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**THE EFFECTS OF A PRE-WORKOUT SUPPLEMENT ON COLLEGIATE TRACK
ATHLETES' SUB-MAX BENCH PRESS**

Cedarville University

Senior Research Paper

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Nutritional supplements are one of the fastest growing industries currently on the market. According to Forbes magazine in 2012, 32 billion dollars in revenue was collected from nutritional supplements alone and it is predicted that number will double by 2021 (Lariviere, 2013). The main consumers of supplements are athletes and avid lifters looking to increase muscle strength and size. Muscle Pharm is one of the leading supplement brands in the industry today. The procedures of this experiment were designed to test the extent of Muscle Pharm's pre workout supplement through a sub maximal bench press test. Subjects were asked to participate in a two week study where each individual came in for four separate sessions. The first session the subjects were tested to find their maximal bench press. The second session was the control day where participants were tested for their maximum number of reps at 75% of their max with no supplement. For the third and fourth session subjects were given either a placebo or a pre workout and tested again at 75% of their max. The results were then compared using the SPSS repeated measures program. The pool of subjects came from Cedarville University's track & field team. The population was 17 student-athletes ages 18-22, both male and female, who were all experienced lifters. Results showed significance between the control and supplement sessions but showed little difference between the placebo and the supplement.

Pre Workout Supplements (PWS) are commonly used for recreational training or in athletics. They claim to help improve focus, energy, and overall workout quality (Blanco, 2011). The primary shortcoming of PWS is that the majority of the research done on its effectiveness is covered by shallow marketing, decreasing its validity. Because it is a supplement, and is not essential for bodily function, the primary goal is to convince active adults or athletes that they need the product to improve their workout quality. Though the claims may be true it has not been proven through extensive scientific research. The advertising requires that the research be

condensed in order to appeal to the average American. The claims that many PWS companies make for their product does not possess scientific research to provide it with a strong stance despite negative publicity. The three primary active ingredients in the PWS used in this experiment are caffeine, creatine, and amino acids (Spradley, et al., 2012). Through research from previous experiments it can be deduced that ingestion of a PWS will positively affect the results of 75% bench press of track collegiate athletes.

The first active ingredient found in the PWS is caffeine, which is where the majority of the desired effect comes from. Caffeine stimulates the central nervous system causing an increase in adrenaline, dopamine, and epinephrine (Hoey, N. P., 2012). The effects of the central nervous system stimulation lead to higher energy levels and a more alert state. This can have direct effects on the quality and length of an individual's workout session. Caffeine can also have an analgesic effect in the body leading to a lower perception a pain. If the pain tolerance of a person is increased they will be able to perform at a higher level in their exercise before their mind signals for them to stop from pain. In a research article written by Juan Del Coso et al. an experiment was conducted on the effects of caffeinated energy drinks on male volleyball players performance (Del Coso et al., 2014). The results showed a positive effect on the players performance caused from caffeine intake before the test. It was deduced from the experiment that 3 mg of caffeine per kg of body weight can have beneficial results on players athletic performance (Del Coso et al., 2014).

In another research article an experiment was performed on cyclists to measure the effects of caffeine on endurance performance as well as on sleep quality. The athletes were tested in an afternoon workout and given either placebo or caffeine supplement. They were given one an hour before the workout, 40 minutes into the workout, and a final dose after their evening

meal. They then monitored the athletes sleep after the workout and supplement ingestion. The research showed that the workout quality was increased with caffeine, but the sleep results were lowered from late afternoon caffeine intake (Miller B. et al., 2014). The research resulting from this experiment gives evidence to the positive effect of caffeine on workouts but includes the possible negative results it can have on sleep quality if caffeine is ingested too late in the day. Sleep deprivation can have drastic negative effects on athlete performance and therefore should be monitored by each athlete. Despite the beneficial aspects of caffeine the intake should be monitored and not recommended for late afternoon or evening workouts.

Creatine is the second active ingredient found in most PWS. Phosphocreatine is catabolized within the cell into its phosphate component in order to create Adenosine triphosphate (ATP) and provide chemical energy for muscle contractions (Arazi et al., 2011). ATP assists in creating action potentials, which causes the energy for the muscle contraction. Increase in phosphocreatine storage can lead to an increase in ATP production, providing more chemical energy availability for muscle contraction (Kraemer et al., 1999). Because creatine provides initial energy it can be deduced that the ingestion of creatine would be most effective for short burst exercises (Branch, 2003). In a study conducted by Hickner et al. on the effects of creatine supplementation on muscle metabolism of a simulated bicycle road race it was concluded that creatine storage is not effective in long duration workouts (Hickner, et al. 2010). Ninety five percent of the phosphocreatine is stored within the body's skeletal muscle (Cooper et al., 2012). Creatine phosphate typically is depleted of its supply of ADP rapidly during exercise therefore the addition of creatine, through supplementation, would provide more energy for the body to draw from to support the rapid rate of muscle contractions (Kraemer et al., 1999). The Assault supplement is geared towards high intensity exercise sessions. Therefore it can be shown

that the ingestion of creatine will help to improve the overall effectiveness of weight lifting exercises. The amount of creatine availability is also regulated by the cell's ability to receive it because it cannot be created in the body (Clark, 1998). When the storage of creatine phosphate is increased it leads to a greater production in ATP, powering the muscles and increasing the rate and length of muscle contraction through faster detachment of actin and myosin cross bridges. (Branch, 2003).

Beyond advancing the availability of ATP for muscle contraction, creatine can also lead to greater glycogen storage (Cooper et al., 2012). The combination of a high carbohydrate diet and creatine can lead to a higher level of glycogen storage after a high intensity workout. The greater the amount of creatine that is available, the longer the body can sustain itself in the initial anaerobic stage using creatine as the main energy source. When creatine is the main energy source, glucose is not depleted in the body initially and therefore allows the individual more energy for a longer workout routine. By extending the overall time the body uses creatine this delays the time before the body uses glucose as the main energy source.

Creatine has also been proven effective in decreasing the process of glycolysis. When this occurs it leads to lower amounts of ammonia build up in the blood plasma which can lead to muscle exhaustion (Birch et al., 1994). It can also prevent muscle soreness by decreasing lactate accumulation (Branch, 2003). A decreased amount of muscle soreness can have an effect on the current workout as well as the recovery afterwards. In the research performed by Birch et al. their results revealed lower levels of Plasma Ammonia despite the increase in performance of their clients in the bike test.

Beyond the effects of creatine alone, when added to other ergogenic aids, it can lead to even better result (Kedia et al., 2014). Assault combines creatine with caffeine and amino acids

to help athletes to better utilize the energy in their bodies for their work outs. Creatine alone has been shown to have beneficial effects for exercise but in combination with the other ingredients those benefits are increased (Kedia et al., 2014). Therefore in light of the ingredients in the PWS it can be deduced that the combination of the ingredients in the PWS will cause an increase in overall athletic performance.

Amino acids are the final major component in the chosen PWS. Amino acids are essential in the body because they are the foundation of muscle protein synthesis. Without amino acids, essential and nonessential, the body would have no way to create and repair new muscle tissue. The reverse is also true. The protein in muscle tissue can also be catabolized to its original amino acid and used as fuel for the body when necessary. For this to occur, the amino acid must travel to the liver and transform into glucose. (Powers, 2012). The more amino acids that are available during exercise, the greater number that can be taken to the liver to be transformed into glucose (Noaska, 2007). This increase of Amino Acid availability does little during exercise, but is helpful in the recovery stage. The Amino Acids present in the PWS would be beneficial with consistent, long-term use to aid in muscle recovery, but should not affect one-time uses. Any increase strength gains seen in our study should be due to other components in the PWS (Ratamess, 2007). After resistance training muscle protein breakdown is increased (Noaska, 2007). Since amino acids are imperative for protein synthesis, the increased availability of amino acids should result in reduced soreness, fatigue, and muscle damage after training (Ratamess, 2007).

In the research studies that currently exist, many had positive results when ingesting a pre workout supplement before intense physical activity. Improved upper and lower body endurance as well as increased perceived energy and reduced fatigue are a few of the most common

findings. Despite this, there are also several studies that showed no specific effect on the participant's performance. We also have to consider that many of these studies are looking only at caffeine, just one ingredient in many pre-workouts on the market today. Because of this, we wanted to see if the combination of creatine, amino acids, and caffeine would have any effect in a bench press.

Methods

We chose to do track athletes, specifically sprinters, jumpers, and throwers. To recruit participants we sent out an email to these athletes asking if they would want to volunteer to take part in our study. During this time we also got in contact with Muscle Pharm and they were kind enough to partner up with us and provide us with both the Assault and a placebo.

Upon the arrival of the athletes on the first day, all subjects signed an informed consent that stated the procedure, the possible risks and benefits, as well as what we expected of them. The subjects completed a survey indicating how often they weight lifted, the approximate amount of caffeine consumed daily, and any activity completed or supplements taken, including caffeine, in the past 24 to 48 hours, respectively. Subjects were asked not to consume any pre workout supplements 48 hours before the testing as well as to refrain from strenuous activity 24 hours before testing. Each subject's height and weight was recorded before beginning the procedure. Each subject then performed a 1RM baseline bench press and from that, 75% of their maximum bench press was calculated from that measurement.

After a two to three day break subjects came in for the second session where they performed 75% of their 1 RM until failure. This was the control day. After another two to three day rest each subject came in for the third session where they were given substance A or B and

asked to perform 75% bench press until failure. For the fourth session, subjects took the other supplement and were tested for their max number of repetitions again.

Before each day of testing, each subject would perform a shoulder warm-up that consisted of internal/external rotation and shoulder circumduction. They would also do a warm-up that involved the bar-bell. This warmed up consisted of doing 55% for 8 reps, 65% for 6 reps, 77% for 4 reps, and 87% for 2 reps. These percentages are based off of what the subject predicted their 1 RM on day one. For the rest of the days the percentage was based off the 75% of their 1 RM. Each client was taken through the same warm up routine for each session to avoid injury.

Results

According to the SPSS repeated measures results showed a p value of .367. According to the pairwise comparison there was not a significant difference between the rounds where participants drank product A or B. The mean difference between the placebo and muscle pharm were not significant. Product A had a mean of 14.67 with a standard deviation of of 4. Product B had a mean of 14.53 with a standard deviation of 3. Therefore, it can be concluded that the difference between the control was significant but the difference between muscle pharm and the placebo were not significant.

Discussion

According to the SPSS results Muscle Pharm did not have a statistical significant difference in comparison to the placebo. There are a variety of factors that we will discuss that could have caused this lack of change.

One of the first causes is the placebo effect on physical performance. It has been proven multiple times that the mind can have a powerful effect on the outcome performance in athletes.

The placebo effect can range from 100% to no effect at all depending on certain factors (Placebo effect, 2014). Three specific factors of the placebo effect are “preset belief and expectations, context of delivery, and biological mechanisms involved (Placebo effect).” In our experiment each subject was aware of their physical fatigue due to the fact that they are all collegiate track athletes and are hypersensitive to their bodies. Both supplement A and B looked similar enough to create an uncertainty of which one was the actual supplement therefore creating the environment for the placebo effect. According to these factors each athlete had the potential to experience the placebo effect. Therefore, this could have been one of the causes in the lack of significant difference between product A and B.

The second cause of the lack of difference would be the design of the test. The Muscle Pharm product is designed specifically to delay fatigue in a complete workout in order to increase the ability of the athlete in his exercise program. Our test was very short and did not truly test the strength and especially endurance of the muscles. The test administered to these athletes was based on a one time repetition to fatigue with the bench press. The results of the PWS would have had a greater effect if the exercise being tested was for a longer period of time. For example if we would have had three rounds of sub max bench press testing where the client had to push to fatigue within each round there is a greater likelihood that the numbers would have had a greater difference. The PWS would have lessened the effect of fatigue therefore allowing the athlete more repetitions within each round.

Finally, the last cause could have been the competitive mindset of the athletes. Track and field is a sport which specifically pushes its athletes to beat themselves. Athletes are always being pushed to run faster, jump higher, or throw farther. This mindset is instilled in collegiate athletes who have participated in track for many years. According to this mindset, it could be

concluded that the different set of scores was based less on the supplement taken and more on the athletes mindset to beat their previous score. Each athlete was randomly given either product A or B first and they were told their previous score. If an athlete was not aware that they had the supplement then their mindset would only be based on their desire to beat their previous score. This factor is difficult to prevent because the athletes can keep track of their previous score and will set that in their mind to beat. For future research should try using individuals who are less competitive or regulating the scores so that individuals do not know what they received the previous round.

For future research on PWS it would be recommended to use a different group of individuals for the testing. The athlete competitive mindset can have an effect on the resulting numbers. An athlete will push themselves to beat their previous score despite having the supplement or not. If the group consists of sedentary individuals then that will lower the risk of higher numbers from the athlete trying to beat their score. It would also be recommended that the researchers change the testing procedure to a longer fitness assessment. For example there would be a better result if the researchers tested the bench press but had three rounds each session where the individual went until failure. The PWS would have a greater effect on the second and third rounds causing a greater significance in the results.

We also had four outliers in the study. There were two main reasons we identified were sickness or muscle endurance. Two of the athletes that we tested were sick during one test and healthy during the other test. This could have been the reason for their skewed test results, since sickness affects how well a person can perform. The second reason we think had to do with the physiological make-up of two of the athletes. While we only tested the track athletes who participate in the field events and the 800 meters and down (who are all more focused on power

than endurance) some athletes are still more inclined to have more Type 1 muscle fibers. This caused their max to be fairly low, but they were able to do many sets at this low weight.

Despite the shortcomings of the research experiment, the results show that there is an effect of the PWS on an athlete's 75% bench press results. The results proved both the effect of the PWS as well as the effect of placebo on individuals exercise capacity. Both the placebo and PWS resulted in increased number of repetitions of the athletes in their bench press results.

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