrates the body needs this vitamin. The released energy from this metabolism is used for respiratory and movement. [16] Thiamine is essential for the final metabolism of carbohydrates and absorption the glucides and digestion depends on it. [13] Although McNeill et al., showed the efficacy of thiamine administration as an ergogenic aid, [14] Webster showed no effect of thiamin on exercise performance, including blood lactate levels.

2. Materials and Methods

An important question in this research was that, could thiamine (vitamin B1) change the blood glucose after maximal aerobic exercise? First of all, selected 36 non-athlete students male from Islamic Azad University that they participants volunteer in this project and next step the subject divided in to 3 groups each group 12 persons; Experimental Group A (EGA) Experimental Group B (EGB) and Control Group (CG). The physical characteristics in the subjects are shown in Table 1.Then the students completed the questionnaire that estimated the rate of calorie and energy that used daily. Subjects having any physical or mental alteration, significant emotional anguish, psychiatric incapacity, arrhythmias, or electrolyte abnormality did not participate in the study. The influence of other factors such as physical state and type and length of exercise has been described and they were controlled in study. Also subjects were sedentary, but they controlled for the amount of physical activity that every one performed before trials, asking them to refrain from exercising for 48 hours before the trials. Then their blood glucose was measured (GOD-PAP method). The students ran on treadmill based on the Balke treadmill protocol for pre-test, but before run them doing warm up for 5 minutes which included some stretching and light movements. Then they started to run to exhaustion and they had their blood tested and the glucose changes were considered during after 5 minutes and immediately after activities covered the level of blood glucose was recorded. Two groups were asked to use B_1 EGA 30 mg, EGB 300 mg and CG only use placebo (control group were not aware of the ingredients of placebo). They were also asked to don't change their activities and calorie. In the end of the Thiamin consumption they had their blood glucose measured again and compare with the level of pre-test and post-test the blood glucose considered. Averages, standard deviations and variance were used to obtain descriptive statistics. Paired Student t-test and 95% confidence intervals were used for the inferential statistics. Differences were considered significant when $p<0.05$.

Table 1: Characteristics of subjects

Variables	Mean ± SD (n = 36)
Age (yr)	22.8 ± 2.4
Height (cm)	174.19 ± 4.67
Body Weight (kg)	76.34 ± 5.36
VO2max (mL/kg/min)	42.36 ± 1.83

3. Results

General information about the 36 subjects participating in the study is shown in Table 2 and Table 3. The blood glucose of the groups before test (before using supplement) there were no any changes in the blood glucose including before and after aerobic exercise which reveal that the groups were congenial.

Table 2: The level of blood glucose among groups before Thiamin consumption

Group	BG before activity (pre-test)	BG after activity (pre-test)
Experimental A	97.57 ±7.9	87.08 ±7.6
Experimental B	95.66 ±7.73	89.75 ±7.46
Control	97.83 ±4.56	91.91 ±5.33

Table 3: The level of blood glucose among groups after Thiamin consumption

Group	BG before activity (pre-test)	BG after activity (pre-test)
Experimental A	97.57 ±7.09	93.83 ±6.86
Experimental B	97.66 ±5.21	85.08 ±5.17
Control	97.58 ±3.62	92.91 ±4.1

After using Thiamin by the groups and considering blood sugar changes in aerobic exercise, the conclusion of variance and standard of deviation there were no changing in blood glucose before activity. But after activity there were some changes in the blood sugar.

4. Discussion / Conclusion

The primary goal of our investigation was to quantify, through the use of supplementary consumption vitamin B1 (thiamine) on blood glucose changes after maximal aerobic exercise. [8] It has been noted in the literature that active individuals with poor nutritional status for a B-vitamin may have decreased ability to perform exercise at high intensities. [11] Administration of thiamine (100 mg/day for 3 days) has proven to reduce serum lactate and improve resistance to fatigue. [14] On the other hand, one study suggests that thiamine supplementation does not influence physical activity or the levels of serum lactate. [16] In a more recent study suspected that based on the available literature thiamine pyrophosphate (TPP) might affect the concentration of serum lactate by improving oxidation of carbohydrates during aerobic metabolism.

[17] The thiamine is absorbed by the small intestine, observed in the skeletal muscles, liver, heart, kidneys and brain with a high concentration and a continuous supply is required with the limited storage in the tissues with half life of 10 to 20 days. However, it is not known whether supplemental administration of thiamin has effects on carbohydrate metabolism in the absence of thiamin deficiency. Mechanism of many of the mineral is unknown for even biochemistry expects and nutritionists have different opinion about the amount & time of the using supplementary foods. Some believe that on equilibrant diet covers all of the needs. But the fact is that these days' people have turned to fast food and less often care of the value of them. Two athletes in the same weight, size, major and food may need to different supplementary food. As in the chart were shown before and after test in control group and group (A) there was no difference and the only difference before and after test was in group B that the level of blood glucose is very lower than before test. [11] These achievements are same with the Suzuki et al., research achievement. [18] Actually it was stated that using 100 mg Thiamin every day increase the blood glucos by Knippel,M reported the reduction of blood glucose in the bike riders who used 900 mg Thiamin every day which are same with the present research. [3] These thiamine effects can be explained as thiamine is converted to thiamine pyrophosphate to exert its cellular action. [19] In a randomized double-blind placebo-controlled study by some researchers, a daily oral dose of 100 mg thiamin hydrochloride (for sixty or ninety days) was given to 556 young male (12 – 21 years). No adverse effects were reported. The thiamin status of the participants is unclear. [19] Based on Gokhale study, a level of 100 mg/day (equivalent to 1.7 mg/kg supplemental thiamin for a 60 kg adult) of supplemental thiamin would not be expected to result in adverse effects. No uncertainty factor has been applied since this guidance is based on human data with large numbers of subjects and no hazard has been

identified from other studies. This level is for guidance only and is applicable to the water-soluble forms of thiamin only. The important point is that using 300 mg during 10 days in non–athlete persons reduce the blood sugar after a tiring exercise. We can consider if from many different angles. First, do non-athlete people need using Thiamin every day or no? If there would be any needs. How much should be the amount? Due to the reduction of blood glucose in the participants, maybe it can be delicately mentioned that by reduction of blood sugar we can be hopeful that using Vitamins can be very useful especially among people who practice aerobic exercise. In fact Thiamine consumption and its relation to carbohydrates can be considered in long-term activities. So Thiamin controls the level of blood glucose and help liver save glycogen. In the whole we can say using Thiamin is essential for metabolism functions and using vitamin B1 300 mg every day during 10 days improved the quality and quantity of the body activities. [20] It is important to note, however, that estimation of nutrient intakes via food records can be difficult. It is important to underline the fact that none of the subjects reported secondary effects following the placebo and thiamine administration. We do not yet have an explanation for that phenomenon that the physical well-being ("without fatigue", "still physically strong", "can do more exercise") described by the subjects at the time of taking the treadmill test after having received the thiamine is noteworthy. Our data indicate that thiamine can lead to reduce fatigue in young people and longer they can continue to physical activity. Through further studies these results could be extended to include high-impact (elite) athletes and so invaluably contribute to the scientific control of athletic training and the improvement of physical capacity. There are different compensating mechanisms that increase the organic capacity to aerobically metabolize carbohydrates, thus reducing the quantity of lactate produced during physical activity. The endurance training with the thiamine supplementation or the complex treatment of glucose or fructose with different glycemic index may be provided as the basic data for the future studies which may verify the effect of biological activity and also future studies could be expanded to determine mechanism and that how much thiamine exactly can be affect on non-athlete or athlete male and male.

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