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The Effect of Pre-workout supplement on Fitness Assessment Tests

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Abstract

Research regarding the benefits and detriments of Pre-workout supplement has gradually increased since its popularity arose in the early 1980's. There have been a number of studies on its effects on human physiology during a workout; however, there are few studies regarding Pre-workout supplement during fitness assessment tests. Therefore, further insights concerning Pre-workout supplement and fitness testing is needed. Pre-workout supplement is taken prior to a training session and has been shown to enhance a workout by increasing aspects such as focus, reaction time, stamina, and power. This could be viewed as solely a psychological enhancement than an actual physical amplification of performance. Considering this, Pre-workout supplement may or may not have an effect on the outcome of a variety of fitness tests. Therefore, the purpose of this study was to determine if a serving of Pre-workout supplement would affect the outcome of various fitness assessments.

Background

Pre-workout supplement is a generic name for a popular group of supplements that, among the athletic and fitness communities, are taken prior to a training session. Individuals consume these supplements with the belief it will enhance their performance abilities by increasing focus, reaction time and power. Pre-workout supplement is made up of multiple ingredients that all combined are thought to create an overall increase in performance. This study was done using Jym Pre-Jym Pre-workout supplement. This Pre-workout supplement has many of the same ingredients that have been found in most commercially available Pre-workout supplements. Pre-Jym has various online reviews reflecting its effectiveness as having an overall noticeable increase in performance.

One of the active ingredients is caffeine. Caffeine is a stimulant for the central nervous system that is most often tied to alertness. Muscular endurance and reaction times are generally influenced by caffeine which is found in most Pre-workout supplements. The caffeine acutely increases the individuals resting heart rate and blood pressure while also stimulating lipolysis. Although one study researched did not state the amount of caffeine administered, there were ergogenic effects shown. With the administration of caffeine, improvements in both aerobic and anaerobic performance were shown (9). Our Pre workout supplement contains 300 mg of caffeine, whereas, one study researched used relative amounts of caffeine per participant weight. This study showed improvements in endurance and energy expenditure (13). Caffeine has also been shown to block adenosine receptors, which then increases dopamine. The increase in dopamine permits the central nervous system to operate differently in a way where an intense workout could be accomplished without feeling fatigued, thus, enhancing performance.

Creatine (Cr), another main ingredient in Pre-workout supplement and has been known to cause effects such as decreasing body fat, increasing fat-free mass (FFM), and improving power and strength. Cr aids by increasing stored creatine phosphate which allows for the regeneration of adenosine triphosphate following high-intensity workouts which in turn ameliorates strength and anaerobic power. Some ergogenic effects of Cr include larger strength gains caused by increasing the training intensity and volume (6). Many Cr supplement users have increases in muscle phosphocreatine (PCr) content; however, this does not affect all users, and many do not experience this increase at all (10). Most users take Cr either 30 minutes prior to exercise or directly proceeding. Cr has shown not to take effect until approximately 30 minutes post ingestion. Cr is maximized when taken more than once per week to optimize the suboptimal Cr stores that is your body's natural state. Post-workout Cr is taken in combination with carbohydrates or protein in order to maximize muscle retention. Another interesting realization is that Cr supplementation does not improve aerobic exercise performance, the rate of maximal force production or maximal isometric strength (7).

Branched chain amino acids (BCAAs) and amino acids both are important components to this Pre-workout supplement as well. The difference between BCAAs and amino acids are BCAA's are essential amino acids that the body cannot produce, thus, they must be obtained from food. Leucine, isoleucine and valine are the 3 BCAAs included in this Pre-workout supplement. BCAAs aid in muscle protein synthesis and recovery times during exercise (8). They have also been shown to aid in fatigue during prolonged exercise. This is due to a few key components, tryptophan, BCAAs, and 5-hydroxytryptamine (5-HT). One study found during long duration exercise an increase in the plasma concentration ratio of tryptophan and BCAAs which in return causes the rate of 5-HT to increase. Elevated 5-HT has been shown to be

responsible for the development of physical and mental fatigue during exercise (2). Another study found that BCAAs given prior to a 30-km cross-country race showed to positively affect both physical and mental performance during the race. To note, this study did not explicitly say the time between ingestion and exercise. The times of even the “slower” runners significantly improved (3).

Beta-alanine, another ergogenic ingredient in Pre workout supplement, is a naturally occurring beta amino acid. It is also a popular supplement among athletes and exercise enthusiasts. It has been shown to not only benefit performance during a workout, but overall health as well. Beta-alanine has the ability to produce carnosine when combined with another amino acid, histidine. There are high amounts of histidine and low amounts of beta-alanine in the body naturally. When beta-alanine is taken in supplemental form, it increases the carnosine levels dramatically. The carnosine is then able to be stored in the skeletal muscles and will work as a buffer against acid that is built up during exercise. This buffer allows for an increase in endurance for the individual. Beta-alanine supplementation has consistently shown to augment carnosine levels in skeletal muscle (7). This amino acid has also been shown to increase exercise capacity. Across two separate studies, the conclusion that beta-alanine supplementation provided significant ergogenic effects, particularly with exercise capacity tests and measures (6).

Overall, Pre-workout supplement and its variety of ingredients has been proposed to enhance exercise performance as a result of the active ingredients. It may improve athletic performance and help individuals perform better during fitness assessment testing. Therefore, the purpose of this study was to determine the effect of a Pre-workout supplement (Pre-Jym) on various fitness test assessments.

Methods

Subjects

This study was completed in the exercise physiology lab at Western Michigan University, Kalamazoo, Michigan. A power analysis (G*Power) determined that a sample size for this study should be 34 subjects. The researchers were able to fully complete 18 participants. Subjects were initially recruited via the Western Michigan University Recreation Center through the posting of flyers requesting volunteers. Additionally, participants were recruited from Western Michigan University, via class presentations, all of whom were undergraduate level college students. Table 1 presents the demographic information of the subjects who completed the study. Sexes were pooled together due to no differences in data between them.

Descriptive Statistics

	N	Minimum	Maximum	Mean + SD
Height (cm)	18	153.0	191.0	174.8 ± 9.17
Weight (kg)	18	55.9	92.3	73.9 ± 10.28
Age (yr)	18	19	23	21.4 ± 0.85
BMI	18	20.4	29.7	24.1 ± 2.36

Table 1. Descriptive Statistics of Population (N=18).

Sessions

There were three sessions for each participant; (1) orientation session (2) first session and (3) second session. The initial meeting for participants was introduced as the orientation session. For all participants this led directly to the first session. The second and third sessions were held a week apart on the same day and same time for most participants. During the orientation session, the investigator used ACSM guidelines (1) for the pre-participation screening to determine if there were any risks for each potential subject. If the potential participant fell under the low risk

classification, the first testing session commenced. The low risk classifications for participating are based on cardiovascular risk factors. In addition, any potential subjects who were currently smokers, taking prescribed medication or had a known long-standing medical condition, were not considered for the investigation.

Orientation Session

During the orientation session, the participant first reviewed the informed consent document. Prior to the start of this study, the WMU Human Subjects Review Board reviewed and accepted this document. If the participant had no questions, the student investigator verbally explained the informed consent document and if there were no further questions, the participant was asked to sign the informed consent document. One copy was maintained and a copy was provided for the participant. Next, the participant completed the ACSM Health/Fitness Facility Preparticipation Screening (1). Once both the screening and consent documents were reviewed by the student investigator, the student investigator then determined if the participant was eligible for the study. Each participant, who chose to, then stayed for what would be called the first session. No data was collected before the informed consent document was signed. All data collected is solely available to the investigators indicated on the consent document. All data is stored in Dr. Michael's office, in a locked file cabinet, and will be retained for three years.

First Session

This session was combined with the orientation session for all 19 participants. Before beginning, the student investigator explained and demonstrated each assessment. They were shown the fitness assessment equipment and how to properly engage in each assessment. All questions were answered prior to completing each test. After familiarization, the investigator took each subject's height, weight, age, resting blood pressure and their resting heart rate. Heart

rate was taken after having each participant put on a Polar FT1 heart rate monitor. After resting 10 minutes in a seated position, heart rate was recorded along with blood pressure.

Next, each participant was randomly given either Pre-workout supplement (T1) or a placebo (T2). For this study, the Pre-workout supplement was Pre Jym Pre-workout and the placebo was one serving of a crystal light packet dissolved in an equivalent amount of water. The color and flavor between the Pre-workout supplement and placebo were matched. Both of which were mixed into 12-ounce water bottles. Each participant then sat for 30 minutes following the ingestion of the Pre-workout supplement or placebo. According to the Pre-workout supplement, 30 minutes is the time frame for the given effects to begin due to Cr being shown to not take effect until approximately this time. After waiting the 30 minutes, the fitness assessment tests began. The order of Pre-workout supplement and Placebo was randomly assigned to each participant.

Second session

This session matched the first session, with the exception of obtaining demographic characteristics. Again, the participant's resting heart rate and blood pressure were taken after putting on the heart rate monitor and sitting for 10 minutes. Following this, the participant took the opposite of what they were given during the first session. For example, if they took T1 for the first session, then they were given T2 for the second session. The subject then sat for 30 minutes and following this the fitness assessment tests began.

Fitness Assessment Tests

All of the fitness assessment tests were completed as specified by the ACSM's Physical Fitness Assessment Testing Manual (7). The tests included 2. Queen's College Step Test; 3. YMCA sit and reach; 4. Curl up; 5. Vertical jump test; 6. YMCA bench test. These tests were

done in this order. These tests were chosen based on the overall effects of Pre-workout supplement such as increased heart rate, increased strength, increased stamina, etc. The following is a further explanation of how each of these tests were conducted.

1. Resting Blood Pressure and Heart Rate

- a. Using ACSM guidelines (7), the subject was seated with the elbow slightly flexed, making sure no substances that can affect BP have been ingested prior. The cuff was placed around the upper arm at heart level. Cuff was inflated to 200 mm Hg or 20 mm Hg over estimated SBP. Release of the cuff pressure 2-3 mm Hg/sec and noted the first Korotkoff sound (systolic) and the last Korotkoff sound (diastolic). The first is the systolic pressure and the second is the diastolic pressure. Heart rate was recorded from a Polar heart rate monitor.

2. Queen's College Step Test

- a. This test is completed using a standardized 16.25 inch step with a rate of 24 steps per minute for men and 22 steps per minute for women. A metronome was set at four times the step rate (96 for men and 88 for women) to allow for coordination of each movement of the leg. The step cadence is four beats; up-up-down-down. The test ended after three minutes. The recovery heart rate of the participant was recorded and was used to calculate $VO_2\text{max}$ using one of two equations based on sex.

3. YMCA Sit and Reach

- a. This assessment was done using YMCA standards (12). It is a test of flexibility. A yardstick was taped onto the floor. The participant placed their heels at the 15 inch mark on the yardstick, legs flat on the ground. They were instructed to slide

their hands, palm over hand onto the yard stick to a maximal distance. It was made sure that they held it for 1-2 seconds to ensure accuracy. The best of two trials was recorded (12).

4. Curl-up

- a. This test measures abdominal strength and endurance. The participant was in a supine position on a mat with their legs at a 90-degree angle and hands face down at their side. The participant followed a metronome set to 50 beats per minute. The participant curled their body up, taking their shoulder blades off the mat then returned to the original position with their back flat against the ground. Each movement was at the pace of the metronome. This test concluded after the participant could no longer go any further or broke pace with the metronome.

5. Vertical Jump Test

- a. The participant stands on a Just Jump contact mat and faced whichever direction that felt most comfortable. The feet were approximately shoulder width apart. The maneuver was done by quickly lowering into a squat as far as they felt comfortable, having their hands on their hips the entire time. The participant jumped and the vertical jump mat manually calculated their jump height based upon the time the feet are not in contact with the mat. Best of three trials was recorded.

6. YMCA Bench Test

- a. This test allows for a standardized method to determine muscular endurance where the participant will complete as many repetitions that they could of a bench press. The participant lies supine on the bench with their feet on the floor. Women

used a 35-pound barbell and men used an 80-pound barbell. The participant had their hands shoulder width apart, holding the barbell above their chest. This test was conducted with a metronome where the bar was lowered at one beat followed by a full extension at the next beat at a pace of 60 beats per minute. This assessment ended after the participant was unable to complete a repetition or keep up with the pace of the metronome.

The fitness tests listed above were conducted under two different conditions during the first and second sessions. One session with Pre-workout supplement (T1) and one session with the crystal light placebo (T2). The trials were randomized between the crystal light placebo and Pre-workout supplement. Each session included the same six fitness testing protocols, a total of twelve tests per participant.

Instrumentation and Data Analysis

Instruments used for this study included: A sphygmomanometer, a metronome, a stethoscope, a heart rate monitor, step, measuring tape, vertical jump mat, and a barbell with fixed weights. For this study, a repeated measures analysis of variance was used to evaluate the difference between the fitness test scores with (T1) or without (T2) Pre-workout supplement and Sex. There were differences between males and females (as expected), however, results were similar within males and females. Due to these outcomes the final analysis was with males and females combined as one group. Data was considered significant at $p < 0.05$.

Results

After the participants completed both session 1 and 2 of the study, the data was analyzed using SPSS v.25 statistical program. Significant results were set a priori at $p < 0.05$. Diastolic blood pressure as the only variable that was found to be significantly different between the two

conditions ($p=0.4$). Table 2 shows the results between the Pre-workout supplement session (T1) and the placebo session (T2).

Fitness Assessment TEST 1 and TEST 2 Values					
Measure	TEST	Mean	95% Confidence Interval		P-value
			Lower Bound	Upper Bound	
SBP (mmHg)	1	120.4±2.15	115.848	124.977	.14
	2	117.6±1.97	113.417	121.783	
DBP (mmHg)	1	79.9±2.05	75.528	84.222	.04
	2	75.9±1.63	72.449	79.351	
RHR (bpm)	1	79.8±3.74	71.897	87.753	.43
	2	78.8±3.29	71.804	85.746	
Sreach (in)	1	17.8±1.02	15.638	19.944	.88
	2	17.7±0.98	15.641	19.797	
VJump (in)	1	18.3±0.91	16.358	20.236	.48
	2	18.5±0.80	16.815	20.195	
BT (reps)	1	30.9±3.00	24.548	37.227	.08
	2	28.4±2.67	22.795	34.080	
CU (reps)	1	44.3±3.68	36.528	52.147	.54
	2	42.0±4.24	33.015	51.010	
StepHR (bpm)	1	161.3±3.91	153.020	169.580	.77
	2	160.6±3.29	153.658	167.617	
VO2max (ml/kg/min)	1	40.2±1.12	37.801	42.554	.74
	2	40.4±0.93	38.405	42.360	

Table 2. Systolic blood pressure (SBP); diastolic blood pressure (DBP); resting heart rate (RHR); sit and reach (Sreach); vertical jump (VJump); YMCA bench test (BT); Queens College Step Test (StepHR).

Discussion

The results of this study determined that the only variable affected by the Pre-workout supplement was diastolic blood pressure. However, research studies (REFS) found that some of the ingredients found in the supplement did have a positive effect on strength and endurance. Outside influences could have affected the results of this study. The investigator sought to keep

test sessions as consistent as possible. Most participants were able to do the testing sessions on the same day of the week as the previous test, and at the same time. However, not every participant was able to keep that schedule. Approximately a quarter of participants were not able to keep this schedule. Also, to note is that many participants had been taking various supplements prior to this study, which could have affected the results. Other factors to consider that were not controlled in this study included: sleep, nutrition, school/work stressors, social life, being aware of what Pre-workout supplement tastes like and if the participant did any strenuous exercises prior to the testing sessions. Participants were advised to abstain from strenuous activities and any caffeine intake prior to testing. Participants were not told if they were given placebo or Pre-workout supplement; however, many participants speculated what they took. A few participants speculated which session was the Pre workout supplement based on the taste.

Given that diastolic blood pressure was the only significant outcome, it is noted that supplements like the Pre-workout supplement used in this study have stimulants in it, specifically caffeine and beta-alanine. Stimulants raise blood pressure. Participants were not asked if they were regular caffeine users which also plays a role in showing the stimulants effects. With consistent caffeine use, increased doses of caffeine are needed for the same effects. The resting blood pressure was measured approximately 30 minutes after ingestion and before exercise began. Thus, supplementation seemed to cause an increase in diastolic blood pressure prior to physical activity. However, there was not a concomitant increase in systolic blood pressure. Since we did not see an increase in systolic blood pressure along with the increase in diastolic pressure, it is plausible to think that this could be due to a number of uncontrolled factors or possible technician error. Further, one study found similar results when measuring the blood pressure with a multi-ingredient Pre-workout supplement intake for active females, ages 19.8 to

23.2 years of age (3). An increase in diastolic blood pressure was observed under resting conditions and also post exercise. This contradictory finding may be attributable to the difference in caffeine dosage combined with the various other ingredients (3). Caffeine works as a vasoconstrictor, which in return causes an increase in vascular resistance. This could potentially be the reason for the unique and isolated rise in diastolic blood pressure rather than systolic blood pressure or both.

Some subjective effects that were observed were subjects mentioning the feelings of “tingling” and “jitteriness” in their hands. These side effects of supplementation can be attributed to beta-alanine and caffeine. Future studies should include some sort of subjective measurement for participants during and after sessions to more accurately record outcomes. Future research should also include an increase in the number of participants. An increase in population size could have potentially ended with more interesting results in regard to this particular study. Some results including the YMCA bench test and resting systolic blood pressure, began to trend towards significance, thus, an increase in sample size is necessary for future research.

Conclusion

Pre-workout supplement ingestion affected diastolic blood pressure, however, no other variable assessed in this study was affected by the supplement. This may be attributable to uncontrolled factors, caffeine, insufficient number of participants, or possible technician error. Additional research on the effects of Pre-workout supplement on fitness testing may be needed. Future research will need to control for outside influences such as previous exercise, diet, previous and/ or current supplement use, psychological stress, and sleep health. Other improvements for future research include increases in sample size and a controlled subjective measurement for participants pre and post assessment. This would furthermore improve the

quality of research. Such studies can provide the evidence needed to support individuals in what exercises to engage in when consuming such supplements in order to gain the most out of their exercise sessions. It is also important to do such studies so we can determine the efficacy of supplements, both from a health standpoint and on manufacturers claims.

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