THE EFFECT OF MAGNESIUM SUPPLEMENTATION ON GLUCOSE AND INSULIN LEVELS OF TAE-KWAN-DO SPORTSMEN AND SEDENTARY SUBJECTS

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ABSTRACT

This study was performed to determine how the magnesium supplementation for a 4-week period affects the glucose and insulin levels at rest and at exhaustion in sportsmen.

This is a 4 week study performed on 30 healthy male subjects varying between 18-22 ages. Subjects were separated into 3 groups. 1st group; group supplemented with magnesium, 2nd group; Magnesium supplementations +exercise group, 3rd group; training group. Glucose and insulin parameters of the groups were measured 4 times; at rest and exhaustion in the beginning of the research and at rest and exhaustion after the end of 4 weeks application period.

Glucose levels in exhaustion measurements both before and after the supplementation significantly increased compared to resting levels ($p<0.05$). Significant difference was determined in the glucose values of 1st and 2nd groups supplemented with magnesium in comparison to their first measurements ($p<0.05$). Insulin values a decrease in all of the 3 groups occurred with exercise both before and after the supplementation ($p<0.05$).

Magnesium supplementation has an important effect on glucose levels whereas it has no effect on insulin levels.

Keywords: Exercise, magnesium supplementation, insulin, glucose.

INTRODUCTION

Many trace elements participate in many physiological and biochemical events in human body. They are especially active in lipid and protein metabolism. Therefore, it is important to observe whether exercise affects the functions of these elements or not (Fernandez-Madrid *et al*., 1973; Cordova and Alvarez-Mom 1996). Magnesium is included in carbohydrates, lipid, protein and ATP composition in mitochondria in metabolism. ATP and magnesium are necessary as cofactors for the reactions catalyzed by hexokinase and phosphor fructokinase (Nuviala *et al*., 1999). Strong changes in serum or plasma magnesium levels are closely related to intense and continuous exercises (Haymes 1987). During high-intensity exercise, glucose oxidation rapidly increases whereas muscle glycogen stores are rapidly consumed. Glucose uptake also increases from circulation (Aydin *et al* 2000). Along with magnesium insufficiency, energy metabolism and physical work capacity may be negatively affected because body magnesium is used with physical exercises. Magnesium can be considered as a substance increasing physical performance (Bohl and Volpe 2002).

Insulin level and blood glucose level show differences according to the duration and intensity of the exercise (Benazra *et al*., 1995). However, it was reported that plasma insulin concentration continuously decreased (Mogulkoc and Baltaci 1997). Aydin *et al*. (2000) showed in their study that insulin hormone level of the subjects decrease after exercise. Juriamme *et al* (1990) applied 30 minutes exercise in form of 30 seconds rest and 30 seconds work upon 15 untrained subjects. Plasma hormone levels were measured by drawing samples before, just after and 1, 6, 24 hours after the study which contained 10 different moves with 70 % loading and decrease in insulin levels occurred. In a study performed on sprinters and distance athletes, it was shown that %100 of maximum oxygen consumption and insulin levels, before and after aerobic on bicycle ergometry, decreased in sprinters and increased in long distance-athletes (Turgut, 1991). Kilic (2003) examined zinc support in his study on wrestlers. It was found that the glucose level increased after exercise. It was seen that the insulin levels decreased after the exercise.

The aim of the present study was to determine how the insulin and glucose levels are affected at rest and exhaustion in sportsmen (Tae-Kwan-do) and sedentary

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Table 1: Plasma insulin and glucose levels in magnesium, magnesium+exercise and exercise groups

	Measures	1.Group (Mg)	2.Group (Mg + Exercise)	3.Group (Exercise)
Glucose (mg/dl)	I.	80.40±8.67 cx	74.40±12.55 dy	79.00±10.80 by
	II.	95.60±6.06 b	99.90±16.80 b	97.10±7.60 a
	III.	85.70±7.97 bcx	87.00±27.60 cx	82.05±12.25 by
	IV.	106.50±6.84 ax	102.60±12.88 ax	98.10±22.68 ay
Insulin (µIU/ml)	I.	12.85± 4.42 a	11.76±5.65 a	11.25±4.17 a
	II.	9.81± 3.65 bx	8.22± 3.27 by	8.27±3.25 by
	III.	11.65±3.25 ay	12.75±4.40 ax	11.82±3.82 ay
	IV.	8.85±2.06 b	8.74± 2.88 b	8.55± 3.20 b

a,b,c; Different letter in same column are significant as statistic ($p<0.05$)
x,y,z; Different letter in same line are significant as statistic ($p<0.05$)

I. Resting levels before supplement, II. Fatigue levels before supplement
III. Resting levels after supplement, IV. Fatigue levels after supplement

subjects before and after 4-weeks magnesium support.

MATERIALS AND METHODS

Thirty healthy male subjects varying between 18-22 ages participated in the research. Before starting the research all the participants were informed about the content and purpose of this study and all subjects joined the study voluntarily. Subjects were separated into 3 groups including 10 people each:

1st group; sedentary group taking magnesium support only (S + Mg)

2nd group: magnesium support and training group (Tr +Mg)

3rd group: only training group (Tr)

1st and 2nd group had magnesium sulphate support additional to normal diet for 4 weeks. Also 2nd and 3rd group had 90-120 minutes Tae-kwan-do training five days a week for 4 weeks. Average age of the 1st group subjects was assessed as 19.9 ± 2.7 (years), and average heights as 173.4 ± 6.2 cm, body weights as 68.49 ± 7.2 kg. Average age of the 2nd group subjects was assessed as 19.3± 2.5 (years), and average heights as 171.3 ± 7.2 cm, body weights as 67.84 ± 6.9 kg. Average age of the 3rd group subjects was assessed as 20.3 ± 2.3 (years), and average heights as 173.3 ± 6.3 cm, body weights as 68.04 ± 6.9 kg. There were no differences for Mg levels in groups.

At the beginning of the research and after the 4-week support period insulin and glucose levels were determined at resting and exhaustion. 20 meters shuttle run test was applied on the subjects to create exhaustion and exhaustion bloods were drawn. Test was applied in Selcuk University body training and sports academy sports saloon. Test starts with a slow running speed (8km/h) and subject should be on the opposite line in each signal. Subject continues the test if he misses one signal sound and catches the rhythm in the other signal. If he has difficulty in catching the signal, if he can not reach 3 ms front line at the edge of track consecutively in 2 tours, test is over for him. Subjects run in 20m track and with signal, touch the line with one foot. Running speed is increased 0.5m/sec every minute. Every minute is a grade. Test result is the grade which subject is stopped and is an indicator of endurance. Length of the test depends on the individual (Zorba, 2001).

Determination of glucose and insulin levels

After the blood samples drawn from subjects were decomposed during 5 minutes in 3000 speed analyzer, they were evaluated in 540-600nm wave length with calorimetric method, in Olympus AU 560 brand auto analyzer, using glucose (mg/dl) and insulin (µIU/ml) kits that belong to the same device.

1. Measurement: resting level before support, 2. measurement: after exhaustion before support
3. Measurement: resting level after support, 4. measurement: after exhaustion after support.

STATISTICS

Statistical analyses were done using SPSS 11.0 package programmer. Variance analysis was used for the determination of measurement differences between groups and inside the groups; Duncan multiple range test was used for the determination of groups with difference.

RESULTS

Plasma glucose and insulin levels of subject groups are given on table 1. When the glucose levels are examined it is seen that the exhaustion levels of 1st group before and after supplementation increased in comparison to resting levels ($p<0.05$). There is no statistical difference between the resting measurements of the first group before (I) and after (III) supplementation. There is significant difference between exhaustion measurements of the first group before (II) and after (IV) the supplementation ($p<0.005$).

When the glucose levels of 2nd group are examined it is seen that there is significant statistical difference between the exhaustion levels and resting levels before and after the supplement ($p<0.05$). Resting level after supplement was found to be higher than resting level before the supplement, similar difference was seen in exhaustion levels as well ($p<0,05$).

When the glucose levels of 3rd group are examined, significant difference is detected between 1st and 2nd measurements ($p<0.05$). Likewise significant statistical difference was found between resting measurements (III) after supplement and exhaustion (IV) measurements after supplement ($p<0.05$).

When the glucose levels among the groups are examined at the first measurement, it is seen that no statistically different. It was seen that levels of the 1st and 2nd group were higher than the 3rd group in 3rd and 4th measurements ($p<0.005$).

When insulin levels were observed, it was determined that resting levels were higher than exhaustion levels in all groups ($p<0.05$). When the insulin levels among the groups after supplement were compared, it was determined that only the resting level of training group with magnesium support (group 2) was higher than the other groups.

DISCUSSION

When the findings of the present study were generally evaluated, it was determined that the glucose exhaustion levels had increased in comparison to resting levels both before and after supplement. Also, when effect of magnesium support was evaluated, increase in insulin levels related to this support was found out whereas there was no statistical difference in only training group. Insulin levels decreased with exhaustion both before and after the support.

Magnesium is a cofactor for many enzymes involved in glucose metabolism. Magnesium has a role in the effect of insulin and as a reciprocal interaction insulin stimulates magnesium uptake of tissues with insulin sensitivity (Takaya *et al*., 2004). High magnesium uptake improves insulin and glucose homeostasis (Song *et al*., 2004). In normal, healthy condition, exercise increases hepatic glucose production and usage in liver. Consequently glucose levels in circulation are kept in a relatively constant level (Coker and Kjaer 2005). This relation between liver and muscle is maintained through endocrine factors released both from circulation and locally. Also blood glucose levels are kept in a certain value by changes in insulin and glucose release stimulated with exercise. Blood glucose level and insulin level show difference according to the intensity and duration of exercise (Benazra *et al*., 1995). However, plasma insulin concentration continuously decreased in other research (Mogulkoc and Baltaci 1997). Aydin *et al*. (2000) reported that insulin hormone level of the subjects before aerobic exercise was 7.72 µIU/ml whereas it decreased to 4,42 µIU/ml after the exercise. Juriamme *et al*. (1990) applied 30 minutes exercise in form of 30 seconds rest and 30 seconds work upon 15 untrained subjects. Plasma hormone levels were measured by drawing blood samples before, just after and 1, 6, 24 hours after the study which contained 10 different moves with %70 loading and decrease in insulin levels occurred. Kilic (2003) performed on wrestlers it was seen that insulin resting levels before exercise which were 26.28 µIU decreased to 1,64 µIU after the exercise. In a study performed on sprinters and distance athletes, it was shown that 100 % of maximum oxygen consumption and insulin levels, before and after aerobic on bicycle ergometry, decreased from 36.7µIU to 14.7µIU in sprinters and increased from 30.65 µIU to 60.7 µIU in long distance-athletes (Turgut 1991). In our study 30 % insulin level decrease was seen in all groups with and without magnesium support after exercise which is parallel to the findings of other researchers. In another study it was found out that insulin levels increased due to low magnesium diet in rats which indirectly supports our study (Chaudhary *et al*., 2004). Another study determined that intravenous magnesium supplement suppressed basal insulin values and this finding shows similarity to decreased insulin values we obtained in the 1st group of our study (Gow *et al*., 2003). With the support, it was seen that the glucose levels of the 1st and 2nd groups after magnesium support made a statistically important increase in comparison to the levels before support ($p<0.05$), but there was no statistical difference in the only training group. However, after 4 weeks experiment, when the groups were compared with each other, the lowest insulin levels were found in the 3rd group which only made training and had no support. These findings reveal that blood glucose levels decrease due to training which is parallel to the data of other researchers (Jessen and Googyear 2005, Holloszy 2005). These researchers state that exercise-muscle contraction increases glucose transportation to muscles. It is emphasized that this transport independently from insulin ((Jessen and Googyear 2005, Holloszy 2005, Barnes and Zierath 2005). However, glucose transportation with insulin dependent mechanism forms a second control mechanism for the arrangement of blood glucose levels. In our study, finding no difference between the groups in terms of insulin after the support, reveals that glucose transportation is performed independently from insulin as the other researches reported.

The results of our study indicate that magnesium support for 4 weeks in sedentary and sportsmen does not significantly affect plasma insulin levels at rest and exhaustion but causes an increase in glucose levels. However, this increase was only seen in the groups with magnesium support which makes us think that it is due to magnesium support.

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