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Research Article

Impacts of Arginine Supplements on the Fat Free Mass (FFM) and Anaerobic Power of Weightlifters

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Abstract: The impacts of arginine supplements (arginine and ornithine) on the physical performances of weightlifters are studied in this study. Double-blind, randomized and crossover trial is carried out taking 8 male weightlifters as studying objects. During such trial, the objects are given amino acid supplements or placebos on a daily basis besides normal weight lifting training for 30 days and after an interval of 30 days, they are given the same amount of the same acid supplements or placebos. Then, the body weight, height, FFM, back strength, pedaling strength of lower limbs and anaerobic power of objects using acid supplements were compared. The study indicated that 1) No weight or height change is found, post-test FFM of acid group increased significantly compared with pre-test FFM; FFM of placebo group remain unchanged; 2) Post-test body fat percentage of acid group is lower than pre-test value; body fat percentage of placebo group remains unchanged; 3) There is no difference of back strength and pedaling strength of lower limbs between the two groups; but the post-test max. anaerobic power increased significantly compared with pre-test value while that of placebo group remains unchanged; 4) There is no difference in the average anaerobic powers and power decreasing rates between the two groups. Arginine and ornithine supplements help increasing FFM and max. Anaerobic power, 40mg/kgwt amino acid supplement will not impact the health of the objects.

Keywords: Amino acid, anaerobic power, FFM, muscle strength, weightlifters

INTRODUCTION

Amino acid supplements can promote growth hormone gh secretion and the muscular tissue building and therefore cause increase of muscle and muscle strength (Kreider *et al*., 1993; Lemon, 1991; Cai and Li, 1995a, 1995b), therefore, amino acid supplements are frequently used as the nutritional supplements by muscle athletes. In fact, the action of amino acid can be affected by various factors, e.g., excessive intake of one amino acid causes competitive effect with other amino acids and affect the absorption of the other acid, or excessive intake of one amino acid causes inhibiting adsorption of this amino acid thanks to the feedback of the body and then affects other diets which leads to nutrition imbalance. Among various common amino acids, arginine and ornithine have special effect on athletes and are not listed as the prohibited list by International Olympic Committee; there are similar products developed on the market and some Chinese athletes are using them. Through study, Alvares *et al*. (2012) suggests that it can stimulate growth hormone gh secretion, increase the muscle proliferation capability and promote the urea cycle in the liver and increase the conversion of urea which excretes to urine. Arginine is also one of the required amino acids in creatine synthesis which increases creatine storage to increase the energy source of ATP (Fricke *et al*., 2008). Weightlifting is one of the few promising sports with international advanced level; study on the improvement of athletic performance is necessary and there are athletes using amino acid supplements. Therefore, it is necessary to carry out scientific research on whether those supplements can improve athletes' performance. This study aims to explore the impacts of arginine supplements on the physical performances of weightlifters and provide some feasible suggestion on athletes and coaches.

MATERIALS AND METHODS

Materials: Top ranking male weightlifters in Chengdu Sport University are taken as the objects with an average age of 19.8±1.55 years old, average height of 166.76±3.57cm and average body weight of 72.45±5.14kg. Each object understands the experimental procedures, precautions, individual right and obligations and sign the informed consent before the experiment.

Methods:

Experimental design: Twelve objects are divided randomly into two groups according to their body weight and height, namely Group A (take L-Arginine monohydrochloride and L-Ornithine Hydrochloride supplements) and Group B (take placebo, i.e., crystalline dextrose). After one month's interval, cross-over trial is carried out, i.e., in the second stage, Group A takes placebo while Group B takes amino acids. Double-blind design is adopted in the supplements, i.e., the supplements are made into capsule by a third party and neither the objects or experiment personnel knows whether the supplements the objects taking are amino acids or placebo; three supplements are made into capsules and two colors are used respectively for arginine and ornithine. The two amino acids are taken 20mg/kg annually before training and sleeping. The placebos are taken 40mg/kg annually using the same method and the placebos are packaged into capsules in two colors, two medicine bottles, with same and indistinguishable appearance, taste and dosage. The experiment lasts for 30 days, during which, the training is carried out as per usual training plan made by weightlifting coach and the training weights are 70~80% of the athletes' best records or more or less according to the status of the athlete, the daily total training weights are recorded.

Experimental procedure: The experiment is carried out in two stages and pre-test and post-test are included in each stage. Two groups respectively taking amino acid or placebo are divided in the first stage, the first stage lasts for 30 days. After interval of 30 days, the second stage is carried out using cross-over design, i.e., the placebos are taken in amino acid group and amino acids are taken in placebo group.

Items subject to pre-test and post-test: the first day: 3m fasting blood in the morning is collected to measure creatinine, BUN, GOT and GPT. The second day: the height, weight and FFM of objects are measured; muscle strength and explosive power (back strength and pedaling strength of lower limbs) are measured; 30s Wingate anaerobic test.

Statistics method: All the data are analyzed by SPSS17.0 statistical analysis software using mean value, standard deviation, repeated measures analysis of variance of two factors with a significance level of a = 0.05.

RESULTS AND DISCUSSION

Results:

Comparison of pre-test and post-test values: Table 1 shows that: the difference of pre-test and post-test physiologic values of amino acid group and placebo group indicates the acts of amino acid to physiological indices together with weight training:

- The pre-test and post-test values of FFM, body fat percentage, max. anaerobic power relative value, average anaerobic power, average anaerobic power relative value, creatinine and BUN varies significantly, specifically, the post-test FFM increased, percentage of body fat decreased and max. anaerobic power relative value and mean value increased significantly compared with pre-test values.
- No difference of pre-test and post-test indexes other than average anaerobic power and relative significance level is found in placebo group.
- From the perspective of health status, in the four blood biochemical indexes, the post-test average values of creatinine and BUN of amino acid group are significantly greater than pre-test average value, however, the blood test value of each object is within the healthy range without any abnormality. It can be seen that dosage pf 40mg/kg body weight will not cause overburden to liver or kidney.

Table 1: Statistics of physiological indices and biochemical indices changes in amino acid group and placebo group before and after the experiment

	Amino acid group		Placebo group	
Index	Pre-test	Post-test	Pre-test	Post-test
Weight (kg)	72.69±8.11	72.87±7.16	72.66±8.06	73.09 ± 7.81
Height (cm)	166.71±6.14	166.38±6.12	166.26±6.29	166.58 ± 7.42
FFM (kg)	61.72± 5.48	63.74±6.17**	62.57±6.58	62.15±6.36
Body fat rate (%)	14.58±6.51	13.11±5.87*	15.16±5.35	15.49±5.27
Back strength (kg)	177.81±16.15	178.21±15.34	176.94±14.21	177.08±10.36
Lower limb power (Watt)	963.25±211.14	965.51 ± 204.17	912.61±212.31	917.26±159.19
Max. anaerobic power (Watt)	601.18±127.57	610.19±116.21	611.13±121.51	608.63±127.21
Max. relative anaerobic power (Watt/kg)	8.57±1.26	9.48±0.86**	9.33 ± 1.48	9.66 ± 0.89
Average anaerobic power (Watt)	469.14±71.87	581.31±88.14**	517.01±121.67	553.27±82.67**
Average anaerobic power relative value (Watt/kg)	6.29±1.28	7.87±0.88*	6.65 ± 1.44	7.88±0.57*
Max. power coast down (%)	35.96±8.58	36.67±9.12	36.81±14.47	34.89±11.55
Creatinine (mg/dl)	1.06±0.09	1.24 ± 0.11**	1.04±0.08	1.11 ± 0.11
BUN(mg/dl)	14.23±3.29	17.26±3.51**	13.57±2.69	14.18±2.60
GOT (U/L)	23.56±5.12	25.11±6.76	23.77±6.15	23.59±9.12
GPT (U/L)	17.21±8.34	18.76±10.67	16.78±7.58	18.56 ± 13.32

*: Stands for significant difference between pre- and post-test at $p<0.05$, **: Stands for significant difference between pre- and post-test at $p<0.01$

- The post-test average anaerobic power and relative values of both amino acid group and placebo group are significantly higher than the pre-test values, therefore, it can be seen that strength training has obvious effect without being affected by amino acid or placebo supplements.

Comparison between amino acid group and placebo group: Table 1 shows that: there is no obvious difference between two groups in pre-test values, which indicates that there is no difference between subjects of the two groups. The post-test value of BUN of amino acid group is significantly greater than that of placebo group, which shows that the effect of taking amino acid is significantly higher than that of placebo group after one month's experiment. For the increase of BUN means urea increase in blood, arginine and ornithine uptake enhance the effect of urea cycle and hence promote urea synthesis and therefore, help to decrease ammonia content in vivo and increase anaerobic power; they may also cause urea content increase in blood due to the inability of urea excretion of kidney. However, the BUN value of each object is within normal scope, it is more likely to cause increase of urea cycle. There is no difference in measured pre- and post-test values of indexes other than BUN between the two groups, including FFM and max. anaerobic power. Maybe greater progress is required to gain a statistical discrepancy with placebo group.

DISCUSSION

Acts of amino acids on the body composition of subjects: Theoretically, the acts of amino acids on body is generally deemed to be achieved though stimulating the secretion of growth hormone that can increase the amount of amino acids delivered in cells and stimulate protein synthesis in cells through various ways and thus affect FFM. Both arginine and ornithine can simulate the secretion of growth hormone. It is reported by some researchers that (Karkoulias *et al*., 2008; Dohm *et al*., 1980; Smrige *et al*., 2007; Forbes *et al*., 2013; Santos *et al*., 2002): five weeks' taking of arginine and ornithine with a daily dosage of 2g causes significant decrease of body fat rate. The result of this study, i.e., significant increase of post-test FFM against pre-test value in amino acid group and no difference in placebo group, provides a further proof of such conclusion. Balon and Nadler (1994) suggests that amino acid can stimulate growth hormone secretion and increase FFM through increasing muscle tissue. Although muscle strength is not significantly increased and muscle strength increase cannot be indirectly proved for statistical significant difference is not achieved, the post-test back strength and pedaling strength of lower limbs are greater than the pre-test values.

Performance changes before and after taking amino acid: Some researchers (Smriga *et al*., 2007; Hickson and Wolinsky, 1994) suggested that: after using arginine supplements, isokinetic muscle strength is not significantly increased in the test, which significantly varies from the result of Balon and Nadler (1994), while Balon and Nadler (1994) found a significantly greater max. iteration scores of five weight training in amino acid group than in placebo group after the supplement of arginine and ornithine. No difference of pedaling strength of lower limbs or back strength is found in amino acid group and placebo group; increase in amino acid group is found without significant difference, it is probably because that number of objects is too limited (12 objects).

In this study, significant increase of post-test FFM is found compared with pre-test value; it is estimated that the body muscle mass is increased, but muscle strength increase isn't reach significance level; maybe a more significant increase of FFM can indicate a significant increase of muscle strength; another possible reason is that the using period is not long enough. Some researchers (Mohr *et al*., 1996; Camic *et al*., 2010) found that there is no significant difference in max. anaerobic power or average anaerobic power between experiment group and placebo group in amino acid nutrition supplement experiment; and in their follow-up study, they found that the average anaerobic power in experiment group is obviously higher than that in placebo group after using amino acid nutrition supplement. In this study, the post-test max. anaerobic power increases significantly comparing with pre-test value in amino acid group and no significant change is found in placebo group. Max. anaerobic power represents anaerobic explosive power and is the locomotor performance taking ATP-PC system as energy source. As the precursor substance of creatine, arginine can increase creatine storage and may increase energy storage in ATP-PC system and therefore increase max. anaerobic power.

In this experiment, post-test average anaerobic powers in both amino acid group and placebo group are greater than pre-test values. Average anaerobic power represents the endurance of anaerobic exercise while taking energy generated by the decomposition of phosphide and the anaerobic decomposition of glycogen as the main energy sources. The average anaerobic powers of objects in both groups have increased; maybe thanks to training, the anaerobic energy system and muscle strength are increased in both groups and are not affected by the amino acid.

Health examination results before and after taking amino acid: In the fourth test (post-test of amino acid examination), BUN of one of the objects is 24mg/dl and creatine of another object is 1.16mg/dl, which is beyond the normal scope, but no abnormality is found. Other biochemical values are within the normal range, it can be seen that a dosage of 40mg/kg body weight/day will not cause overburden of liver or kidney. Statistic result

show that: Post-test creatinine is obviously higher than the pre-test value in amino acid group and no difference is found in placebo group; post-test urea nitrogen content is significantly higher than pre-test value. It can be seen that the supplement of amino acid can increase creatinine and urea nitrogen; health assessment shall be carefully carried out if higher dosage amino acid research is required.

CONCLUSION

In this study, top-ranking male college athletes about 20 years old are selected as objects and it is found after 30 days' taking of arginine and ornithine or placebo: the supplement of arginine and ornithine has no effect on the height, weight, back strength, pedaling strength of lower limbs and average anaerobic power of weightlifters. After using those two amino acid supplements, the FFM of objects increased significantly, body fat percentage decreased significantly and their max. anaerobic power improved significantly. Amino acid supplements with a daily dosage of 40mg/kg weight will not impact the health of objects and a higher dosage research may be carried out while taking other documents as reference.

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