

## Research Article

# The effect of supplementation of HMB (beta-hydroxy betamethyl butyrate) and plyometric exercises on performance and body composition of elite parkour athletes in Tehran

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### Abstract

**Background:** Parkour is a sport with alternating energy system in which some items such as lower body explosive power, muscular strength, production of high levels of power in the shortest period of time and high agility are of particular importance. Considering the anabolic and anticatabolic properties of beta-hydroxy beta-methyl butyrate (HMB), the aim of this study is to investigate the effect of taking this supplement along with plyometric training on body composition, agility and standing jump power of parkour athletes.

**Materials and Methods:** For this purpose, forty parkour trained men (19-26 years old) have been chosen and randomly categorized into four groups: HMB group, Plyometric group, HMB and Plyometric group and control group. The training program was performed for plyometric and plyometric-HMB group, three sessions per week for eight weeks which took one hour each Session. Also HMB and plyometric-HMB groups consumed three grams of HMB per day for eight weeks. Body composition analysis and Illinois test and standing jump power test were conducted before and after eight weeks of plyometric training and HMB supplementation. Research data was analysed by ANCOVA statistical test.


**Results:** The results of statistical analysis of each group showed that performing eight weeks of plyometric training significantly improves the standing jump power, agility and body fat percentage of the parkour athletes ( $p < 0.05$ ).

**Conclusion:** These findings indicate that plyometric training increase the standing jump power and agility and reduce the body fat percentage in parkour athletes, but taking HMB supplement along with plyometric training only helps to burn more fat in the parkour athletes.

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## 1. Introduction

For a long time, the issue of adopting an appropriate training method and dietary supplement in order to prepare athletes in order to achieve better results and perform sports skills to the desired level, has been considered by coaches and athletes (1). To this end, the heroes of ancient Greece greatly consumed meat and ate the hearts and testicles of animals to gain more power (2). One hundred years before Christ, Roman horsemen used substances made from honey and alcohol to increase the performance of their horses, and gladiators used stimulants and hallucinogens to reduce fatigue and injury (3). Today, ergogenic materials are available to athletes in a variety of materials and doses, such as capsules, tablets, or powders (4). Amino acids, proteins, creatine and caffeine are the most commonly used substances in the manufacture of ergogenic products (5). Leucine is a branched-chain amino acid, about 5% of which is converted to HMB. This substance is converted in the liver to a precursor called beta-hydroxy beta-methylglutaryl coenzyme A, which is required for cholesterol biosynthesis (6). According to research, skeletal muscle cells that are damaged during exercise need an external source of coenzyme A to produce cholesterol in cell membranes to restore normal structure and function (7). Conversion of leucine to HMB also activates muscle protein synthesis and reduces muscle protein breakdown (8). Some studies show that taking HMB has more benefits such as the ability to increase strength, musculoskeletal hypertrophy and aerobic function in both groups of trained and untrained individuals (9).

HMB is present in two forms, calcium monohydrate (HMB-Ca) and its calcium-free form. Supplementation is the only practical way to get 3 grams of HMB per day. Because otherwise, you will need to consume more than 600 grams of high-quality protein to get enough leucine (60 grams) to convert to HMB (10).

A review of safety data from 9 studies has shown that consumers tolerate HMB well and consume 3 grams daily for 3 to 8 weeks in younger people (18-47 years old) and older people (62 to 81 years old) does not cause any side effects in both men and women who exercise or do not exercise (11). The International Society of Sports Nutrition (ISSN) recommends that healthy adults taking HMB supplements, should take 1-2 grams of HMB-Ca, 60 to 120 minutes before exercise or 1-2 grams of HMB-FA, 30 to 60 minutes before exercise (12). One of the important points to increase performance in parkour is to increase explosive power in muscles and agility. Also, having a better body composition improves performance in this sport. Plyometrics are exercises that enable the muscles to reach their maximum strength in the shortest possible time. In a short period of time, these exercises take a lot of force from the athlete's nervous and muscular system and put a lot of pressure on the joints. Considering that plyometric trainings to increase jump power and agility, it can be hypothesized that plyometric training can increase performance and improve the position and stability of joints in parkour (13).

Although studies on HMB supplementation have shown the positive effects of its use on sports activities and exercises, but so far no study has been done on the quality of the effect of this supplement on the performance indicators of parkour athletes. Also, the effects of taking this supplement along with performing plyometric trainings are ambiguous. Therefore, due to the increasing importance of specific supplementation in sports and quality assessment of its effects, the present study was designed and conducted with the aim of the effect of HMB supplementation and plyometric trainings on body composition, agility, and standing jump power of parkour athletes.

## 2. Materials and Methods

### Subjects

The present study is a quasi-experimental study in the field and laboratory (8 weeks of supplementation and plyometric trainings and body analysis with In Body body composition analyzer in the clinic of a nutritionist as a pre-test and post-test and standing jump power and Illinois tests before and after eight weeks of research) were performed to investigate the effect of HMB supplementation and plyometric trainings on body composition and agility and standing jump power of elite parkour athletes aged 19 to 26 in Tehran. Among the eligible volunteers, 40 people who did not have any acute or chronic disease were selected as a statistical sample and were randomly assigned to experimental and control groups. In the present study, the following items were used as inclusion criteria:

- At least 6 years of professional parkour training experience
- Young men aged 19 to 26 years
- Do not smoke any tobacco until at least three months ago
- No history of cardiovascular disease, blood, liver, kidney, respiratory diseases, which was collected as a questionnaire.
- Do not use androgenic and energy supplements for at least three months
- Parkour training more than three days a week

## Exercise protocol

First, the participants were selected as a sample from people who did not have acute or chronic disease or did not take sports supplements and special medications. And the health questionnaire, consumption of tobacco and supplements, consent form and personal characteristics, physical activity questionnaire and food form consumed in the two days before Parkour training were distributed among them. In the second step, after filling in the medical-sports records form, the subjects were homogenized based on individual characteristics such as height, age, weight and body fat percentage, and then the goals and methods of conducting the research were explained to the individuals and written consent was obtained from them. Illinois and standing jump power and body composition tests were taken before and after the training program. Subjects were also asked to fast for the analyze body analysis and also to have not exercised or taken a bath before. In addition, subjects were asked not to take any sports supplements, anti-inflammatory or performance-enhancing drugs before the Illinois and standing jump power tests, and to follow the recommended diet. To measure the body composition and weight of the subjects, the In Body 230 body composition analyzer with an accuracy of one tenth of a kilogram was used. The subjects were weighed without shoes and socks and with minimal clothing. Subjects' height was measured manually. Subjects stood against the wall while their body weight was equally distributed on their foot and their heads parallel to the horizon, So that the back, shoulders, head, and heels feel the wall. Then, using a meter with an accuracy of one centimeter and the distance from the ground to the marked place was measured.

To measure the body mass index (BMI) of the subjects, the method of dividing weight (kg) by height squared (m) was used. Body composition was measured by bioelectrical impedance. In this method, which is used by hand-held devices and body impedance analysis (BIA), a small electric current passes through his body. Adipose tissue, water and fat disrupt the electrical current and thus measure the result and present it in the form of a sheet that contains the amount of water, fat and muscle all over the body (14). The Illinois test was used to measure agility. The necessary equipment for this test is 8 cones, chronometers and meters to measure the dimensions of the earth. In this test, on a 10-meter-long and 5-meter-wide ground, the runner starts running from the beginning, and after a 10-meter course, rotates around the cone and then returns to the same starting point. Then it goes around again and on the way back and forth, it passes the cone in a zigzag pattern. Finally, he turns and runs 10 meters to the next cone, and after rotating the cone, he returns to the finish line (15). The standing jump test was used to measure the standing jump power. This test is used to measure the explosive power of the legs. The measuring equipment for this test is a meter to measure the amount of jump and determine the take-off point. The subject stands behind the take-off line and puts his legs together. By swinging his arms and bending his knees, he puts more pressure to move forward and jumps. For each subject, the best record is recorded in three tests (16). In the third step, the subjects were randomly divided into four groups, which are:

**The first group** Eight weeks of supplementation and their own parkour training routine

**The second group** Eight weeks of plyometric training and their own parkour routine

**The third group** Eight weeks of plyometric training and HMB supplementation and their own parkour training routine

**The fourth group** The control group who participated only in pre-test and post-test along with their own parkour trainings

In the fourth step, to acquaint the subjects with the plyometric trainings and its intensity, the subjects were taught two sessions on how to perform the plyometric trainings and were given a suggested diet also nutritional behaviors and their effects on their performance and athletic development were discussed with the subjects. All four training groups continued training without significant injury (an injury that prevented them from continuing their activities). The HMB group and the HMB-plyometric group consumed three grams of HMB daily (with three meals a day of HMB biotech usa 1000 tablets). plyometric and HMB-plyometric groups attended plyometric trainings at 5 to 6 pm on odd days and performed the specified trainings. The training program for plyometric trainings was three sessions per week for 8 weeks. The training sessions began with a general and specialized warm-up of the joints and muscles of the whole body for 15 minutes (5 minutes of running to warm up the general body and 10 minutes to warm up the joints and muscles of the body).

## Statistical analysis

Two sections of descriptive and inferential statistics were used to analyze the data. The research data were first examined from a descriptive perspective to determine the mean, standard deviation, the relevant results of which are presented in Table 1. Then, Kolmogorov-Smirnov test was used to investigate the normal distribution of variables. Also ANCOVA statistical test was used to analyze the research data. results are presented in Table 1. Then to investigate the natural distribution of variables, the Kolmogorov-Smirnov test was used (Table2). Also all statistical analyzes were performed at the significance level of 0.05 and using IBM STATISTICS SPSS 25 statistical software.

### 3. Results

The results of 8 weeks of HMB supplementation and plyometric trainings on performance and body composition of elite parkour athletes in Tehran showed that there was no significant difference in 8 weeks of HMB supplementation on standing jump power, agility, improving body fat percentage, weight loss and BMI in male parkour athletes ( $P < 0.05$ ). Also, 8 weeks of plyometric training or taking HMB supplements along with plyometric training caused a significant difference in standing jump power, agility, improving body fat percentage, weight loss and reducing BMI of male parkour athletes ( $P < 0.05$ ). There are no significant differences between the pre-test and post-test measured in any of the dependent variables of the research in the control group ( $P < 0.05$ ).

### 4. Discussion

#### **standing jump power index changes**

According to the results, performing 8 weeks of plyometric training program and HMB supplementation increases the values associated with standing jump power. Increasing the of standing jump power in two groups of plyometric training and HMB-plyometric training are consistent with the results of research by Ramirez et al. (17) and Azbar et al. (18) and Imani et al. (19) who showed that plyometric trainings can increase strength and agility.

**Table 1: Descriptive statistics related to physical and functional indicators**

Variable	levels	groups			
		HMB	plyometric	HMB-plyometric	Control
Age(years)	Pre-test	22.6±2.3	22.8±1.9	22.5±2.3	22.1±2.2
	Post-test	---	---	---	---
Height(cm)	Pre-test	175.4±5.9	176.4±6	174±6	174.9±6.6
	Post-test	---	---	---	---
Weight(kg)	Pre-test	68±7.1	70.4±8.2	73±11.4	69.3±8.7
	Post-test	68.4±6.7	69.9±7.6	72.2±10.6	69.6±8.3
BMI(kg/m <sup>2</sup> )	Pre-test	22±1.1	22.5±1.6	24±3.2	22.5±2
	Post-test	22.1±1.1	22.3±1.5	23.7±2.9	22.6±1.9
BODY FAT (%)	Pre-test	11.5±2.2	11.5±2.3	13.3±5.1	12.6±4.2
	Post-test	11.3±2.2	11±1.8	12.6±4.5	12.7±4
standing jump(CM)	Pre-test	262.8±12.8	258.8±14.6	254.4±14.9	254.4±12.3
	Post-test	263.7±13.6	262.3±13	258.5±14.8	253.8±11.3
Illinois Test(s)	Pre-test	16.5±0.6	16±0.9	16.5±1.2	16.3±1.5
	Post-test	16.2±0.6	15.7±0.6	16.1±1.1	16.3±0.9



**Table 2: Results of one-way analysis of variance in research groups**

Variable	Source of changes	Total squares	Df	Average squares	F	P	Eta squared
standing jump(CM)	group	0/002	1	0/002	0/10	0/741	0/001
	Error	5/133	9	0/203			
	Total	7223/324	12				
Agility	group	0/002	1	0/002	0/020	0/830	0/002
	Error	4/294	9	0/650			
	Total	3097/000	12				
Body composition	group	0/003	1	0/002	0/10	0/878	0/001
	Error	3/875	9	0/439	0/10		
	Total	2671/491	12				



According to a study conducted in 2017, two new and experienced groups in parkour were compared with each other, and the experienced group performed better in jumping (20). According to another study conducted in 2015 by the same researcher, parkour training increases jumping power and muscle structure related to jumping (21). However, in the present study, no significant difference in standing jump power was observed for the control group who performed only routine parkour trainings. The reason for this can be attributed to the short study time of the groups (8 weeks). This is in line with the results presented in (20) in which the dependence of the increase in standing jump power of athletes overtime after training is mentioned (20).

#### agility index changes

The results of the agility index changes for the four groups are consistent with the changes in standing jump power presented in the previous section. Therefore, the obtained results are consistent with the findings of Chile et al. (22) and Azbar et al. (18) which show that performing plyometric trainings has a positive effect on agility. In addition, the control group performed better on average in the post-test than in the pre-test. The reason for the performance improvement in the control group was that the subjects practiced the Illinois test to record a better post-test record after the pre-test and complete familiarity with the Illinois test. The subjects in the control group, tested the Illinois test at least once between pre-test and post-test and tried to improve their performance. Of course, this also applies to other groups who, after full acquaintance after the pre-test, in order to improve their performance, which was not part of the trainings.

Also, beta-hydroxy-beta-methylbutyrate supplementation on agility in ANCOVA test, although not consistent with limited research by Mikalski et al. (23) and Miramonti et al. (24), but with a study by Connor et al. (25) And many other studies have suggested that HMB supplementation may be ineffective in professional athletes.

#### Body composition analysis index changes

In the present study, the results of ANCOVA statistical test showed that 8 weeks of plyometric training program and HMB supplementation along with plyometric trainings significantly improved the values related to body fat percentage, but weight loss and BMI indices of athletes in all the groups remained unchanged. In the control group, all indicators of body composition analysis were unchanged.

In the HMB group, body fat percentage in athletes did not change significantly, which is contrary to the opinion of Benton et al. And Mikalski et al. (23) and is in line with the results of Hoffman and Creeder (27). According to the results of ANCOVA test in the HMB-plyometric group compared to the plyometric group, it can be said that the combination of HMB supplement with plyometric trainings may increase the fat burning effect in professional parkour athletes.

## Δ. Conclusion

The research results of this study on male parkour athletes in the four groups show that performing plyometric training for 8 weeks without affecting the weight and BMI of athletes, increases the indicators of standing jump power, agility and improves body fat percentage. According to the research of this study doing routine parkour training alone for 8 weeks can not significantly increase the performance of this training. Also, studies show that taking HMB supplement alone does not have an effect on dependent variables in this research and only along with polymetric trainings can it cause more fat burning in athletes.

Therefore, according to the results, this research supports plyometric trainings compared to routine parkour trainings or taking HMB supplements.

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## Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethical approval** the research was conducted with regard to the ethical principles.

**Informed consent** Informed consent was obtained from all participants.

## Author contributions

Conceptualization: A.D., M.A.; Methodology: A.D., M.A.; Software: M.GH.; Validation: A.D., M.A.; Formal analysis: A.D., M.A.; Investigation: A.D., M.A.; Resources: A.D., M.GH., M.A.; Data curation: A.D., M.A.; Writing - original draft: A.D., M.A.; Writing - review & editing: A.D., M.GH.; Visualization: A.D.; Supervision: A.D.; Project administration: M.A.; Funding acquisition: A.D., M.A.

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