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Original Article

EFFECT OF VITAMIN E SUPPLEMENTATION TOWARDS DEVELOPMENT OF THE ANAEROBIC POWER AND PHOSPHATE MEDIATED RECOVERY OF SPRINTERS

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ABSTRACT

Objective: Anaerobic exercise has been considered as short duration high-intensity exercise requires anaerobic conversion of available biological phosphates to its active phosphorylated form by the enzymatic action of creatine kinase. Several research studies have been pointed out the role of vitamin supplementation and amelioration from exercise-induced oxidative stress. Vitamin E is a potential lipid soluble antioxidant has profound roles in amelioration of free radicals generated during endurance exercise. In this study, our attempt is to observe the effect of vitamin E towards development of anaerobic power and recovery by restoration of biological phosphates.

Methods: In this study, we have taken 30 male subjects from 100m and 200m sprinters of which half of them were given vitamin E supplement. The serum creatine and creatine kinase activity were measured in 100m and 200m sprinters after their exercise. Rapid Anaerobic based Sprint test and phosphate recovery test were applied to test the sprinting ability and recovery.

Results: It was observed that in both 100 and 200m sprinters subjects with vitamin E supplementation have better sprinting ability as confirmed from RAST test and quicker recovery than subjects whom vitamin E supplementation was not given; which are correlated with serum creatine kinase and creatine level suggesting that the vitamin E can improve in anaerobic performance.

Conclusion: From this study, it can be concluded that vitamin E supplementation develops the anaerobic power and phosphate mediated recovery of hundred meters (100m) and two hundred meters (200m) sprinters.

Keywords: Vitamin E, Anaerobic exercise, Creatine kinase, Rapid Anaerobic based Sprint Test, Phosphate recovery

INTRODUCTION

Vitamin E is a potential lipid soluble antioxidant has profound roles in amelioration of free radicals generated during endurance exercise. *In vivo* effect of vitamin E to reduce pro-inflammatory cytokines in different types of cells was proved by Huey and the team of Illionis researcher. To test whether the *in vivo* effect of vitamin E might have similar effects on skeletal and cardiac muscle, the same research group put Vitamin E to the test in mice. The team included study designer Rodney Johnson, whose previous work suggested a possible link between short-term Vitamin E supplementation and reduced inflammation of the brain in mice. The study showed the *in vivo* effects of Vitamin E administration on local inflammatory responses in skeletal and cardiac muscle [1, 2]. Our previous studies showed that Vitamin E supplementation boosted up the performance level of hill land football players but can be predicted that sole morphology do have a relationship with goal scoring ability considering the impact of hitting the ball and vitamin E also can improve leg strength, explosive strength and exercise oxygen uptake of male students along with treadmill exercise [3, 4].

Anaerobic exercise is an exercise that is intense enough to trigger lactate formation. It is used by the athletes in non-endurance sports to promote strength, speed and power and by the body, builders to build muscle mass. Muscle energy systems using anaerobic exercise trained to develop differently in compared to that of aerobic exercise, leading to a greater performance in short duration, high-intensity activities, which last from mere seconds to up to about two minutes [5]. A hundred meters (spelt meters in US), or hundred-metre dash, is a sprint race in track and field competitions. The shortest common outdoor running distance and it is one of the most popular and prestigious events in the sport of athletics. The two hundred meters (also spelled two hundred meters) is a sprint running event. The two hundred meter places more emphasis on speed endurance than shorter sprint distances as athletes rely on different energy systems during the longer sprint.

The purpose during recovery from exercise is to restore the homeostatic condition and energy balance of muscles and active part of the body involved in the exercise to their pre-exercise condition. Restoration of the body during recovery includes replenishing the energy stores that were depleted and removing lactic acid that was accumulated during exercise processes which require adenosine triphosphate (ATP). The oxygen consumed during the recovery period supplies the immediate ATP energy required during the recovery period. Restoration of the phosphate muscle stores (ATP+PC) requires only a few minutes whereas full restoration of the muscle and liver glycogen stores requires a day or more [6]. The speed of removal of lactic acid from blood and muscle can be greatly increased by performing light exercise rather than by resting during the recovery period. Small amounts of oxygen stored in muscle in chemical combination with myoglobin, are important during the performance of intermittent exercise because they are used during the work intervals and are quickly restored during the recovery intervals [6].

One of the most important factors in sprinting activity is to win the series of contests which typically involve high-intensity efforts. These high-intensity efforts will leave the player with depleted creatine phosphate (CP) stores and an accumulation of lactic acid in the muscles and blood. The levels of CP depletion and lactic acid accumulation will depend upon the duration and intensity of the efforts. The ability of players to keep producing high-intensity efforts may be dependent upon how effectively the CP system is replenished and upon the removal of metabolic by-products such as intracellular hydrogen ions and inorganic phosphates which are known to inhibit peak force during the high-intensity exercise.

The replenishment of CP stores and the oxidation of lactate are both oxygen-dependent processes. Significant correlations have been found between the maintenance of repeated sprint performances and aerobic power. However, the present study is an attempt to find out the relationship between the vitamin E supplementation on the development of the anaerobic capacity and phosphate mediated recovery. There is no evidence about the vitamin E supplementation mediated development of the anaerobic capacity and phosphate mediated recovery.

MATERIALS AND METHODS

The totals of sixty (60) male sprinters were taken as the subject of the study who has represented their District. Out of them, thirty were of hundred meters (100m) sprinters and rests of them were two hundred meters (200m) sprinters. The age of the subject ranged from 19-24 y. They were undergoing for a specific training programme throughout the year under the guidance of a qualified coach. The personal data of the subject that is the name, age, height and weight were taken. The sprinters were divided into 4 groups-1) Fifteen hundred meters (100m) sprinters without Vitamin E supplementation, 2) Fifteen hundred meters (100m) sprinters with Vitamin E supplementation, 3) Fifteen two hundred meters (200m) sprinters without Vitamin E supplementation and 4) Fifteen two hundred meters (200m) sprinters with Vitamin E supplementation. The subjects were informed in detail about the study and the consent of them regarding their voluntary participation was taken. Blood samples were collected by professionals in the presence of a doctor.

Vitamin E were supplemented in the form of capsules (Evion® 400 of Merck Serono, India division which was selected by consultation with medical professional) at the dose one capsule for every day (as per Takanami *et al.*, 2000) after lunch for 5 d per week for six weeks duration for group no 2 and 4 along with exercise and for group no 1 and 3 only exercise, no supplementation was given [7]. The entire subjects were from Nadia district, West Bengal.

Procedure for collecting data

Age, Height, and Weight of the subjects was considered as personal data. The procedure followed for collecting data for these measurements were as follows–

Age

Age was collected from the date of birth, and the information was obtained from the school records.

Height

The subjects were barefooted and stood erect with heels together, and the arms are hanging naturally by the sides. The heels, buttocks, upper part of the back of the head were in contact with the upright to look Straight ahead and taking a deep breath; then the head was brought down to the vertex of the subject. The vertical distance between there and vertex where the body height.

Weight

The weights of all the subjects were taken from a standard weighing machine. During weight taking the subjects were barefooted erect with heels together and hanging naturally by the sides on the platform of weighing machine.

Running based anaerobic sprint test

Prior to the test, the weight of each subject was taken for use in calculations followed by a warm-up. Cones were set up at each end of thirty-five meters of running track. Two testers were required as one person is required to time each run of thirty-five meters the other to time the ten seconds recovery period. The subject stands at one end of the thirty-five-meter track and starts a maximal sprint on the command 'go' ensuring the subject sprints maximally through the line each time. After ten seconds the next sprint starts from the opposite end of the thirty-five-meter track. The procedure was repeated until six sprints were completed.

Scoring

The time taken was recorded for each sprint to the nearest hundredth of a second (using timing gates provides greater accuracy). The sprint times along with body weight can be used to calculate maximal minimal and average anaerobic power outputs in watt.

Phosphate recovery test

This test involves seven flat-out sprints each lasting seven seconds, with twenty-three seconds recovery. Marker cones were placed two meters apart for the first twenty meters. At forty meters from the first cone, cones were again placed two meters apart to sixty meters. The subjects set themselves at the first cone (Start 1); on the command "go" each subject was sprinted all out for seven seconds. At seven seconds "time" is called and an observer had noted at what cone the subject had just past. The subject then had a twenty-three-second passive recovery (walk/jog) period before the next sprint. For the second sprint subjects were set themselves at the last cone (Start 2) facing back along the cones. At thirty seconds after the start of their first sprint they were sprinted again for seven seconds in the direction they had come. Again "time" is called at seven seconds and the distance run was recorded [8].

Scoring

The drop off distance was calculated by subtracting the distance covered in the last sprint by the distance covered in the first sprint. It is expected that the last sprint would cover less distance than the other sprints due to fatigue.

Blood collection and serum preparation

Blood was collected by using sterile dispovan syringe, and this blood was used to prepare the serum.

Creatine determination in serum

Creatine level in serum was determined directly on serum. Creatine was removed from ten ml of serum by the passage of the serum over one ml of a column of Dowex 50-H+. This step was required to separate the creatine from a large amount of pyruvate present in the serum as this amount will oxidize all the DPNH in the assay system. The creatine was eluted from the column with five (N) NHIOH and the solution evaporated to dryness. This creatine was then measured after dissolving it in a known volume of water. All of the creatine was removed, as repassage of the same serum over the column did not yield any more creatine. In addition, the passage of a known amount of creatine onto this column with subsequent elution gave full recovery of the creatine without conversion to creatinine. The serum contained 13.8 mg per liter of creatine.

Measurement of serum creatine kinase (CK)

Creatine kinase was determined according to the Alternate assay methods which were described by Dinovo *et al.*, (1973) [9].

Statistical evaluation

Each experiment was repeated at least three times. Data were presented as means±SE. The significance of mean values of different parameters between the various groups was analyzed using Students't' test. Pearson product moment correlation was used to test the significant co-relation between the variables. Statistical tests were performed using Microcal Origin version seven for Windows.

RESULTS

The data gathered from different tests were statistically analyzed adopting the method mentioned in methodology. The data on the personal variable and the fitness variables were analyzed in this chapter.

Personal data of subjects were measured, and these have been shown in table 1.

Table 1: Personal data of the subjects

Group	Height(cm)	Weight(kg)	Age(years)
Hundred meters (100m) sprinter without Vitamin E supplementation (n=15)	168.38±8.26	55.42±7.09	24.4±0.15
Hundred meters (100m) sprinter with Vitamin E supplementation (n=15)	166.91±8.69	55.81±3.62	24.4±0.75
Two hundred meters (200m) sprinter without Vitamin E supplementation (n=15)	169.40±9.34	57.60±5.58	24.2±0.45
Two hundred meters (200m) sprinter with Vitamin E supplementation (n=15)	168.21±3.94	57.21±7.92	24.4±0.25

Values are expressed as mean±SE for all of the four groups.

Table 2 represents the Pearson correlation between phosphate recovery and anaerobic power. It was observed that the r value was found to be greater that the corresponding r value at 0.01 level hence null hypotheses was rejected. Therefore a significant correlation exists between phosphate recovery and anaerobic power with vitamin E supplementation in case of a sprinter.

Table 2: Pearson product moment co-relation of between phosphate recovery and anaerobic power between hundred meters (100m) and two hundred meters (200m) sprinters with and without vitamin E supplementation

Groups	Phosphate recovery (meter)	Anaerobic power (watt)
Hundred meters (100m) sprinter without Vitamin E supplementation (n=15)	43.73±2.25	6.71±0.44
Hundred meters (100m) sprinter with Vitamin E supplementation (n=15)	52.19±1.31*	7.24±0.17*
Two hundred meters (200m) sprinter without Vitamin E supplementation (n=15)	54.41±1.81	6.97±0.37
Two hundred meters (200m) sprinter with Vitamin E supplementation (n=15)	67.27±2.55*	7.88±0.02*

The values are expressed as mean±S. E.; *P<0.001 as compared to values of the subjects without Vitamin E supplementation using Student 't' test.

Table 3 represents the mean value of the activity of the enzyme (i.e. creatine kinase) and level of creatine at serum for both hundred meters (100m) sprinter and two hundred meters (200m) sprinter groups. It was observed that the r value was found to be greater that the corresponding r value at 0.01 level hence null hypotheses was rejected. Therefore a significant correlation exists between phosphate recovery and anaerobic power with vitamin E supplementation in case of a sprinter.

Table 3: Effect of vitamin E supplementation on the activity of serum creatine kinase (CK) and creatine level of hundred meters (100m) and two hundred meters (200m) sprinters after exercise

Groups	CK activity (Units/min/ml)	Creatine level (mg/ml)
Hundred meters (100m) sprinter without Vitamin E supplementation (n=15)	39.04±0.27	0.83±0.002
Hundred meters (100m) sprinter with Vitamin E supplementation (n=15)	26.41±0.44*	0.65±0.012*
Two hundred meters (200m) sprinter without Vitamin E supplementation (n=15)	40.48±1.02	0.71±0.001
Two hundred meters (200m) sprinter with Vitamin E supplementation (n=15)	29.47±0.31*	0.52±0.004*

The values are expressed as mean±S. E.; *P<0.001 as compared to values of the subjects without Vitamin E supplementation using Student't' test.

DISCUSSION

Anaerobic exercise is an exercise intense enough to trigger lactate formation. It is used by athletes in non-endurance sports to promote strength, speed and power and by the body, builders to build muscle mass. Muscle energy systems trained using anaerobic exercise develop differently compared to aerobic exercise, leading to a greater performance in short duration, high-intensity activities, which last from mere seconds to up to about two minutes [6]. The purpose during recovery from exercise is to restore the muscles and the rest of the body to their pre-exercise condition. Restoration of the body during recovery includes replenishing the energy stores that were depleted and removing lactic acid that was accumulated during exercise processes. The oxygen consumed during the recovery period supplies the immediate ATP energy required during the recovery period. Restoration of the phosphate muscle stores (ATP+PC) requires only a few minutes whereas full restoration of the muscle and liver glycogen stores requires a day or more.

In case of running based sprinting activity it is extremely important for an athlete to generate anaerobic power at maximum threshold, simultaneously recovery from this high-intensity exercise is also an important factor as because replenishing of energy stores by inorganic phosphates like ATP, GTP, CTP, TTP, CP prepares for further activity and restore the energy balance. Studies by Zagatto *et al.*, (2009) had shown that RAST has a significant co-relation with the Wingate test and more easily be applied for measuring anaerobic power [8].

Serum creatine kinase enzyme activities increase during and after exercise. The highest post-exercise serum enzyme activities are found after very prolonged competitive exercise such as ultra distance marathon running or triathlon events [9]. Weight-bearing exercises, which include eccentric muscular contractions such as downhill running, induce the greatest increases in serum enzyme activities [10]. We have observed that vitamin E supplementation significantly reduces serum creatine kinase activity in both the sprinter tested after exercise.

In this study, we have found that there is a significant positive co-relation between phosphate recovery as well as anaerobic power with vitamin E supplementation in both the sprinter groups. Several research studies like Dawson, (1991) have found a significant co relation between total sprinting time and anaerobic power [6]. For high-intensity exercise, this mediate phosphate recovery is important as it de-phosphorylated ATP, CTP, TTP, GTP combines with Creatine phosphate to restore the biological triphosphates by the enzymatic action of creatine kinase [11]. As anaerobic power refers the ability to produce high energy within a very short duration of time, so this production route bypasses glycolysis and directly produce ATP,GTP,CTP,TTP by the enzyme creatine kinase which in turn use de-phosphorylated phosphates as the substrate, so it is extremely important that anaerobic power generation is largely based on phosphate mediated recovery, and in this study we have reported a relationship between vitamin E supplementation with anaerobic power and phosphate mediated recovery.

CONCLUSION

The high-intensity periods during the RSA test is long enough to deplete CP stores to the extent which requires large contributions from the anaerobic glycolysis. Although speculative, the largest contribution to the energy demands of the test is likely to be made by the phosphagen system. Therefore for continuous high-intensity events like sprinting, phosphate mediated recovery is very important to produce anaerobic power and thereby to achieve peak performance. This study had established that vitamin E supplementation can potentially improve anaerobic performance. Further studies to be focused on appropriate diet combined with supplements with a complex set of exercise towards quicker phosphate mediated recovery will open a new avenue in this field.

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CONFLICTS OF INTERESTS

Declare none

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