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The Impact of Ammonia Inhalants on Strength Performance in Resistance Trained Males

Scott R. Richmond¹, Adam C. Potts², Joseph R. Sherman¹

¹Department of Kinesiology, Missouri State University, Springfield, MO, USA, ²Lamar University Strength & Conditioning Department, Lamar University, Beaumont, TX, USA

ABSTRACT

Richmond SR, Potts AC, Sherman JR. The Impact of Ammonia Inhalants on Strength Performance in Resistance Trained Males. **JEPonline** 2014;17(2):60-66. Ammonia Inhalants (AIs) have been suspected to enhance athletic performance through an increased awareness and subsequent increase in physical strength. The purpose of this study was to examine the impact of AIs on strength performance. Twenty-five college-aged males with at least 3 yrs of resistance training experience performed as many repetitions as possible with the back squat and bench press at 85% of one repetition maximum (1RM) after inhaling either AIs or placebo (Vick's[®] VapoRub[®], VVR). There were no significant differences between the number of repetitions performed in the back squat ($P = 0.403$) or the bench press ($P = 0.422$) after inhaling the AIs compared to the VVR. While no differences in performance were observed, many individuals may still continue to use AIs. Therefore, if an individual has no pre-existing medical conditions and feels that AIs improve performance, there appears to be no contraindications to using low doses.

Key Words: Smelling Salts, Resistance Training

INTRODUCTION

Pre-workout supplements are very popular in today's fitness realm. Many athletes, bodybuilders, power-lifters, and recreational lifters use supplements prior to training to increase motivation and muscular strength. Previous studies have shown that significant benefits in muscular strength and power can be acquired from using pre-workout 'energy' supplements within an hour prior to the resistance training session (2,9). Ammonia Inhalants (AIs), or smelling salts, are often used to enhance performance in sports competitions and prior to heavy resistance training bouts. AIs are becoming more widespread among athletes and weight lifters who attempt to gain an edge or increase strength or performance (3,4).

AIs are typically found in the form of capsules containing ammonium carbonate combined with scents or perfumes. They are categorized as a respiratory stimulants and when inhaled, the nose, lungs, and mucus membranes rapidly become irritated causing involuntary inhalation (4). The involuntary inhalation is reported to accelerate respiration and stimulate a higher degree of consciousness (4). A "higher degree of consciousness" may be responsible for increasing primary attentional focus, which allows the weight lifter to block out unnecessary distractions. The increased focus on the task of executing the exercise is a psychological trait that many expert athletes utilize to perform successfully under pressure (7).

The use of AIs is approved by the United States Food and Drug Administration for the treatment of fainting. Although AIs can be purchased over the counter, ammonia is toxic in large amounts and should only be administered in small doses to users with no pre-existing medical conditions (10). Complications caused by AIs in athletes have been reported, but are extremely rare, and include lung irritation/damage, loss of consciousness, and anaphylaxis (3). People with respiratory issues such as asthma should avoid using AIs due to the potential of the lungs becoming irritated. It is also recommended that AIs should not be used to aid head and neck injuries because of the risk of a sudden, unexpected reflex (10).

Athletes commonly use AIs immediately before or during competition, such as prior to attempting a one repetition maximum (1RM) in the bench press, back squat, deadlift or power clean. AIs have also been used before the opening kickoff of a football game, between rounds of a boxing match or in locker rooms during breaks or intermissions of games (10). Although AIs have been used for many years, little is known about their effects on athletic performance. Therefore, the purpose of this study was to examine the impact of AIs on strength performance.

METHODS

Subjects

Twenty-eight males were recruited from university physical conditioning courses and local fitness establishments (age: 21.5 ± 2.2 yrs, height: 181.1 ± 4.6 cm, weight: 93.4 ± 14.2 kg). A training history questionnaire was required to ensure that all subjects: (a) were experienced, which was defined by at least 3 yrs of resistance training experience (RTE: 7.3 ± 2.6 yrs); and (b) could back squat 1.5 times their body weight and bench press 1.0 times their body weight (1). Individuals who did not meet these criteria were excluded from participation in the study. Prior to participating in the investigation, the subjects: (a) were informed of the potential risks and procedures involved with the study; (b) completed an informed consent in accordance with the Human Subjects Committee Review Board (Study #: 13-0316) and the World Medical Association 1964 Declaration of Helsinki; and (c) completed a medical history form to assist in screening out individuals with any cardio, respiratory or muscular conditions that would affect the study. Vick's[®] VapoRub[®] (VVR) was

chosen as a placebo because of its strong menthol scent that is comparable to an AI. The back squat and bench press exercises were used because they are measures of upper and lower body strength. They are also highly utilized in training and correlate to athletic performance (5).

Procedures

The initial session consisted of completing pre-participation paperwork and estimating the subjects' 1RM on the back squat and the bench press. The subjects were instructed not to engage in any demanding physical activity at least 48 hrs prior to the testing sessions so that the central nervous system and muscular system would be fully recovered (6). They were also instructed to follow the same dietary regime throughout the trial and eat a meal at least 3 hrs prior to each testing session.

After the completion of all pre-screening paperwork, the subjects began a general warm up on an Aerodyne Ergometer for 5 min followed by the back squat warm up (8). The subjects performed the back squat testing prior to the bench press because the squat exercise involves larger muscle groups, which should be trained prior to smaller muscle groups (1). A standard squat rack with a 20 kg barbell was used throughout the testing. Although the subjects were already familiar with proper back squat technique from previous training experience, proper technique was re-emphasized prior to and during all lifting. Each subject was required to descend with the hips and knees until the thighs were parallel to the floor and, then return to a standing position from the squat (1).

Following at least 3 warm up sets consisting 2 to 6 repetitions; the resistance was increased in 5, 20 kg increments until the subjects could only perform 2 to 5 repetitions with maximal exertion and proper technique. The 1 RM was estimated using the number of squat repetitions performed with that weight (1). After the back squat RM, the subjects rested for 5 min before starting the bench press warm up. The bench press technique consisted of the head, back, hips, feet, and legs contacting the bench or floor at all times. The subjects were instructed to lower the barbell to touch the chest and then raise the barbell by fully extending the elbows. The repetition was not deemed successful if the subject failed to use the demonstrated technique. Next, the participant completed at least 3 warm up sets before attempting the RM set. The 1RM was estimated using the number of bench press repetitions performed with that weight (1). See Figure 1 for detail of the timeline of testing session throughout the study.

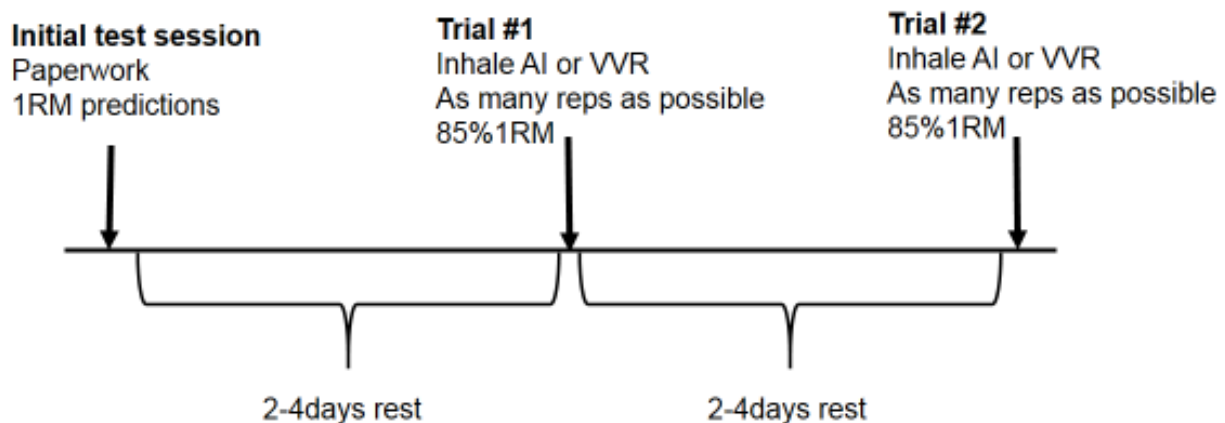


Figure 1. Overall Timeline of Events.

Approximately 2 to 4 days (at least 48 hrs and no more than 96 hrs) after the initial testing, the second testing session took place. The subjects started with a 5-min warm up on the Aerodyne Ergometer and then began the squat warm up. Each subject completed at least 4 back squat warm up sets with approximately 1 min between sets. During the warm up sets a marked coin was flipped to randomly assign which substance the subject would inhale first. A 2-min rest was given prior to completing the maximal exertion set (ME), which consisted of performing as many reps as possible with 85% of the subject's predicted 1RM. Three seconds before initiating the ME set the subject inhaled either the AI or the VVR (placebo). The AI was in liquid form and VVR in gel form. Both were contained within a micro-centrifuge tube. During testing, the substance inhaled was unknown to the subject and to the researcher who administered it. After the ME set was completed, there was a 5-min break prior to beginning the bench press warm up. After 4 sets of bench press warm up, each subject also completed the ME set at 85% 1RM. Three seconds prior to the ME set the subject inhaled once again either the AI or the VVR. The same substance was inhaled for both the bench press and back squat. The third testing session was 2 to 4 days (at least 48 hrs and no more than 96 hrs) after the second session. The third session was identical to the second testing session except the subject inhaled the substance that they did not inhale during the second session (Figure 2).

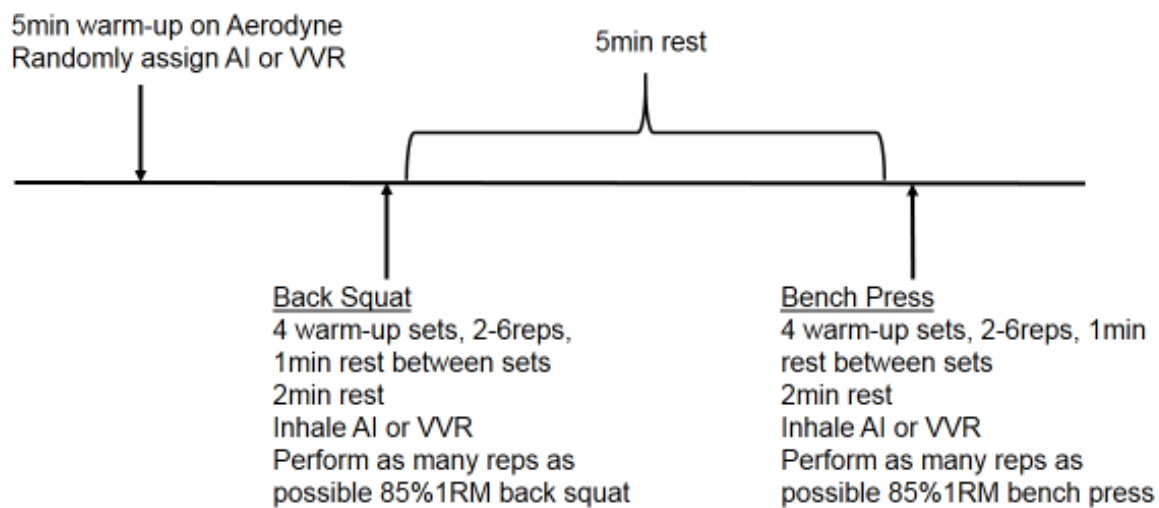


Figure 2. Sample Timeline of 85% of 1RM Trial.

Statistical Analyses

Using SPSS (v19.0) a Paired Samples *t* test was used to measure differences in the number of repetitions completed after inhaling the AI or the VVR. A one-way analysis of variance (ANOVA) was used to measure any differences in the calculated 1RMs of all three sessions (pre-test, AI, and VVR).

RESULTS

The statistical results are based on 25 male subjects who completed all 3 testing sessions. Three subjects did not finish the study due to scheduling issues. All subjects who completed the study reported no physical injuries due to the testing protocol. There was no significant difference between the number of repetitions performed in the back squat (AI = 6.7 ± 2.3 vs. VVR = 6.4 ± 1.8 ; $P = 0.403$) or the bench press (AI = 5.4 ± 1.2 vs. VVR = 5.2 ± 1.6 ; $P = 0.422$) after inhaling the AI

compared to the VVR (Table 1). There was also no significant difference between the calculated 1RM for both back squat and bench press when using AI, VVR or initial testing session (no substance inhaled).

Table 1. Repetitions Performed with 85% of 1RM (Mean \pm SD).

	Back Squat	Bench Press
VVR	6.4 \pm 1.8	5.2 \pm 1.6
AI	6.7 \pm 2.3	5.4 \pm 1.2

VVR; Vick's[®] VapoRub[®], AI; Ammonia Inhalant

Table 2. Predicted 1RM (Mean \pm SD).

Conditions	Back Squat	Bench Press
Pre-test (kg)	170.7 \pm 33.1	129.2 \pm 20.4
VVR (kg)	176.4 \pm 35.5	128.9 \pm 21.4
AI (kg)	177.4 \pm 33.9	129.7 \pm 21.2

VVR; Vick's[®] VapoRub[®], AI; Ammonia Inhalant

DISCUSSION

Although AIs are often used to enhance performance in sports competitions and prior to heavy resistance training bouts among athletes and weight lifters (3,4), the results of this study indicate no significant differences in the AI testing sessions compared to the VVR sessions in the back squat and bench press. Although more research is needed on the effects of AIs relating to exercise performance, our data suggests that there may be no significant link between the two. A placebo effect interaction due to participants not inhaling substances before lifting on a regular basis could somewhat explain the results.

While there were no differences in performance, this study does not account for any potential psychological impact of AIs. Subjects reported anecdotally that the substances “made them feel like they were more aroused and awake.” If an individual has no pre-existing medical conditions and feels that AIs do improve their performance, then, there are no known contraindications to use in low doses. However, people with respiratory issues like asthma should avoid using AIs due to the potential for the lungs to become irritated. It is also recommended that AIs should not be used to aid head and neck injuries due to the risk of a sudden, unexpected reflex (10).

Potential limitations to this study include the amount of Ammonia that was inhaled by each subject. Although each subject inhaled the ammonia from the same size capsule, the amount of inhalation by each subject may have been much different. Another issue that will have to be answered in future research is whether the AI would have had a positive influence on the back squat and bench press performance at a higher percentage of 1RM (i.e., >85% of 1RM). It is understood that anecdotal reports suggest that AIs are used for short anaerobic bursts of strength. It may be

possible that with when using AIs the amount of weight someone can perform after 2 or 3 repetitions decreases significantly. Utilizing a weight closer to predicted maximum may create a more realistic picture of a power-lifting or sport-specific activity. Further research is needed to clarify this point.

The practical significance due to a psychological impact of the AIs is an area that should also be explored by subsequent research. Determining if AIs impact the nervous system in a way that improves motor unit firing, biomechanics, and muscle fiber activity may help explain the anecdotal accounts of its ergogenic effects. Further research is needed to determine if this effect is repeatable with other substances used as a control.

CONCLUSIONS

While there were no differences in performance, this study did not account for any potential psychological impact of AIs. Therefore, if an individual feels that AIs do improve their performance, and has no pre-existing medical conditions that would present harm with AI use, then there are no contraindications for use in low doses. However, given the lack of a significant impact of AIs on the back squat and bench press performance, AIs should not be prescribed universally by trainers and strength coaches.

Address for correspondence: S. R. Richmond, PhD, Department of Kinesiology, Missouri State University, Springfield, MO, Phone: 417-836-8481, Email: ScottRichmond@MissouriState.edu

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