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Short-Term Effects of Glutamine Supplementation on Levels of Blood Lactate and Fatigue Index in Male Elite Swimmers

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Abstract

Food supplementations are public assistance for a variety of championships sports. Competitive and recreational athletes use the nutritional supplements to improve their performance in a long time. In this context, there is lack of information about whether glutamine supplementation has the potential to help improve the muscle recovery after a period of intense aerobic exercise to exhaustion. This study aimed to assess short-term effect of glutamine supplementation on the levels of lactate and fatigue index in male elite swimmers. Research method was mid-experimental and research design was a pretest-posttest with control group that was administered as double-blind. Twenty swimmers with age range of 26-18 years were selected based on convenient sampling. Then, based on swimming record results of 50 and 100 m freestyle breasts were randomly divided into glutamine and swimming training group (n = 10) or placebo and exercise swimming group (n=10). Then the glutamine was given to supplementation group and the placebo was given to the control group, both groups began to swim for 4 weeks. Studied variables including lactate levels, fatigue and athletic performance index were measured before and after the study. The results showed that use of glutamine amino acids led to a significant reduction in the fatigue index and produced lactate in the supplementation group compared to the placebo group. The time of athletes' performance wasn't significantly increased. The results showed the glutamine supplementation in areas such as swimming where the athlete must take part in a day in several competition, has a significant impact on the reduction of blood lactate concentration and more endurance of athletes than accumulation of lactic acid and reduction of swimming athletes fatigue index . However, more research is needed in this area.

Keywords: glutamine, lactate, fatigue index, athletic performance, swimming

Introduction

One of the problems that have always plagued the athletes is fatigue and coaches are always trying to postpone it. (Fuleco et al., 1999). Continuous attention to intense physical exercise willingly or unwillingly gets along with the phenomenon of analyzing the protein in the muscles. (Antonio and Street, 1999).

It seems that nutritional supplements such as amino acids of glutamine in combination with diet and exercise can help to improve the recycling and anti-inflammatory activities and muscle damage. (Batel, 1999) it is said that glutamine have had a powerful effect on increasing natural secretion of growth hormone in the body. (Lagrana et al., 2005). Glutamine stores reduction can reduce the glutamine protective function against launching apoptosis in neutrophils, macrophages and lymphocytes. Research is considered the effect of glutamine as a part of the daily diet on immune system cells (Brolinson and Eliot, 2007). Glutamine is also involved in the transfer of

nitrogen from a member to another member, and directly affects the balance of protein synthesis (anabolic processes) (Savaki et al., 2004).

The relationship between reductions of plasma glutamine during exercise can increase need to glutamine supplement to faster recover, avoid overtraining and prevent fatigue (Walsh et al., 1998). More made recommendations in this case is to use glutamine for the periods of recovery after intense workouts. (Krayb et al., 2006; Antonio and Street, 1999). Rubottom DJ, et al (1996) have reported in their studies, reduce in plasma glutamine indicates overtraining and athletes need to rest and proper nutrition. The researchers considered the increase of glutamine after exercise as a required process for the metabolism of cells and tissues that use the glutamine as a food source, Heob et al (1998) in their study didn't observed a significant difference between lactate level and bicarbonate between glutamine supplementation group and placebo. Finally, the researchers reported, glutamine supplementation doesn't have any impact on increasing athletic performance. Welbrun et al (1998) in another study found that those who had consumed the glutamine supplementation in comparison with bicarbonate group excreted more lactic acid.

Favno et al (2008) observed that a mixture of carbohydrate and glutamine supplementation compared with carbohydrate group alone reduced the fatigue during activity (Favno et al., 2008). Akbarnejad et al (2006) concluded that glutamine supplementations during the acute weight loss and glutamine with creatine during recovery can have beneficial impacts on athletic performance (Akbarnejad et al., 2006).

Given that in this regard that if glutamine supplementation has the potential to help to improve muscle recovery after a period of intense aerobic exercise to exhaustion, there is lack of information and need to further research to explore this potential. This study was conducted with the aim of evaluating the short-term effect of glutamine supplementation on the levels of lactate and fatigue index in male elite swimmers.

Methodology

Due to the nature of the subject, research is mid-experimental. Research design was pretest-posttest with control group that was conducted as double-blind.

Table 1: Characteristics of the subjects participating in the study

Statistical Indicators of Variable	Group	Number	Mean
Age (Year)	Control	10	19.32±2.72
	Glutamine	10	20.32±2.66
Height (Cm)	Control	10	179.67±3.50
	Glutamine	10	176.89±3.80
Weight (KG)	Control	10	73.39±4.25
	Glutamine	10	7179±3.98
BMI (kg/ m^2)	Control	10	23.18±3.39
	Glutamine	10	23.06±3.12
Fat Percentage(%)	Control	10	14.47±1.25
	Glutamine	10	13.89±1.55
Swimming 100m record (s)	Control	10	60.11±1.79
	Glutamine	10	60.41±1.22

Regarding the length of time is the cross and in terms of using obtained results is applied.The sample was all male elite swimmers at the age of 20-32 year old of Esfahan city that had a history of more than 3 years participating in the championship. 20 swimmers were selected as targeted and voluntary and based on the results of swimming 100 meters freestyle as sample and then randomly

placed into two groups glutamine - swimming training (n = 10) and placebo - swim training (n = 10). All the athletes who participate in the study as voluntary completed a questionnaire containing physical characteristics, medical and history of swim. Subjects were healthy and had no history of bone disease, neuromuscular, cardiovascular, respiratory, liver, kidney, brain and hormones, as well as a history of smoking, alcohol, caffeine and using drugs. Also, all of the selected people completed the food questionnaire (for 4 days). The subjects in the control group (placebo) during the investigation continued swimming regularly and at the beginning and end of the study, participated in the pre-test and post-test. All the subjects signed voluntary consent to participate in the research process. Characteristics of subjects that a week before the main stage of the research process is measured, presented in Table 1.

Implementation of research tests

Referring to the Board of swimming in Esfahan while achieving agreement of coaches and harmony with the swimmers, at a meeting on the subject, the purpose of the implementation and implementing stages of research was explained to the swimmers. Then all subjects completed the consent form and demographic information, medical and physical activity level. At first meeting all the subjects were fully familiar with the test. Subjects personal and primary information such as name, surname, age, occupation, educational level, history of the game, the number of exercise sessions in per week, and… were recorded. Then, using reliable and valid instruments, the physical characteristics including height, weight and body mass index was measured. To evaluate the diet and investigating its effect on considered blood parameters, 24-hour Yadamad questionnaire of dietary in 2 days before the first stage of bloodletting and end 48 hours before the second stage bloodletting was used; the analysis of the questionnaire was conducted using computer software of food processing and by nutrition expert.

In the second session, anaerobic power variables of upper on the hand static, lower aerobic power and fatigue index using Wingate test and levels of lactate and creatine kinase and using a blood sample about 6 minutes after intense exercise was measured and obtained information were recorded. After finishing the initial tests, in order to further familiarity with the experimental and control groups with practicing programs, the use of glutamine supplementation and explaining the method was held in a briefing session. Then from the second week the study groups under the supervision of coaches and experts for 4 weeks, per 6 sessions of 90 minutes with intensity 60 to 85 percent of maximum heart rate began to swim. During this period, subjects of supplement group in addition to swimming training used glutamine supplement manufactured by SAN America to 0.1 grams per kilogram of body weight as a capsule, while placebo group in addition to swimming training received similar capsules each containing 4.0 grams of starch. The material in the same batch from someone outside of the research process was given to the subjects and they were asked according to the research reports 5 minutes after exercising take this drug. At the end of the study all the physical variables, aerobic variables using the Bruce protocol on treadmill, anaerobic power and fatigue index using the Wingate test and blood lactate levels were measured again.

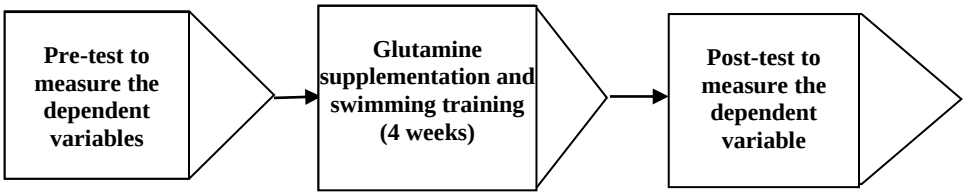

Figure 1: The various stages of research

Calculating the anaerobic power indices of lower body

Subjects did two stages of 30-second Wingate test after heating for 10 minutes on Monark 891 E model ergometer and stretching. Seat height was set to the upper limb length of subjects. Applied resistance was 7.5 g per kg of the body mass of the subjects. The subjects were asked to pedal in maximum speed, so that within 30 seconds reach to its maximum speed, then release key of weight pressed and resistance applied, and subjects must continue to pedal for 3 seconds. Over 30 seconds, subjects were not allowed to get up from the chair and were also encouraged to do their best.

How to measure the anaerobic power of the upper body

According to the swimmers when swimming most commonly used upper body, for simulation in this study, was tried to measure anaerobic power of upper body and base on it fatigue index is calculated. For this purpose, subjects after warm up for 10 minutes on the ergometer Monark 891E model and stretching did a stage of 30-second Wingate test. Seat height was set to the length of their upper limbs. Subjects took the ergometer pedal by hand and continued to the pedal in the form of sitting. Applied resistance was 40 g per kg of the body mass of subjects. The subjects were asked to pedal in the maximum speed, so that within 30 seconds reach to its maximum speed, then release key of weight pressed and resistance applied, and students should continue for 3 second to pedaling. Over 30 seconds subjects were not allowed to get up from the chair and were also encouraged to do their best.

Lactate measuring: In this study, blood lactate was measured about 6 minutes after two times the Wingate test. After sampling the blood sample was centrifuged for 5 minutes at 2500 rpm and the plasma was separated. After plasma separation, plasma separated at a temperature of 0 to 4 degrees Celsius stored in the refrigerator. The test was performed in the shortest possible time. The method as COLORIMETRIC (colorimetric) by spectrophotometer and in biochemical method of pyruvate and by Kate lactate RAN DOX America was conducted.

Results

To investigate the data distribution, Kolmogorof-Smirnof test was used. According to the test results base on the normality of distribution, parametric tests were used. To investigate the within group changes in the research variables before and after the study in each group, t-test and to investigate the changes between the group of variables after calculating the average difference before and after each group, independent t-test was used. All statistical tests at the significant level of $p<0.05$ were evaluated. Lactate: Results of within group and between the groups changes in blood lactate of swimmers is provided in Table 2.

Table 2: Results of within group and between group changes in blood lactate of swimmers

Groups		Pretest	posttest	t dependent	significant	difference	t independent	Significant
Lactate (mmol)	Glutamine	13.80±1.69	8.90±2.18	-6.02	0.001	-4.90	-4.740	0.001
	Control	13.50±1.51	11.70±1.49	-3.105	0.01	-1.80		

As Table 2 shows, there is a significant decrease in mean of blood lactate of swimmers after 4 weeks swimming with supplementation compared to baseline in each of receiver groups of glutamine supplement and placebo groups ($p<0.05$). Comparison of the mean of changes showed a significant difference between the two groups. So, hypothesis of study accepted on the effectiveness of 4 weeks glutamine supplementation on the reduction of blood lactate in the supplementation group compared with the placebo group ($p<0.05$).

Fatigue Index: The results of changes within the group and between groups of swimmers fatigue index is presented in Table 3.

Table 3: The results of changes within the group and between-group of swimmers fatigue index

Groups		Pretest	posttest	t dependent	significant	difference	t independent	Signify cant
Fatigue index (watt per second)	Glutamine	37.70±2.21	3070±3.59	5.006	0.001	7.00	2.496	0.002
	Control	36.40±3.60	33.90±2.33	2.197	0.06	2.50		

As Table 2 shows, there is a significant decrease in mean of fatigue index of swimmers after 4 weeks swimming with supplementation compared to baseline in each of receiver groups of glutamine supplement ($p<0.05$). while the difference in the placebo group was not significant. Comparison of the mean of change showed a significant difference between the two groups. So, hypothesis of study accepted on the effectiveness of 4 weeks glutamine supplementation on reducing the fatigue index in the supplement group compared with the placebo group ($p<0.05$).

The time of performance: the results of changes within the group and between the groups of swimmers performance time index is presented in Table 4.

Table 4: Results of within the group and between the groups changes of swimmers performance time variable

Group		Pretest	posttest	t dependent	Signify cant	Differ rence	t inde-pendent	significant
Time of performance (s)	Glutamine	61.44±7.99	60.2±3.76	0.489	0.64	-1.24	0.512	0.62
	Control	61.52±437	61.92±4.82	-0.205	0.84	0.40		

As Table 2 shows, there is no significant difference between the mean of swimmers performance time after 4 weeks swimming with supplementation compared to baseline in each of receiver groups of glutamine supplement and placebo ($p<0.05$). The comparison of mean of changes didn't show a significant difference between the two groups. So the hypothesis of research is rejected that the effectiveness of the 4-week glutamine supplementation on improving the performance time in the supplement group compared with the placebo group ($p<0.05$).

Discussion

During extreme anaerobic exercise, acidosis role in the development of fatigue is still very controversial, and evidence suggests that PH decrease of muscle can exacerbate fatigue directly or indirectly (Lambert, 2005). The increase in H + due to reduction of blood PH and muscle can reduce glycolysis by interfering the release of calcium from the endoplasmic and increase perception of fatigue after some exercise (Stoke Havs, 2001). The first line of defense against muscle acidification is intracellular buffer such as phosphate, proteins, peptides and amino acids. Glutamine including sport supplements. Intense physical activity, high-intensity physical exercise, chronic fatigue, muscle damage and weight loss can reduce plasma glutamine and skeletal muscles (Velbron et al. 1995).

The most important speed competition of swimmers is swimming 100 meters, which is very involved the glycolysis system. So that in a 100-meter swim the share of phosphagen energy systems, anaerobic and aerobic glycolysis, respectively 16, 46 and 38 percent is mentioned (Jeison, 2011). In the short-term intense exercise, anaerobic glycolysis is the most important energy system that has the largest share of the production ATP. This dependence on large amounts of glucose leads to high production of lactic acid and decrease in PH of muscle and blood. Increasing the

concentration of hydrogen (H) indicates the main reason of fatigue in this type of practice, ions H + primarily through inhibition of key glycolytic enzymes, especially phosphofructokinase, exert their effect. So much evidence introduces PH as an important limiting factor. Buffering action of the body is the fight with any changes in the acid –base balance (Stoke Havs, 2001). So if we can increase the capacity of buffer to keep the acidity level of the environment, is likely to lead to improve performance. The study found that glutamine supplementation had a significant impact on blood lactate levels of swimmers, the findings were consistent with the results of other researchers, so that Madduk et al (2011) reported in their study glutamine consumption leads to significant reduction of lactate, but some studies reported no impact of glutamine to lactate. The researchers reported the reason of their contrasting findings the types of used exercises and the amount and dosage of consumption (S Chifer et al., 2002). However, it seems that glutamine has a significant impact on the reduction of lactate. Several factors are involved in this field. Studies have shown that glutamine by increasing bicarbonate levels is able to reduce the level of blood PH (Velbron et al., 1995). Bicarbonate is a buffer that during exercise acts the increase of lactate level and other measures that reduce the PH as cell and tissue protection. However, it seems that the impact of glutamine in the reduction of lactate continues for up to 24 hours after physical activity. According to the results of the survey, the use of glutamine can reduce blood lactate level with the buffering impact, and thus the reason of reduced lactate follows the glutamine supplementation in this study (Velbron et al. 1995). In this study, fatigue index of swimmers after 4 weeks swimming with supplementation compared to baseline in the receiving group of glutamine supplements compared with the placebo group was significantly reduced. This reduction can be considered to lower levels of buildup lactic acid in end of test in receiving group of glutamine supplement compared with the placebo group, as the relationship between high levels of blood lactate and fatigue index is well proved (Lambert, 2005).

Conclusion

According to conducted studies, can be realized the importance of using glutamine supplementations in different conditions of practicing according the nature of different sports. In addition, due to the high pressures of practice in individual sports, especially swimming, it is necessary to study the supplement impacts and how to use them in a variety of sports. According to conducted research, glutamine supplements can lead to increase of athletic performance as well as help to athletes energetic through control of exercise program. Accordingly, it is needed investigate the impacts of supplements on lactate levels and fatigue and physiological indices professionally. According to the obtained results of this research can be concluded that glutamine supplementation in areas such as swimming where the athlete must take part in a day in several competitions has a significant impact on the reduction of the blood lactate concentration, and tolerance of athletes to buildup lactic and reducing the fatigue index of athletes. However, more research is needed to control the factors influencing in research variables.

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