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EFFECTS OF BETA-HYDROXY-BETA-METHYLBUTYRATE SUPPLEMENTATION ON PHYSICAL PERFORMANCE OF YOUNG PLAYERS DURING AN INTENSIFIED SOCCER-TRAINING PERIOD: A SHORT REPORT

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ABSTRACT
Purpose. The objective of the study was to assess the effects of a 4-week intensified period of in-season soccer training with addition of explosive training and beta-hydroxy-beta-methylbutyrate (HMB) supplementation on maximal-intensity and endurance performance in young male soccer players, compared with a parallel training with placebo (i.e. magnesium stearate) supplementation.
Methods. A randomized, double-blind, placebo-controlled trial was conducted. Male athletes (age, 18.6 ± 1.4 years) were assigned either to a group receiving HMB supplementation (n = 9) or to a placebo group (n = 7).
Results. The athletes were evaluated for maximal-intensity jumping and endurance performance before and after the intervention. Before the intervention, the two groups were characterized by similar age, body mass, height, and soccer experience. In addition, no differences between groups were observed for physical performance measures other than a greater countermovement jump performance in the HMB group compared with the placebo group. After the intervention, neither group showed any significant change in any of the physical performance measures.
Conclusions. Compared with a 4-week intensified period of in-season soccer training with addition of explosive training and placebo supplementation, HMB supplementation did not add further adaptive changes related to maximal-intensity and endurance performance in young male soccer players.
Key words: muscle strength, strength training, ergogenic aids, maturity, plyometric training

INTRODUCTION

Muscle strength [1] and power [2] are key physical performance factors in soccer, predicting performance in speed and vertical jump, key actions during soccer matches [3] and competitive leagues [4]. Muscle strength and power may also play a role in injury prevention [5]. Specific endurance (e.g., Yo-Yo intermittent recovery test performance) may also positively affect the physical performance of players during a soccer match, especially among the young [6]. Therefore, training approaches aimed at increasing these fitness traits should be incorporated in the regular schedule of athletes, especially during the in-season period, to aid players in their competition endeavours. Explosive strength training leads to significant gains in strength and power-related measurements in soccer players [7–9], as well as endurance performance, particularly among young players [10–12], during the in-season period [13]. However, its incorporation during an intensified period of in-season soccer training and its interaction with other factors that may mediate adaptations to power, strength and endurance performances, such as dietary supplements [14–15], is unclear.

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Beta-hydroxy-beta-methylbutyrate (HMB) is a metabolite derived from leucine [16], stimulating protein synthesis by a mechanism dependent on mammalian target of rapamycin [17], growth hormone and insulin like growth factor 1 [18]. Because of this, HMB has become a popular sport supplement. Evidence shows that it is safe and can contribute to the overall health and well-being of users [19]. In young subjects, when combined with exercise, HMB supplementation has proved to be effective in increasing muscle mass and strength [20–21], to reduce fat mass [22], and to increase maximal oxygen consumption and ventilatory threshold [23]. Also, it may be effective in delaying the onset of neuromuscular fatigue [24], thus potentially helping to train more, perform better, and better tolerate intensified periods of training. However, studies in competitive athletes have found no effect of HMB supplementation on performance [25]. Moreover, the effects of HMB supplementation on strength measures such as reactive strength and on intermittent endurance have not been well addressed before. In addition, the effects of HMB supplementation on intermittent endurance, strength, and power of young soccer players during an intensified period of in-season soccer when mixed with explosive training are unknown.

Therefore, the objective of this study was to assess the effects of a 4-week intensified period of in-season soccer training with addition of explosive training and HMB supplementation intervention on maximal-intensity and endurance performance in young male soccer players, compared with a parallel training with placebo supplementation. We hypothesized that HMB supplementation would help to better sustain maximal-intensity and endurance performance in young male soccer players compared with a placebo intervention.

MATERIAL AND METHODS

The study was designed to address the question of how supplementation of HMB for a short-term (4 weeks) can influence the strength (reactive strength), power (vertical jump), and endurance (Yo-Yo endurance intermittent recovery test) of young soccer players participating in an intensified in-season soccer training program, aimed at increasing explosive and specific endurance performance. After baseline measurements, the participants were randomly assigned to a placebo control group (n = 7; age, 19.0 ± 1.5 years; body mass, 73.5 ± 7.7 kg; height, 1.77 ± 0.09 m; soccer experience, 3.1 ± 1.8 years) or to an experimental group receiving HMB (n = 9; age, 18.3 ± 1.2 years; body mass, 71.2 ± 7.3 kg; height, 1.75 ± 0.06 m; soccer experience, 3.6 ± 1.8 years). Both groups added an intensified period of 4 weeks of explosive training during the intervention. A similar number of defenders (2; 3), midfielders (2; 3), and forwards (3; 3) were present in the placebo and HMB groups, respectively.

Subjects

Initially, 24 outfield male semi-professional soccer players (age range, 19–23 years; four 90-minute soccer practices per week + one competition) participated in the study. Exclusion criteria were the following: (i) any medical problems or a history of ankle, knee, or back condition that compromised the participation or performance in the study; (ii) any reconstructive surgery on lower limbs in the previous 2 years or any unresolved musculoskeletal disorder; (iii) < 3 months of regular training in the team. As a result of these requirements, 8 participants were excluded from the study. All participants were informed about the experimental procedures and the possible risks and benefits associated with the participation in the study and signed an informed consent. The study was conducted in accordance with the Declaration of Helsinki and was approved by the ethics review committee of the responsible institutional department.

Procedures

Participants became familiar with the test procedures 2 weeks before the initial evaluation to reduce the effects of learning. The measurements were carried out 1 week before and after the intervention. To reduce the potential cumulative effect of fatigue on the results of the dependent variable, before and after the intervention, the athletes had at least 72 hours of rest between the last training/competition session and measurement session. The tests were completed on a given day and always in the same order, at the same time of the day, and by the same researchers, who were blinded to each participant's group assignment. The participants were instructed to wear the same shoes and sportswear during all testing sessions. The tests were performed indoors, on a wooden surface. Throughout the testing, the researcher to subject ratio was 1:1. A 10-minute standard warm-up (i.e. submaximal running with changes of direction, 20 horizontal and 10 vertical submaximal jumps) was executed before initiating the measurement procedures.

For the physical performance tests, 3 maximal trials were allowed, with the exception of the single Yo-Yo test. At least 2 minutes of rest were permitted between each maximal trial to reduce the effects of fatigue. The anthropometric measurements employed a stadiometer (Bodymeter 206, SECA, Hamburg, Germany) and electrical scales (BF 100 Body Complete, BEURER, Ulm, Germany). The tests for the squat jump, countermovement jump, and 20-cm drop jump followed the previously described protocols [26]. The Yo-Yo test was executed as previously described [6, 27]. Before testing, the participants performed a warm-up consisting of the first 4 running bouts in the test. The athletes were requested to achieve maximal effort during testing.

Training program

Both groups participated in the same soccer training program, with similar time of exposure to training and competition. The experiments were completed during competition (i.e. in-season), which was similar between groups. The participants in both groups added explosive drills [28] immediately after warm-up and before the technical-tactical part of the usual 90-minute practice, twice per week for 4 weeks. All training sessions were supervised with the coach to player ratio of 1:4. Both training groups completed the same number of total drills, sets, repetitions, used the same surface and time of day for training and the same rest intervals. A detailed description of the explosive training program added to the regular in-season soccer training of the athletes can be found elsewhere [28].

HMB supplementation, blinding procedure, and side effects

The HMB group participants received 3 g/day of HMB (MET-Rx, USA) over the course of the 4 weeks, divided equally into 3 parts, in accordance with the procedure described previously [21]. The first dose (i.e. 1 g) was given 30 minutes before exercise and the other 2 were administered at lunch and dinner. On non-training days, the participants were instructed to consume 1 of the 3 parts with separate meals throughout the day. The athletes in the placebo group were given the same dosage (i.e. 3 g/day) of magnesium stearate. Both HMB and placebo supplements were presented in capsules (1 g per capsule) with the same taste and texture. Compliance to supplementation was monitored weekly via personal communication. None of the athletes reported side effects. The supplement packages were coded, so that neither the investigators nor the participants were aware of the contents until completion of the analyses. The supplements were distributed by a staff member who was not an investigator in the study. Although this was not a diet-controlled study, the participants were asked to keep their regular eating habits during the intervention, and 1 week immediately before and after the intervention, each participant's energy and macronutrient intake was determined, as previously described [14, 15, 29].

Statistical analysis

The statistical analyses employed the STATISTICA package (version 8.0; StatSoft Inc, Tulsa, USA). All values are reported as means ± standard deviations. Normality and homoscedasticity assumptions made for all data before and after intervention were checked with the Shapiro-Wilk and Levene tests, respectively. The groups were compared with the use of a repeated-measures ANOVA, which allowed to determine the effects of the intervention on performance adaptations. When a significant F value occurred for interaction between groups or for main effects of group or time, Tukey post hoc procedures were performed. A one-way ANOVA was conducted to compare the pre-post Δ changes between the groups. The level of statistical significance was set as $\alpha = 0.05$.

Ethical approval

The research related to human use has been complied with all the relevant national regulations, institutional policies and in accordance the tenets of the Helsinki Declaration, and has been approved by the authors' institutional review board or equivalent committee.

RESULTS

Before the intervention, the two groups were characterized by similar age, body mass, height, and soccer experience. In addition, no differences between groups were observed for physical performance measures other than a greater countermovement jump performance in the HMB group compared with the placebo group (Table 1).

After the intervention, neither group showed any significant change in any of the physical performance measures (Table 1). When the pre-post Δ changes between the groups were compared, no significant differences were observed.

Table 1. Fitness performance measures before and after the intervention

	Before	After$^{\Delta}$	Change
Yo-Yo distance (m)			
Placebo group	1900 ± 327	1933 ± 464	+1.7%
HMB group	1823 ± 464	2000 ± 391	+9.7%
Squat jump (cm)			
Placebo group	32.0 ± 5.9	30.9 ± 7.9	–3.4%
HMB group	37.4 ± 2.6	37.6 ± 2.5	+0.5%
Countermovement jump (cm)			
Placebo group	32.0 ± 7.0	34.7 ± 7.1	+8.4%
HMB group	40.8 ± 4.0	41.5 ± 2.8	+1.7%
Elastic index (cm)			
Placebo group	0.5 ± 1.2	2.1 ± 2.3	+320%
HMB group	3.1 ± 3.0	3.5 ± 3.7	+12.9%
Drop jump (cm)			
Placebo group	32.6 ± 6.0	33.1 ± 7.4	+1.5%
HMB group	37.9 ± 6.0	38.4 ± 6.9	+1.3%
Drop jump (ms)			
Placebo group	241 ± 57.2	238 ± 50.2	–1.2%
HMB group	224 ± 59.1	224 ± 62.2	0.0%
Drop jump (ms/ms)*			
Placebo group	1.43 ± 0.5	1.42 ± 0.3	–0.7%
HMB group	1.78 ± 0.5	1.80 ± 0.5	+1.1%

HMB – beta-hydroxy-beta-methylbutyrate supplementation
Values presented as mean ± standard deviation.
* calculated as flight time / contact time; $^{\Delta}$ all changes $p > 0.05$

DISCUSSION

The objective of the study was to compare the effects of a 4-week intensified period of in-season soccer training with and without HMB supplementation intervention on maximal-intensity and endurance performance in young male soccer players. We hypothesized that HMB supplementation would help to better sustain maximal-intensity and endurance performance in young male soccer players compared with a placebo intervention. However, the results indicate that HMB supplementation is not more effective than placebo to sustain maximal-intensity or endurance performance in young male soccer players during an intensified period of in-season soccer training.

Contrary to our hypothesis, HMB supplementation did not aid soccer players to increase performance in the Yo-Yo test compared with placebo. Previous meta-analyses partially agree with these results, indicating that HMB supplementation might not be effective [25, 30] as a supplementation strategy. However, previous studies have proved an increased performance after explosive training was incorporated in soccer training [14]. The observed lack of improvements in endurance after explosive training might be explained with a lack of adaptations in neuromuscular factors related to running economy [31, 32] that otherwise may have positively affected the athletes' change-of-direction endurance results. However, independently of the lack of improvements, this is the first study to demonstrate that the combination of HMB plus explosive training did not induce a greater increase in the Yo-Yo test compared with placebo.

Both training groups showed a lack of performance improvement in their maximal jumping and power performances after the intervention. These results are in contrast with a previous study [12]. However, in our study, only a 4-week intervention period was applied. Longer interventions may lead to greater improvements [32]. Whether a greater training duration induces greater adaptations or a difference between the placebo group compared with the HMB group deserves further research consideration.

As neither group changed their dietary intake during the experimental period, the maintenance of body mass and body mass index in both training groups was not surprising. In general, these variables do not change in soccer players during short-term in-season soccer training periods [12] or periods comprising soccer-specific drills plus explosive training [14]. In addition, it has been already observed that there is no significant direct effect of HMB supplementation on the individual's body mass or body composition in highly-trained athletes [25, 30], such as those that participated in our study.

It is acknowledged that the motion characteristics of soccer players during match play may vary according to playing position [33], which might have changed the response to the training program. However, in our study, a similar number of defenders (2; 3), midfielders (2; 3), and forwards (3; 3) were present in the placebo and HMB groups, respectively. Therefore, the current results are probably independent from the variation of motion characteristics of players during match play and training. In addition, all participants were enrolled in the same competition time (in-season) and both groups participated in the same soccer and plyometric training program, with the only difference between the groups being the supplementation versus the placebo intervention, which reinforces the notion that the current findings are probably independent from factors associated with differences in soccer-training loads between the groups.

In conclusion, compared with an intensified period of in-season soccer-specific training plus placebo, the use of HMB supplementation during a 4-week period did not induce greater jumping or endurance improvements in high-level male soccer players.

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Disclosure statement

No author has any financial interest or received any financial benefit from this research.

Conflict of interest

Authors state no conflict of interest.

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