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The Effects of Pre-Maximal Exertion Inhalation of Ammonia and the Performance Effects During Deadlift Maximal Tests

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THE EFFECTS OF PRE-MAXIMAL EXERTION INHALATION OF AMMONIA AND THE PERFORMANCE EFFECTS DURING DEADLIFT MAXIMAL TESTS

by

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ABSTRACT

THE EFFECTS OF PRE-MAXIMAL EXERTION INHALATION OF AMMONIA AND THE PERFORMANCE EFFECTS DURING DEADLIFT MAXIMAL TESTS

Justin Nicholas Vigil
Old Dominion University, 2015
Director: Dr. David Branch

The purpose of this study was to investigate the effects of ammonia as a stimulant on athletic performance during a deadlift one maximal repetition (1-RM) absolute strength test. It was hypothesized that ammonia inhalation would result in a larger 1-RM, possibly due to immediate catecholamine release attributed to the fight-or-flight response. If proven effective, ammonia inhalation would present an option to increase power and strength performance during training and competition based on an acute manipulation of natural occurring hormones, eliminating the side effects attributed to other supplementation methods. Subjects (n = 10 males, X±SD age = 21±1 years, mass = 72.5±6.8 kg; n = 10 female, age = 22±5 years, mass = 66.2±8.1 kg) were required to have at least two years of resistance training experience while lacking a history of asthma, lightheadedness, fainting, anaphylaxis, sickle cell traits, and other respiratory disorders. After a baseline 1-RM test, subjects were paired by 1-RM performance and gender, then randomly assigned in a counterbalanced treatment order to control/blinding water or ammonia trials after a minimum 72-hour recovery period for another 1-RM test involving attempts at 100%, 102.5%, 105%, and 107.5% of the established 1-RM value. Testing was then repeated after the minimum rest period for the remaining trial. Results revealed the expected sex main effect for dead lift 1-RM (93.0±29.5 [females]; 152.0±29.5 kg [males] ($_{1,18}F = 20.09$, $p<0.001$), but no trial main effect ($_{2,36}F = 0.135$, $p = 0.874$) or sex

by trial interaction effect (baseline = 93.0±15.3; 151.8±42.3 kg; water = 92.0±12.5; 150.9±37.8 kg; ammonia = 92.5±16.4; 153.4±37.9 kg) for females and males, respectively ($_{2,36}F = 0.591$, $p = 0.559$). Limitations to this study included the possibility that the delivery system was flawed; usage of an ammonia concentration not potent enough; and other extraneous factors. Within the limitations of this study, there is no basis for the support of ammonia inhalation to improve 1-RM efforts in training, competition, or any other circumstance.

ACKNOWLEDGEMENTS

I would like to thank Dr. David Branch for his constant support, knowledge, and patience throughout the course of this project, as well as his willingness to step into an area of Exercise Science that was not his specialty. I also could not have done this project without the guidance of Mr. Phil Sabatini, who through the course of this study kept me motivated and driven while providing invaluable experience and knowledge on the subject matter. The contributions of these men helped make this study on a new and untouched subject of muscular performance possible. I would also like to thank Mrs. Tierney Murphy, a fellow classmate and significant person in my life who was my rock through this endeavor, keeping me focused on my work through family issues and life experiences, stress derived from graduating soon as well as a full internship combined with working full time as well. She had a major hand in the success of this project, and a thank her from the bottom of my heart for her contributions.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I – INTRODUCTION

Over the course of history, changes in scoring, participation, regulations, equipment, and athleticism requirements have been introduced to all sports. With some of these changes, the lines of legal and illegal performance have become blurred (Kisaalita & Robinson 2014). In addition to the introduction of technologically superior equipment and materials, supplements such as steroids have become the center of sports enhancement, with coaches and athletes often years or decades ahead of regulatory agencies. Many of these substances are currently in use to artificially increase the levels of testosterone, human growth hormone, and other performance-enhancing hormones for the purpose of improving both chronic and acute performance.

Anabolic supplements can be utilized by strength and power athletes over a long-term period to increase overall strength, power, muscle mass, and fat loss. Other methods are favored for their ability to mimic natural physiological processes such as adapting to a hypoxic environment while training at higher altitudes (which is allowed by the World Anti-Doping Agency [WADA]) without the need to actually train at altitude. While some substances are utilized for their acute effects and others for more chronic adaptations, some of these known supplements have been banned by most, if not all, drug-monitoring athletic agencies (Ramachandra et al., 2012). Positive results are based on the detection of prohibited substances, their metabolites, and markers in biological samples supplied by athletes; usually at a randomized and unknown time and place. As stated by the WADA, substances classified as “exogenous” refer to those that cannot naturally be produced by the body while “endogenous” substances are ordinarily

produced by the body. What links these substances together is that they all not only target a specific hormone, but they often are designed to mimic its effects or prevent any side-effects of its greater presence, while increasing the substance's levels in the body to abnormally high concentrations. Increased concentrations of banned substances and/or any metabolites are criteria for a positive test and possible suspension and/or disqualification of the athlete. The WADA classifies these substances as banned from competition through the following criteria: 1) enhances performance, 2) represents a risk to health, and 3) violates the "spirit of sport" (Savelescu et al., 2004). Within these criteria, it is possible for athletes to utilize steroids for medical purposes where that intake is prescribed as a component of a treatment for health, rehabilitative, or preventative measures.

However, these benefits to performance come at a cost, as many of these supplements have negative long-term consequences ranging from mental health (Lindqvist et al., 2013), structural, circulatory changes and responses (Boyadjiev et al., 2010), organ complications, to even death (Montisci et al., 2012). Hence, the purpose of this study is to find an alternate method of enhancing acute strength performance while eliminating any negative chronic consequences. It has been suggested (Gorguner & Akgun, 2010) that there are few, if any, chronic consequences of acute inhalation injury from certain gaseous substances, in this case ammonia, when the proper precautions are taken. However, there is very little well designed research on the efficacy of ammonia inhalation on strength performance.

STATEMENT OF PROBLEM

In today's performance focused athletics, finding methods to increase performance, both in training and competition while not violating any regulations, has become a vital component in strength and conditioning programs at all levels of athletics from professional to high school competitions.

For the purpose of this study, the methodology was designed to observe the possibility of enhancing 1 repetition for maximal load lifts (1-RM) without the chronic consequences commonly associated with established methods of performance enhancement, specifically steroids and other such substances. The largest consideration is whether it is possible to influence the body's natural endocrine systems and processes without any chronic side effects or consequences while staying within the current regulations in place by the WADA. Specifically, the goal of the current study was to examine the acute effect of inhaling small amounts of ammonia prior to performance of a strength exercise; in this case the deadlift exercise and the loads achieved in a standard 1-RM test.

There are several methodological challenges with identifying any potential ergogenic effect caused by this inhalation. It is difficult to measure catecholamines (epinephrine, norepinephrine) and other stress hormones; hence the lack of measurement in this study and the assumption that acute sympathetic arousal is the mechanism for any observed ergogenic effect of ammonia inhalation. This is based on the assumption that the hypothalamic-pituitary-adrenal axis (HPA axis) is the origin of the mechanism causing the release of the catecholamines (epinephrine, norepinephrine, cortisol, ACTH, etc.) following ammonia inhalant during the 1-RM tests. Previous research has

demonstrated that the HPA axis stimulates the release of cortisol from the adrenal gland as a reaction to stress (Embi & Scherlag, 2014). It has also been observed that there is no negative effect on HPA-axis stimulation in children after inhaling glucocorticosteroids (Wolthers & Honour, 1998). However, due to the speed of both the response to inhalation and the brief time frame of effect, it is assumed that sympathetic nervous system stimulation and the corresponding norepinephrine release is the focus of this study.

Even though ammonia is an essential DNA, RNA, and protein synthesis metabolite for the maintenance of the acid-base balance (Gerberding, 2004), exposure to concentrated gases result in upper respiratory airway burns and obstructions, distress, and edema. However, acute exposure to 500 ppm levels or higher has also been shown to increase respiratory minute volume, which is well below the concentrations needed to the previously mentioned complications.

NULL HYPOTHESIS (H_0:)

There will be no significant effect of the ammonia inhalant independent variable on 1-RM test results when compared to the control inhalant or the baseline 1-RM tests.

RESEARCH HYPOTHESIS (H_A:)

The ammonia inhalant treatment will significantly increase 1-RM compared to the control inhalant and baseline treatments.

ASSUMPTIONS

For the purpose of this study, it was assumed that all subjects, due to their resistance training experience, were performing the deadlift with proper form. It was also assumed that the subjects were familiar with 1-RM conditions, and were willing to exert themselves to a true 1-RM and did not end a session without lifting at their maximum

effort. It was also assumed that all subjects did not change their daily routine during the duration of the testing trials, remained consistent with no changes to their personal training program, and had access to the same facilities and equipment over the past six months; thus minimizing bias based on environment and availability of resources for training. Finally, it was also assumed that subjects' diets did not change, and there was no consumption of alternate or additional ergogenic or dietary supplements during the course of this study while still meeting the necessary caloric and nutritional consumption needed for their metabolic demands.

DELIMITATIONS

In this study, the back squat and bench press are not being included despite their status as commonly tested multi-joint exercises due to the limited or non-existent data on the deadlift exercise. This was based on filling the current lack on scientific knowledge, while also allowing minimal training to be required to effectively perform the simple technique of the deadlift. This study was also focusing on subjects from the ages of 18 to 24 years due to the high relevancy of the topic in question to athletes of similar ages. This is the same age group where many athletes are on the brink of professional careers, and often where they are looking for any methods, banned or otherwise, that allows them to distinguish themselves within the vast numbers of rival athletes.

LIMITATIONS

All testing took place at the Student Recreation Center at Old Dominion University, which may have limited data collection due to the lack of ideal testing locations. The only current deadlifting platform was located in the middle of the facility and was often surrounded by students pursuing their various fitness goals, providing a

substantial quantity and range of verbal, visual, and physical distractions during testing. These stressors may have helped to replicate the environment found in many power-lifting competition and athletic training settings. Any lack of judgment on the researcher's part pertaining to subjects reaching full hip, knee, and elbow extension for full control of the loads during these lifts could have resulted in false achieved lifts. Due to the fact that subjects were full time students, scheduling three trials around academic courses became a threat to the study. Steps were taken to standardize the testing time of day despite the length of time between trials to account for diurnal variation and other metabolic considerations to assure consistent experimental conditions.

SIGNIFICANCE OF THE PROBLEM

This study could provide evidence for the ergogenic effect of ammonia inhalant, a legal external substance, in increasing acute muscular strength as measured by a deadlift 1-RM. This would allow athletes to improve their performance during training and competition without using banned agents such as androgenic-anabolic steroids that have been banned by the WADA and have harmful effects on health.

CHAPTER II – REVIEW OF THE LITERATURE

BACKGROUND

For most sports, it is difficult to achieve the desired success without a significant amount of strength to assist with the athletic demands in a particular sport. Strength training is one way to target both the neural and muscular components of muscular adaptation, stressing the central nervous system while impacting the increase in muscle mass. Methods used to target muscular adaptations include adjusting the intensity, scope of work, duration, rest periods, and loads involved. The ideal program chooses the methods that will produce the greatest effects in the shortest time period possible. Most fitness professionals in today's professional, collegiate, and recreationally competitive society favor this approach.

RESISTANCE TRAINING

Due to the complexity of strength as a concept, it is necessary to break it down into specific components. There are four basic methods of achieving maximal muscular effort: lifting maximal resistance (the method of *maximal effort*), lifting submaximal resistance to failure (*repetitive effort)* (Stankovic et al., 2013), lifting resistance as fast as possible, termed *dynamic effort*; and lifting a submaximal load at a moderate volume of repetitions for as the method of *submaximal effort*. In this investigation, we are examining the lifting maximal resistance method to supplement the established research (Richmond et al., 2014) on submaximal resistance to failure due to the acute effects of inhalants to maximize their effect on the sympathetic nervous system. To test this maximal method, this study tested subjects under a maximum load that they are able to

lift only once in a slow, constant velocity (Baechle & Earle, 2008). The maximal resistance method is considered as the most effective for improving intra- and inter-muscular coordination and maximizing the effects of strength training. This method requires the largest number of motor units with the best discharge frequency of the nervous system (Stankovic et al., 2013). Although there is an inherent risk of injury due to the load involved as well as increased conditions for muscle hypertrophy, this remains the preferred method for measuring absolute strength for programming purposes. The advantages of the maximal effort method in terms of muscle activation and adaptation outweigh the disadvantages of having developed form, strength, and proper testing progression at lower intensities; although this is without any supporting research (Baechle & Earle, 2008; Ch. 12). The data obtained from the maximal effort method allows the researcher to utilize mathematics to identify the intensities, loads, and durations necessary to achieve the desired results in the athlete.

ENDOCRINE SYSTEM

Strength training has an effect on all of the body's internal systems, including the endocrine system, in particular the testosterone level. During strength training, testosterone is released to meet the demands placed on the body. This occurs in order to control protein synthesis, muscular development, bone growth, and calcium retention (Stankovic et al., 2013). Testosterone release as a result of resistance training is related to the size of the exercising muscle mass, the total volume of training (defined as resistance x repetitions x sets), and total duration of the training, with a higher emphasis being placed on intensity as the main factor to alter catecholamine responses to exercise (Zouhal et al., 2008). For the purpose of this thesis, testing will be geared toward the

manipulation of the catecholamine response only, ignoring any other resulting effects or stimulated chemical reactions in response to ammonia inhalation. However, due to the lack of proper testing equipment and facilities, this study will be assuming that the release of any hormones as a result of the ammonia inhalation is the HPA-axis-facilitating homeostasis maintenance (Silverman et al., 2005). The HPA axis has also been observed as an avenue to respond to stress, which causes the release of metabolic factors such as cortisol into the blood causing an increase in cardiac tissue glycogen concentration levels (Embi & Scherlag, 2014). Although this study is not relating to the phosphogen system focus of this study, it did demonstrate the effect of stress on intramuscular substances affecting performance. In essence, the HPA axis responds to psychological and physical stressors by utilizing the neuroendocrine feedback loop to maintain or return to homeostasis (Handa & Weiser 2013). There seems to be no prior research suggesting or identifying any effect on reflex up-regulation or motor recruitment, suggesting that all targets and methods of influence are focused on hormonal release or retention and receptor activity to achieve the desired influences on performance.

PHYSIOLOGICAL EFFECT OF INHALANTS

Due to its highly irritating nature, ammonia inhalation causes rapid eye, nose, and throat irritation, coughing, and possibly bronchospasms even at low concentrations. However, due to its low odor threshold there is an early warning of its presence, and olfactory adaptation and desensitization can occur and render it less detectable (Gorguner & Akgun, 2010). When ammonia is inhaled, it forms ammonium hydroxide by reacting with the water present in the mucus in the respiratory tract. This is the cause of

immediate laryngospasm and laryngeal edema, while severe exposure can lead to non-cardiogenic pulmonary edema, residual chronic lung disease in the forms of bronchitis, bronchiectasis, airflow obstruction, interstitial fibrosis, and impaired gas exchange. These acute effects are well known, and although there is less research on the long-term effects of ammonia inhalation, it is thought that the extent of respiratory injury is dependent on the duration of exposure, gas concentration, and depth of inhalation (Leduc et al., 1992). This study included the preventative steps of utilizing small amounts of inhalants for a brief, split-second inhalation. Subjects were exposed to brief ammonia inhalation a total of six times throughout the study, and never within twenty-four hours of each instance, minimizing both the duration and depth of the exposure. These brief exposures are consistent with anecdotal observations of inhalant use by weight lifters in training and competition.

Ammonia products are included in basic first aid kits in the forms of smelling salts, ammonia capsules, and other products that are designed for preventing and treating lightheadedness, fainting and dizziness (Velasquez, 2011). Ammonia products are also being utilized for pre-lifting rituals before powerlifting attempts, “clearing an athlete’s head” in sporting events such as football and boxing, and overall “psyching up” of the individual. When inhaled, the ammonia instantaneously irritates the lungs, nose, and mucous membranes of the nasal cavity (Gorguner & Akgun, 2010). This irritation leads to an involuntary inhalation reflex while stimulating the respiratory muscles to a higher work rate, which is thought to achieve a higher degree of consciousness and is one focus of this study. Although ammonia is considered to be a toxic substance, its inhalation is merely a symptom of relief since the dosages required to cause damage are at levels

much greater than possible to achieve with over-the-counter products. There is an inherent risk for individuals with certain underlying complications, such as asthma, anaphylaxis, sickle cell traits, and other respiratory disorders. These potential complications emphasize the importance of knowing the athlete and taking the proper precautions with any respiratory issues, which may include rare usage, smaller dosages, or avoidance all together. In spite of these potential complications, all of these ammonia products are considered safe since they have met the requirements to be allowed in the inventory of a standard medical kit, which is much less than the amounts considered hazardous except in the absence of any underlying respiratory issues. However, in the interest of safety and liability, screening of subjects for these exclusionary criteria was conducted in this study despite the precaution of utilizing products considered safe for all circumstances.

Past studies have utilized inhalants other than ammonia for the purpose of manipulating the muscular and endocrine systems for performance enhancement. Decorte et al., 2013, specifically observed the effects of salbutamol on neuromuscular function during a quadriceps fatigue test, observing that inhaled β_2-agonists increased quadriceps endurance without any significant effect on neuromuscular activity in the form of maximum voluntary contraction readings. Prior to this study, Decorte et al., (2008) focused on both quadriceps fatigability and force output with the acute effects of salbutamol inhalation. They reported no effect on strength, fatigue, and recovery of the quadriceps in subjects without asthma. Similar findings were reported by Kindermann in 2007 during a qualitative review of 19 studies, in which 17 showed null effects on muscular strength and performance from inhaled β_2 agonists, although there were some

effects following oral administration. This is supported by another review (Pluim et al., 2011), in which β_2-agonists showed no significant effects on endurance, strength, or sprint performance in healthy athletes. Based on these reviews, there is scant evidence for an effect of inhaled β_2 agonists on performance.

PREVIOUS RESEARCH ON THE EFFECTS OF AMMONIA INHALANTS ON MUSCULAR STRENGTH

Richmond et al., (2014) examined the effect of ammonia inhalants on bench press and squat strength exercises in twenty-five male subjects. Subjects performed a submaximal-load (85% of their 1-RM) maximal-repetition test. They found no difference in repetition performance between the inhalant and placebo trials. The researchers attributed this to a possible need of a higher percentage of 1-RM. This change would better utilize the anaerobic energy system that ammonia inhalation is hypothesized to stimulate, and stay within the ideal time frame to utilize the effect of the ammonia, a time period in which this study may have exceeded.

PREVIOUS RESEARCH ON INHALANTS AND EFFECTS ON PERFORMANCE

In related studies, it has also been found that high-dose inhalations of salbutamol have no effect on aerobic capacity or oxygen uptake (Elers et al., 2012). However, this study also examined short-term performance of about 20-25 minutes of activity, where the immediate effect of inhalants and the induced responses as a result take full effect then decline within seconds of inhalation. Other studies have shown that inhalants could have an effect on performance even with this small window of effect if administered at the right time. For example, inhaling a therapeutic amount of salbutamol at the end of a

cycling race increased sprint cycling performance at the end of the race (Bedi et al., 1988). It has also been observed that usage of salbutamol ($ß_2$-adrenergic agonist) inhalants do not have an ergogenic effect on performance during a 5 km race (Dickinson et al., 2014), where runners inhaled up to 1600 μg of salbutamol 15 minutes prior to racing. Their goal was to stimulate bronchodilation to reduce airway resistance with the result of increased oxygen minute ventilation and improved performance. Despite differences in energy systems, the goal of this study was similar to that of Dickinson et al., in 2014. Although this study was targeting a different inhalation response and energy system, the objective was similar to that of Dickinson's study: stimulation of a beneficial response to inhalation of an involved system in the particular sport for a rapid and acute increase in athletic performance with little or no side effects or traces. However, unlike salbutamol, ammonia is not on the WADA prohibited substances list or even considered at this point to be a candidate to be added to that list, making it not only a potential ergogenic aid but also a legal one.

CONCLUSION

Research has shown ergogenic aids influence athletic performance through forced adaptations and overloading of existing bodily systems. Some ergogenic aids result in negative acute and chronic consequences. These consequences are the core reason why many of these substances are banned by the WADA, as well as the unfair advantage caused by their usage to increase existing bodily reactions and systems involved in desirable outcomes. However, these substances are only supplements to a training regimen, which is still the core of athletic performance.

According to Bedi, et al. (1988), substances that do not have any adaptation effects on natural occurring responses can be utilized to affect performance by dictating when these responses, such as catecholamine release, occur. Without any chronic adaptations, it has been observed that we can acutely influence the timing of beneficial reactions without tampering with the systems already naturally structured in the body. However, all of these tests have been conducted during moderate to long duration exercise, eliminating any true effects on performance due to the short duration of effect of the inhalants.

The goal of this study was to examine the short-term consequences of ammonia inhalation on deadlift 1-repetition maximum. Focusing on the deadlift, a short duration power exercise, eliminated the limitation of diminishing effects of ammonia inhalation on a task of longer duration. Taking advantage of the body's natural fight-or-flight reactions and controlling the timing of their onset, the goal was to increase performance to the same degree as the current banned techniques, while staying within the restrictions of the WADA.

CHAPTER III – METHODS

SUBJECTS

Subjects were college aged male and female undergraduate students approximately 18-24 years of age. Subjects were recruited from the Exercise Science undergraduate program at Old Dominion University, specifically from the EXSC 250, Strength and Conditioning Leadership, in which they received extra credit points toward their lecture grade in that course with the instructor's approval. If students showed interest in the study but did not meet the inclusionary criteria, they were allowed to submit a resistance training specific article report for the same credit points, which was made available for all students regardless of their interest in the study. All subjects were required to have a minimum of two years of resistance training experience, specifically experience with the deadlift exercise. Participants with a history of asthma, lightheadedness, fainting, anaphylaxis, sickle cell traits, and other respiratory disorders were excluded from the study due to the risk of fainting, rapid and involuntary contraction of the neck and head for ammonia inhalation, and in significantly higher doses not available in over-the-counter products, toxicity, sickness, and death. A total of 20 participants (10 females and 10 males) were recruited for the study. This study included the preventative steps of utilizing small amounts of inhalants two inches from the nose for a brief, split second inhalation. Subjects were only exposed a total of six times throughout the study, and never within twenty-four hours of each instance, minimizing both the duration and depth of the exposure. Prior to all testing, the Institutional Review Board of Old Dominion University approved the study protocol.

Participants received a verbal explanation of the study and provided written informed consent.

DESIGN

All subjects participated in a 1-RM test for the deadlift, with the subject progressively performing single repetitions in increasing heavier loads until they achieved one maximal effort that could not be surpassed by another effort. Equipment utilized in the study included a standard Rogue Fitness (Columbus, Ohio) Echo Series Bumper Plates (2.5, 5, 10, 15, 25, 35, 45, 55 pound options) and a standard 20-kg Rouge 28MM Training Bar. Testing took place on a standard Olympic regulation weightlifting platform located in the Student Recreation Center (Pro-Maxima FW-147 8’ x 8’ platform). Subjects were allowed to use any weightlifting accessories such as Olympic weightlifting shoes, belts, sleeves, etc., and were required to use the same equipment and the same grip and lifting technique for all trials. The ammonia inhalant utilized in this study was Pac-Kit (South Norwalk, CT) Ammonia Inhalants medical kit refills (2.125" x 4" x 0.625"), with the control substance being water in an identical bottle. Subjects should have been able to use their experience with the deadlift to achieve maximal effort within three to five repetitions of their initial warm-up, utilizing previous 1-RM tests as a guide to the load selection for their attempts. The loads selected for these attempts as well as the success and failure were recorded for testing design purposes during the trials later in the study. Subjects had a minimum of 72 hours between each session to allow for full recovery from their exertions and exposure to the particular inhalant in that trial.

Subjects followed the procedures in Tables 1 and 2 for the initial baseline 1-RM test and both experimental trials, which were the experimental condition with the

ammonia supplementation or the control condition with water as the control substance. Subjects were paired within sex by similar 1-RM baseline results and randomly assigned to counterbalanced treatment orders. All substances involved in this study were stored in blank bottles by a fellow graduate student for the blinding of both the researcher and the research subjects. Using the data collected from the baseline maximal test, the researcher calculated the progressive increase in weight (in percent) per each attempt for the subject for both trials. Based on this information, subjects performed two repetitions at 65% and two at 75% 1-RM, and one repetition at 85%, 90%, and 95% of 1-RM, followed by the final attempt at either 100% and/or 100% and higher as stated in the following protocol.

Table 1. Standardized warm-up for each trial

1. 2 x 10 Fire Hydrants per leg
2. 2 x 10 second Lunge Stretches
3. 2 x 10 Dumbbell Good Mornings @ 10 & 20 pounds
4. 1 x 10 @ Barbell
5. 3 x 5 @ 45%
6. 2 x 3 @ 50%

For trial 1, the subject inhaled the assigned inhalant and attempted to lift 100% 1-RM plus 2.5% of the 1-RM achieved in baseline testing. In trial 2 the subject inhaled the same inhalant and attempted to lift 100% 1-RM plus 2.5, 5, and 7.5% respectively. In these two trials, the subject was asked to set their feet and all other personal necessities prior to the lift (tighten belt, set straps, etc.), take in one maximal inhalation from either bottle one or two and perform the lift within 15 seconds of inhalation as the effects of the

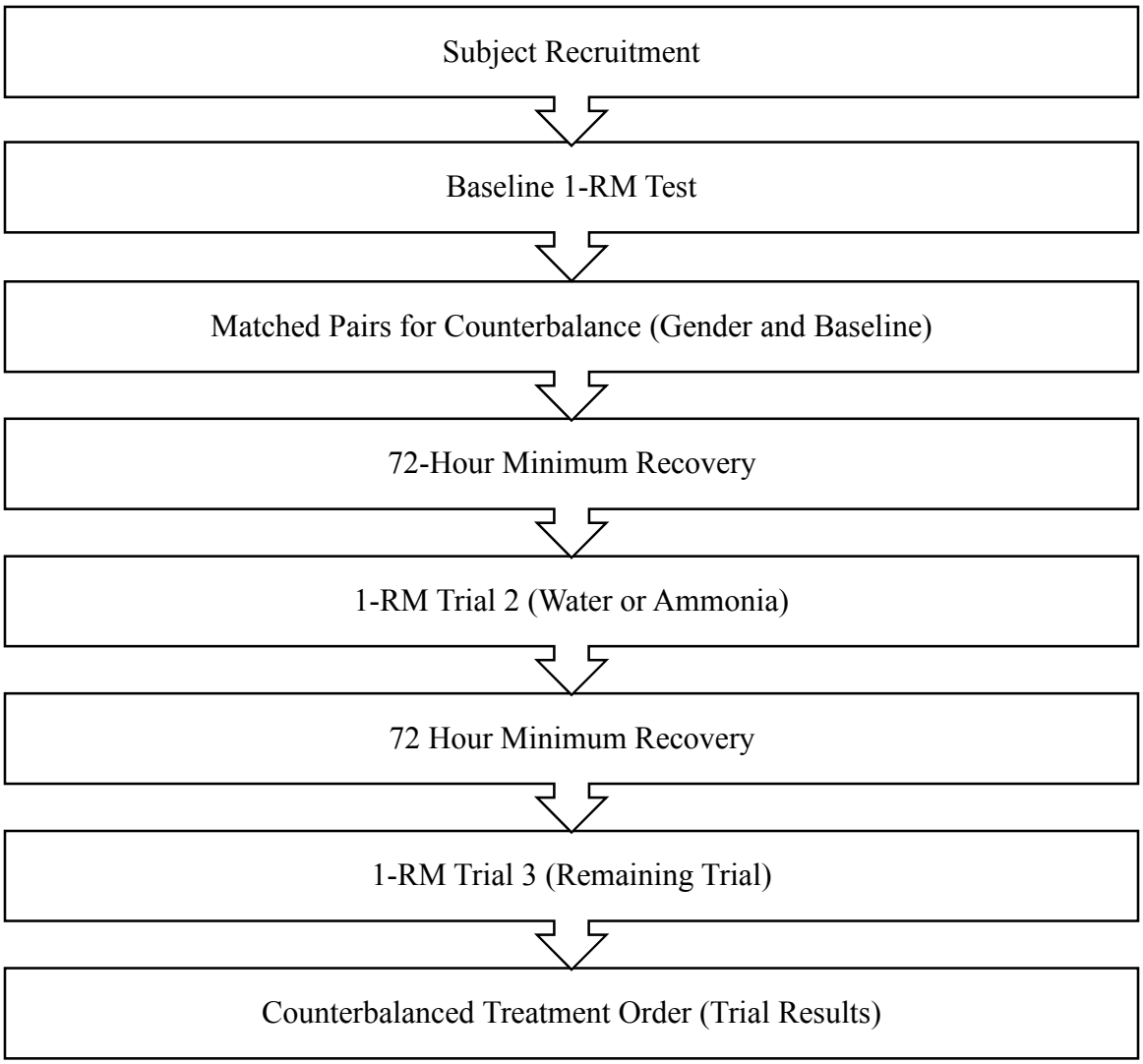
inhalant are felt. Trials were then repeated for the second inhalant with an identical process to Trial 1 and Trial 2 in Trial 3. If the subject failed an attempt, they were allowed a second attempt at the weight with identical procedures, including another inhalation of the prescribed inhalant. All subjects had a timed rest interval of three minutes between all attempts during this study for ideal recovery time without compromising performance (Matuszak et al., 2003).

Table 2. TRIAL WEIGHT PROGRESSION BASED ON BASELINE 1-RM

	Warm-up	65%	75%	85%	90%	95%	100%	Trial
Baseline	Methods Table 1 p. 17	x 2@	x 2@	x 1@	x 1@	x 1@	x 1@	N/A*
Ammonia or Water	Methods Table 1 p. 17	x 2@	x 2@	x 1@	x 1@	x 1@	x 1@	RM + 2.5, 5, 7.5%
Remaining Trial	Methods Table 1 p. 17	x 2 @	x 2@	x 1@	x 1@	x 1@	x 1@	RM + 2.5, 5, 7.5%

* Subject continues to perform single repetitions until a maximum lift was achieved that could not be bettered.

Table 3 TESTING DESIGN



STATISTICAL ANALYSIS

Baseline descriptive variables (age, height, mass, years of weightlifting experience) and 1-RM data for Trials 1, 2 and 3 were examined for normality. 1-RM data were analyzed with repeated-measures analysis of variance with Bonferroni adjustments for planned *post-hoc* comparisons using IBM SPSS (Version 21, Armonk, NY). The criterion for statistical significance was be $\alpha=0.05$. Unless otherwise indicated, values were reported as mean±SD.

CHAPTER IV – RESULTS

Ten male and 10 female subjects completed all three testing sessions. Baseline characteristics are presented in Table 4. As expected, males were significantly heavier and had greater ($p \leq 0.05$) absolute (kg) and relative ($kg \cdot kg^{-1}$) dead-lift performance. There were no reported issues or injuries from participation in the study outside of normal soreness and Delayed Onset of Muscle Soreness (DOMS) signs and symptoms. After testing was completed for all subjects, the ammonia was revealed to be contained in Bottle B, with Bottle A containing water for the controlled substance (Table 3). Matching of subjects in pairs according to baseline performance and randomized assignment to treatment order (water/ammonia; ammonia/water) resulted in no order effect ($p=0.533$).

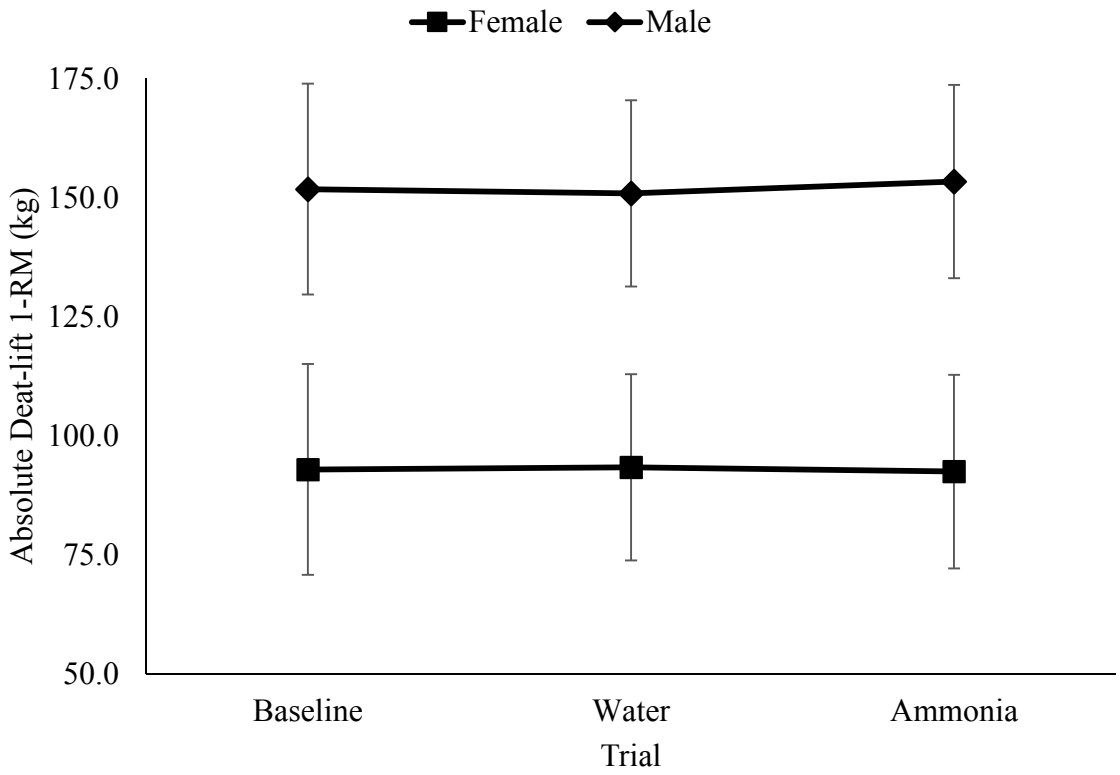
Table 4. Baseline characteristics of subjects. Values are X ± SD.

Variable	Females (n=10)	Males (n=10)
Age (years)	22 ± 5	21 ± 1
Body mass (kg)*	66 ± 8	75.2 ± 6.8
Absolute Baseline dead-lift 1-RM (kg)*	93.0 ± 15.4	151.8 ± 42.3
Relative Baseline dead-lift 1-RM ($kg \cdot kg^{-1}$)*	1.42 ± 0.27	2.01 ± 0.5

*Males > Females, $p \leq 0.05$

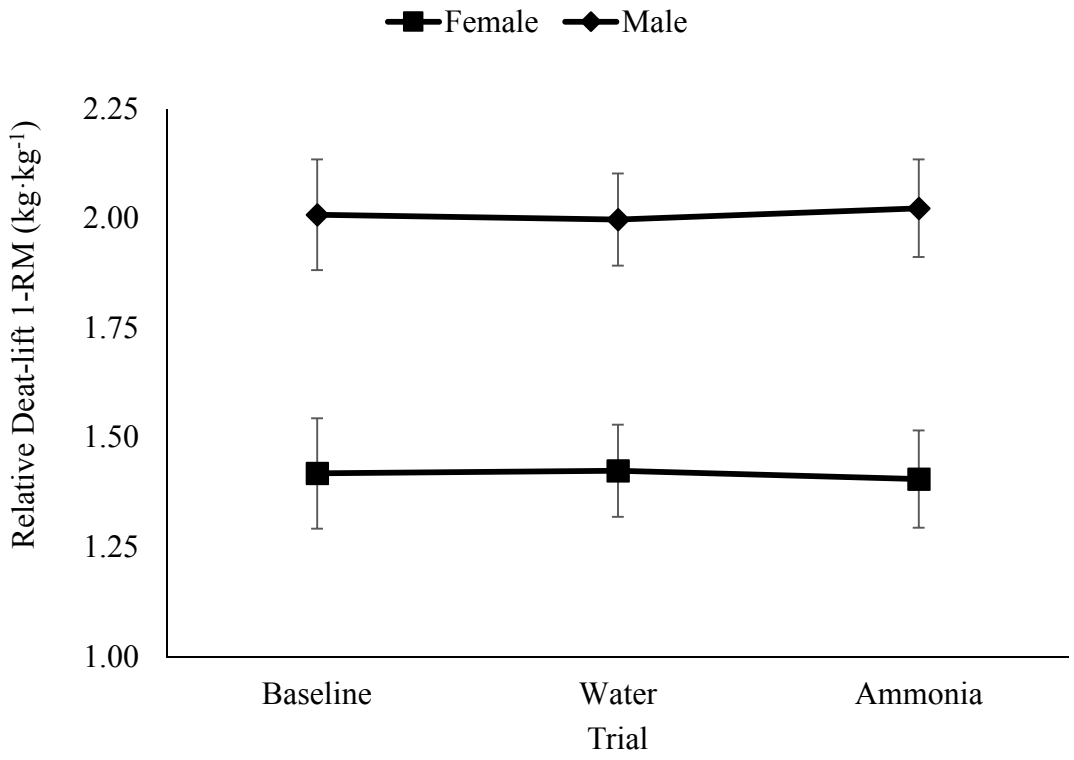
The effect of treatments on absolute dead-lift performance is presented in Figure 1. As expected, there was a significant sex main effect ($p<0.0001$) in favor of males. However, there was no trial main effect ($p=0.874$) or sex by trial interaction effect ($p=0.559$).

Figure 1. Subject Absolute Deadlift comparison between trials. Values are X±SE.



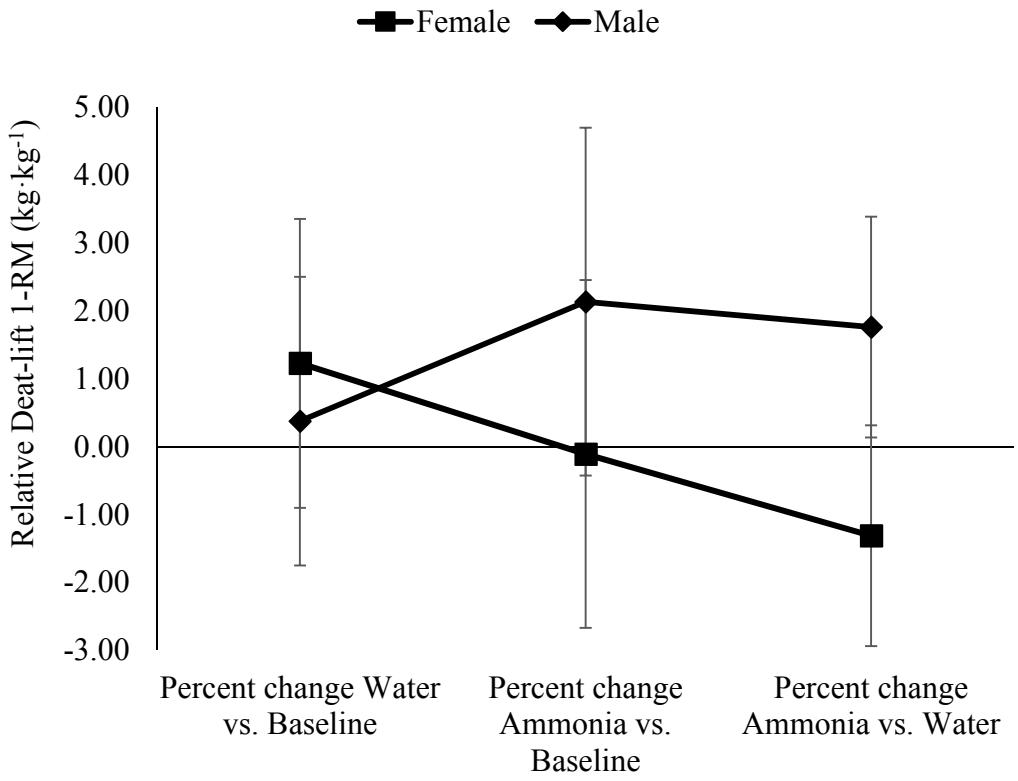
The effect of treatments on relative dead-lift performance is presented in Figure 2 with all relative calculations based on body mass measured at baseline. Males had greater relative dead-lift strength across all trials compared to females ($p<0.001$), but there was no trial main effect ($p=0.946$) or sex by trial interaction effect ($p=0.553$). This indicated no difference across the trials within subjects, while confirming the absence of sex interactions.

Figure 2. Subject Relative Deadlift comparison between trials. Values are X±SE.



As shown in Figure 3, percent changes in absolute dead-lift strength (water vs. baseline; ammonia vs. baseline; ammonia vs. water) were similar (p=0.869) with no gender main effect (p=0.552) or gender by percent comparison interaction effect (p=0.412)

Figure 3. Percent changes in Absolute Deadlift strength. Values are X±SE.



CHAPTER V – DISCUSSION

Ammonia inhalants are often used during Olympic weightlifting and powerlifting events for the purpose of improving athletic performance in both competitive and training situations. However, this study has shown no significant difference in achieved 1-RM loads between maximal deadlift attempts with ammonia compared to water or baseline treatments in male and female recreational weightlifters. Although our data suggest there is no effect on performance, more research is needed on this topic with emphasis on ammonia concentration, greater recovery time allowed between trials, and standardizing the time between trials.

Subjects commented during ammonia experimental trials that the inhalant made them "more alert," "more awake," or "hyper-alert," with confirming dilated eyes and increased respiratory rate as observed by the researcher during testing. There was some coughing as a result of the inhalant, although subjects exhibiting this response recovered within seconds of its onset. The order of trials did not have a significant effect on testing.

One variable that this study failed to account for was the effect of final exams on the subjects involved in the research. All subjects were students finishing the spring semester of the 2015 school year; hence many subjects were not in their ideal or regular schedules and habits. Issues such as sleep deprivation, altered diet inactivity, scheduling, sickness (one subject, which more than likely was stress-induced from final exams between trials and did not mention the illness until after testing), and stress may have impacted the subjects' performances. Training experience was another complication with the subjects. Although many of the subjects had the required weightlifting experience, some subjects

of both sexes had never tested their 1-RM for the deadlift, stating that their training goals never required knowledge of their maximal effort abilities, which may account for the slightly lower baseline achieved loads compared to the experimental trials in some subjects, and hints at their ability to achieve greater loads due to just never having been subjected to such a load. However, the absence of significant differences in deadlift 1-RM between baseline and water or ammonia experimental conditions supports the absence of a learning effect as well as the hypothesized treatment effect. With a subject pool of this background, submaximal testing may have been more ideal due to its design being more applicable to their training methods, but the focus of this study was measurement of maximal strength. The short-term efficacy of ammonia in improving deadlift 1-RM might be more apparent in more homogeneously experienced male and female powerlifters. One recommendation for future study is the replication of this design with such a study population against the utilized population of recreational lifters utilized in this study.

Other uncontrolled variables in this study were the difference in techniques and equipment utilized. These were standardized within subjects but not across the subject pool in an effort to keep subjects in their ideal comfort state, as well as maintaining the methods they use to train while not introducing new variables to a familiar task. Approximately 33 percent of subjects used belts, which could have a significant effect on their performance due to the increase ability to create and hold pressure in the torso, allowing the maintenance of posture that would otherwise be compromised. One female subject also utilized powerlifting straps, which eliminated her grip from the lift, which is thought to be a major limiter of barbell movements (Ratamess et al., 2007). Overall,

many different stances, grips, grip widths, and shoes were utilized by the subjects, all of which individually could have significant effects on the subject's performance. These variations were expected due to different training goals, body mechanics, individual weaknesses and strengths, all which are included in the process of identifying the method used to perform the deadlift within the standard of reaching full torso, hip, and knee extension while lifting the barbell from the floor. However, there was no protocol to address any benefit of equipment or usage of different techniques within each subject and the overall subject population since that was not the focus of this study.

For female subjects specifically, there was no tracking of the menstrual cycle, which also could have had an effect on performance if testing was performed during specific time frames of the cycle (Birch and Reilly, 2002), although overall there seems to be no observed effect based on this study's findings. One female subject lifted 205 pounds in her baseline trial, but only 185 pounds in the water trial, and then 155 pounds in the ammonia trial. This could have been due to inability to recover from prior trials, but the subject was shocked at her inability to reach her baseline value, which leaves the cause for her performance up for question.

The concentration of the ammonia component could have also been a factor. In many competitions, inhalants utilized can be up to three times the concentration of the capsules utilized in this study. These concentrations were not tested due to subject safety, with the focus being on the consistent amounts of fresh ammonia present in each capsule, where competition smelling salts come in "bulk" bottles and have to be resealed after each use. This study was also based on the assumption that ammonia is the substance utilized during competitions.

Timing could also have been a confounding variable within the study in a few instances. Although each subject tested at the same time of day during the study, this was determined by availability, not by individual ideal training time. A given subject might have been in a more ideal training state in the afternoons, but was instead scheduled to test in the mornings. The timing of the maximal lift could have been an issue. Some subjects took longer to recover from the initial "hit" of the ammonia to the point where after the lift (which was within 20 seconds of inhalation) subjects were still recovering from the initial response to the ammonia. Future studies should standardize the time between lifts and inhalation, not seconds so that subjects can be in the desired heightened state, but have adequate time to begin returning to homeostasis. Although the standardized recovery time between trials was enforced, for some subjects there was an unexplained inability to fully return to homeostasis. There may be value in future studies to keep subjects within twenty seconds between inhalation and lifting, while testing different specific times within that range.

A major limitation in this study was the bottles containing water and ammonia treatments. All substances were stored and administered in taped (for blinding) travel size shampoo bottles, which were all discarded after use. To administer the substance after shaking, the tester flipped open the cap of the bottle, where the subjects were inhaling the substance through the narrow opening of the lid, which was much smaller than the opening of the bottle itself. This taping of the capped bottle not only blinded the subject but the researcher as well through all trials. Although this was planned for the purpose of double-blinding, post-testing review reveals that the lids may have limited the subjects from getting full exposure to the ammonia capsule. This could have prevented the

subjects from getting the full exposure to the ammonia, as well as eliminated the need for longer recovery time between inhalation and performing the lift. Future studies can also benefit from a modified protocol utilizing more trials over a greater time period, with two trials for both the water and ammonia treatments to provide more data on whether or not there is an effect attributed to the ammonia, while limiting the possibility of the subject being able to guess which substance is being utilized in that trial.

Reviewing the only prior research related to this topic, there was similar findings by Richmond et al., in 2014 during submaximal testing of bench press and squat at 85% of baseline maximal testing while inhaling Vick's VapoRub. Similar to this study, there was no observed differences between the experimental and blinding substances, while still recommending athletes can continue to utilize the substance without negative consequences to take advantage of any psychological effects due to usage, but at their own decision. Although this study focused on submaximal testing compared to maximal testing in this study, both studies are comparable, making two studies not finding any significant effects attributed to inhalants on performance.

CONCLUSION

In conclusion, this study is the first to truly test the effects of ammonia inhalation on 1-RM testing. The acknowledged design flaws and limitations encountered in this study underscore the importance of additional investigation. Future research should examine the effect of ammonia inhalation in a more experienced study group with better control over diurnal variations in strength measurement; potential effects of menstrual cycle phases in female subjects; use of standardized equipment and technique; and lifts in addition to the dead-lift. Within the limits of this study, there was no ergogenic effect of ammonia inhalation on dead-lift performance in recreational male and female weightlifters. Based on these findings, it is not recommended to strength and conditioning professionals to incorporate inhalants into their training programs. Given these findings, if athletes and/or coaches feel that ammonia inhalants have a psychological benefit for their programs, there is no basis to encourage or discourage their usage if their athlete has no prior medical issues or history similar to that which was screening in this study.

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Appendix 1- Subject Data

Subject	Age	Weight	Baseline	Trial A	Trial B
F1	20	148	230	245	235
F2	19	139	270	245	275
F3	22	131	215	225	215
F4	19	159	195	195	195
F5	34	176	210	215	220
F6	21	122	205	185	155
F7	21	131	155	170	165
F8	20	155	215	195	195
F9	25	165	195	210	210
F10	20	130	155	170	170
M1	22	177	290	290	295
M2	20	170	415	415	415
M3	21	139	230	240	250
M4	21	169.5	235	245	250
M5	22	189	425	425	425
M6	22	176	440	440	450
M7	21	155.5	205	225	230
M8	21	172.5	385	365	365
M9	19	151	290	290	290
M10	23	155	425	385	405

Study Flyer

EXSC 250, 240 Extra Credit Opportunity

Subjects are needed for the following research study; participating will satisfy the current extra credit requirements stated in your course syllabus. Alternate opportunities are available if you do not met the requirements of participation in this study.

The Effects of Pre - Maximal Exertion Inhalation of Gaseous Agents and the Performance Effects During Barbell Movements.

It has been observed at Olympic weightlifting meets with multiple athletes inhaling fumes from ether a small bottle with an unknown substance, as well as actual ammonia capsules prior to stepping on the platform for their lifts. This usage, while obvious, has not been addressed or regulated due to ammonia (azane) not being in the World Anti-Doping Agencies list of prohibited substances. This may be due to lack on knowledge on its effects on performance, or because its effects are not severe/extreme enough to warrant being included in the prohibited list. In this study, ammonia inhalant capsules acquired from Pac-Kit First Aid safety Equipment Company will be utilized to address the stimulant that we assume is what has been seen utilized in competition.

All subjects will undergo a 1-RM test for the deadlift, with the subject progressively performing single repetitions in increasing heavier loads until they have performed one maximal effort that cannot be surpassed by another effort. Equipment

utilized in this study will be standard Rogue Fitness (Columbus, Ohio) Echo Series Bumper Plates (2.5, 5, 10, 15, 25, 35, 45, 55 pound options) which will be utilized with a standard 20-kg Rouge 28MM Training Bar, testing will take place on a standard Olympic regulation weightlifting platform. Any weightlifting accessories will be allowed such as Olympic weightlifting shoes, belts, sleeves, etc. Subjects must wear the same equipment for all trials, while also performing or utilizing the same grip and lifting technique for all trials. The ammonia inhalant being utilized in this study is Pac-Kit (South Norwalk, CT) Ammonia Inhalants medical kit refills (2.125" x 4" x 0.625"), with the control substance being water in an identical bottle. Subjects should use their experience with the deadlift to achieve maximal effort within three to five repetitions of their initial warm-up, utilizing previous 1-RM tests as a guide to the load selection for their attempts. The loads selected for these attempts as well as the success and failure will be recorded for testing design purposes during the trials later in the study. Subjects will have a minimum of 72-hours between each session to allow for full recovery from their exertions and exposure to the particular inhalant in that trial.

Subjects will follow the procedures in Table 1 for both the initial baseline 1-RM test as well as for the experimental trials, after being counter-balanced to either the experimental condition with the ammonia supplementation or the control condition with water as the control substance. Subjects with similar 1-RM baseline results and gender will be paired together for data analysis before the two experimental trials. All substances involved in this study will have been stored in blank bottles by a mentoring faculty member for the blinding of both the researcher and the research subjects. Using the data collected from the baseline maximal test, the researcher will calculate the progressive

increase in weight (in percent) per each attempt for the subject for both trials. Based on this information, subjects will perform two repetitions at 65% and 75% 1-RM, and one repetition at 85%, 90%, and 95%, of 1-RM, followed by the final attempt at either 100% or 100% and higher.

For trial 1, the subject will be inhaling the assigned inhalant and attempting to lift 100% 1-RM plus 2.5% of the 1-RM achieved in baseline testing. In trial 2 the subject will be inhaling the same inhalant and attempting to lift 100% 1-RM plus 5%. In these two trials, the subject will be asked to set their feet and all other personal necessities prior to the lift, take in one maximal inhalation from either bottle one or two and perform the lift within 15 seconds of inhalation as the effects of the inhalant are felt. Trials will then be repeated for the second inhalant with an identical process to Trial 1 and Trial 2 in Trial 3. If subject fails an attempt, they will be allowed a second attempt at the weight with identical procedures, including another inhalation of the prescribed inhalant. All subjects will have a timed rest interval of three minutes between all attempts during this study for ideal recovery time without compromising performance (Matuszak et al. 2003).

Warm-up for Each Trial

1. 2 x 10 Fire Hydrants per leg
2. 2 x 10 second Lunge Stretches
3. 2 x 10 Dumbbell Good Mornings @ 10 & 20 pounds
4. 1 x 10 @ Barbell
5. 3 x 5 @ 45%
6. 2 x 3 @ 50%

Table 1

	Warm-up	65%	75%	85%	90%	95%	100%	Trial
Trial 1	Methods	x 2@	x 2@	x 1@	x 1@	x 1@	x 1@	N/A
Trial 2	Methods	x 2@	x 2@	x 1@	x 1@	x 1@	x 1@	RM + 2.5%
Trial 3	Methods	x 2 @	x 2@	x 1@	x 1@	x 1@	x 1@	RM + 5%

*** By utilizing the subject's bodyweight in the following formula, it will provide another method of analyzing any improvement in strength due to the acute effects of the prescribed inhalant.

Performance= Load Lifted / Bodyweight. Example- 445# / 190# bodyweight=2.34 score

APPENDIX D

INFORMED CONSENT DOCUMENT

OLD DOMINION UNIVERSITY

PROJECT TITLE: The Effects of Pre - Maximal Exertion Inhalation of Ammonia Agents and the Performance Effects During Deadlift Maximal Testing.

INTRODUCTION

The purpose of this form are to give you information that may affect your decision whether to say YES or NO to participation in this research, and to record the consent of those who say YES. The Effects of Pre - Maximal Exertion Inhalation of Gaseous Agents and the Performance Effects During Barbell Movements. For the purpose of this study, the methodology is designed to observe the possibility of enhancing 1-RM (1 repetition for maximal load) lifts without the chronic consequences commonly associated with established methods of performance enhancement, specifically steroids and other such substances. The largest consideration is whether it is possible to influence the body's natural endocrine systems and processes without any chronic side effects or consequences while staying within the current regulations in place by the WADA. Specifically, we are trying to determine the possibility to being able to utilize the acute consequences of inhaling small amounts of ammonia prior to performance of a power exercise; in this case the deadlift exercise and the loads achieved in a standard 1-RM test.

RESEARCHERS

Principal Investigator

J. David Branch, B.A., M.S., Ph. D., Darden College of Education, HMS Associate Professor; Responsible Project Investigator

Investigators

Justin Vigil, B.S., Darden College of Education, HMS Masters Student.

Phil Sabatini, B.S., M.S., HMS Lecturer

DESCRIPTION OF RESEARCH STUDY

The purpose of this study is to provide evidence for the ergogenic effect an ammonia inhalant, a legal external substance, in increasing acute muscular strength as measured by a deadlift 1-RM. This study is designed to assess the effect of ammonia inhalant on the subject group with that of a control group between an ammonia inhalant product and a water as a control substance.

If you decide to participate, then you will join a study involving research of subjects will perform a 1-RM test for the deadlift, with you progressively performing single repetitions in increasing heavier loads until you have performed one maximal effort that cannot be surpassed by another effort. All subjects will undergo a 1-RM test for the deadlift, with the subject progressively performing single repetitions in increasing heavier loads until they have performed one maximal effort that cannot be surpassed by another effort. Equipment utilized in this study will be standard Rogue Fitness (Columbus, Ohio) Echo Series Bumper Plates (2.5, 5, 10, 15, 25, 35, 45, 55 pound options) which will be utilized with a standard 20-kg Rouge 28MM Training Bar, testing

will take place on a standard Olympic regulation weightlifting platform. Any weightlifting accessories will be allowed such as Olympic weightlifting shoes, belts, sleeves, etc. Subjects must wear the same equipment for all trials, while also performing or utilizing the same grip and lifting technique for all trials The ammonia inhalant being utilized in this study is Pac-Kit (South Norwalk, CT) Ammonia Inhalants medical kit refills (2.125" x 4" x 0.625"), with the control substance being water in an identical bottle. Subjects should use their experience with the deadlift to achieve maximal effort within three to five repetitions of their initial warm-up, utilizing previous 1-RM tests as a guide to the load selection for their attempts. The loads selected for these attempts as well as the success and failure will be recorded for testing design purposes during the trials later in the study. Subjects will have a minimum of 72-hours between each session to allow for full recovery from their exertions and exposure to the particular inhalant in that trial.

Subjects will follow the procedures in Table 1 for both the initial baseline 1-RM test as well as for the experimental trials, after being counter-balanced to either the experimental condition with the ammonia supplementation or the control condition with water as the control substance. Subjects with similar 1-RM baseline results and gender will be paired together for data analysis before the two experimental trials. All substances involved in this study will have been stored in blank bottles by a mentoring faculty for the blinding of both the researcher and the research subjects. Using the data collected from the baseline maximal test, the researcher will calculate the progressive increase in weight (in percent) per each attempt for the subject for both trials. Based on this information, subjects will perform two repetitions at 65% and 75% 1-RM, and one

repetition at 85%, 90%, and 95%, of 1-RM, followed by the final attempt at either 100% or 100% and higher.

For trial 1, the subject will be inhaling the assigned inhalant and attempting to lift 100% 1-RM plus 2.5% of the 1-RM achieved in baseline testing. In trial 2 the subject will be inhaling the same inhalant and attempting to lift 100% 1-RM plus 5%. In these two trials, the subject will be asked to set their feet and all other personal necessities prior to the lift, take in one maximal inhalation from either bottle one or two and perform the lift within 15 seconds of inhalation as the effects of the inhalant are felt. Trials will then be repeated for the second inhalant with an identical process to Trial 1 and Trial 2 in Trial 3. If subject fails an attempt, they will be allowed a second attempt at the weight with identical procedures, including another inhalation of the prescribed inhalant. All subjects will have a timed rest interval of three minutes between all attempts during this study for ideal recovery time without compromising performance.

Warm-up for Each Trial

1. 2 x 10 Fire Hydrants per leg
2. 2 x 10 second Lunge Stretches
3. 2 x 10 Dumbbell Good Mornings @ 10 & 20 pounds
4. 1 x 10 @ Barbell
5. 3 x 5 @ 45%
6. 2 x 3 @ 50%

Table 1

	Warm-up	**65%**	**75%**	**85%**	**90%**	**95%**	**100%**	**Trial**

Trial 1	**Methods**	**x 2@**	**x 2@**	**x 1@**	**x 1@**	**x 1@**	**x 1@**	**N/A**
Trial 2	**Methods**	**x 2@**	**x 2@**	**x 1@**	**x 1@**	**x 1@**	**x 1@**	**RM + 2.5%**
Trial 3	**Methods**	**x 2 @**	**x 2@**	**x 1@**	**x 1@**	**x 1@**	**x 1@**	**RM + 5%**

*** By utilizing the subject's bodyweight in the following formula, it will provide another method of analyzing any improvement in strength due to the acute effects of the prescribed inhalant.

Performance= Load Lifted / Bodyweight. Example- 445# / 190# bodyweight=2.34 score

If you say YES, then your participation will last for 3 one-hour sessions with a minimum of 48 hours between sessions at the Old Dominion Student Recreation Center, room 1006C and more specifically, the deadlift platform located within the facility. Approximately 19 other subjects will be participating in this study.

EXCLUSIONARY CRITERIA

All subjects are required to have a minimum of two years of resistance training experience to participate in this study. Any subjects with a history of or exhibiting any cardiovascular issues including but not limited to asthma, lightheadedness, fainting, anaphylaxis, sickle cell traits, and other respiratory disorders will be kept from participating in the study.

RISKS AND BENEFITS

RISKS: If you decide to participate in this study, then you may face a risk of muscle injury (sprains, ligament strains), spinal injuries (pinched nerves, herniated disks, etc.), hiatal hernias (rupture or tear in the abdominal cavity), or other injuries pertaining to muscular exhaustion and overexertion. There is also an inherited risk of fainting, rapid and involuntary contraction of the neck and head; and in significantly higher doses (not available in over-the-counter products, hence should not be an issue in this study) toxicity, sickness, and death. Ammonia levels will also be kept to minimal levels, far from the concentrated levels required to put subjects at risk for toxicity. And, as with any research, there is some possibility that you may be subject to risks that have not yet been identified. AED devices and center staff certified in first aid and CPR response will be on site, as well as the primary investigators also holding CPR, First Aid, and AED certified.

BENEFITS: There are no direct benefits for participation in this study.

COSTS AND PAYMENTS

The researchers want your decision about participating in this study to be absolutely voluntary. Yet they recognize that your participation may pose some cost to park to attend the trials, which there will be no assistance with.

NEW INFORMATION

If the researchers find new information during this study that would reasonably change your decision about participating, then they will give it to you.

CONFIDENTIALITY

The researchers will take steps to keep private information confidential, such as giving all subjects a number to protect their identity, while storing all identifying paperwork in a

locked office. The researcher will remove identifiers from the information, destroy tapes, store information in a locked filing cabinet prior to its processing. The results of this study may be used in reports, presentations, and publications; but the researcher will not identify you. Of course, your records may be subpoenaed by court order or inspected by government bodies with oversight authority.

WITHDRAWAL PRIVILEGE

It is OK for you to say NO. Even if you say YES now, you are free to say NO later, and walk away or withdraw from the study -- at any time. Your decision will not affect your relationship with Old Dominion University, or otherwise cause a loss of benefits to which you might otherwise be entitled. The researchers reserve the right to withdraw your participation in this study, at any time, if they observe potential problems with your continued participation.

COMPENSATION FOR ILLNESS AND INJURY

If you say YES, then your consent in this document does not waive any of your legal rights. However, in the event of harm or injury arising from this study, neither Old Dominion University nor the researchers are able to give you any money, insurance coverage, free medical care, or any other compensation for such injury. In the event that you suffer injury as a result of participation in any research project, you may contact Dr. David Branch at 757-683-4514, Dr. George Maihafer the current IRB chair at 757-683-4520 at Old Dominion University, or the Old Dominion University Office of Research at 757-683-3460 who will be glad to review the matter with you.

VOLUNTARY CONSENT

By signing this form, you are saying several things. You are saying that you have read this form or have had it read to you, that you are satisfied that you understand this form, the research study, and its risks and benefits. The researchers should have answered any questions you may have had about the research. If you have any questions later on, then the researchers should be able to answer them:

Justin Vigil 505-366-1257

Dr. David Branch 757-683-4514

Phil Sabatini 757-683-4995

If at any time you feel pressured to participate, or if you have any questions about your rights or this form, then you should call Dr. George Maihafer, the current IRB chair, at 757-683-4520, or the Old Dominion University Office of Research, at 757-683-3460.

And importantly, by signing below, you are telling the researcher YES, that you agree to participate in this study. The researcher should give you a copy of this form for your records.

Subject's Printed Name & Signature	**Date**

INVESTIGATOR'S STATEMENT

I certify that I have explained to this subject the nature and purpose of this research, including benefits, risks, costs, and any experimental procedures. I have described the rights and protections afforded to human subjects and have done nothing to pressure, coerce, or falsely entice this subject into participating. I am aware of my obligations under state and federal laws, and promise compliance. I have answered the subject's questions and have encouraged him/her to ask additional questions at any time during the course of this study. I have witnessed the above signature(s) on this consent form.

Investigator's Printed Name & Signature	**Date**

HMS Testing Sheet

Subject:

Age:

Gender:

Weight:

Warm-up for Each Trial

1. 2 x 10 Fire Hydrants per leg
2. 2 x 10 second Lunge Stretches
3. 2 x 10 Dumbbell Good Mornings @ 10 & 20 pounds
4. 1 x 10 @ Barbell
5. 3 x 5 @ 45%
6. 2 x 3 @ 50%

Table 1

	Warm-up	65%	75%	85%	90%	95%	100%	Trial
Trial 1	Methods	x 2@	x 2@	x 1@	x 1@	x 1@	x 1@	N/A
Trial 2	Methods	x 2@	x 2@	x 1@	x 1@	x 1@	x 1@	RM + 2.5%
Trial 3	Methods	x 2 @	x 2@	x 1@	x 1@	x 1@	x 1@	RM + 5%

*** By utilizing the subject's bodyweight in the following formula, it will provide another method of analyzing any improvement in strength due to the acute effects of the prescribed inhalant.

Performance= Load Lifted / Bodyweight. Example- 445# / 190# bodyweight=2.34 score

Achieved Trial 1 Weights:

Baseline 1-RM achieved:

	65%	75%	85%	90%	95%	**100%**	102.5%	105%	107.5%
Trial 2 "A"									
Success	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N
Trial 3 "B"									
	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N	Y / N

EXERCISE TEST SCREENING QUESTIONNAIRE

Read the questions to potential subjects and interpret the responses. Do not have the person fill out the questionnaire

on his/her own.

ID # _____ Sex _____ Age _____ Date _____

I. Risk Factors

___ 1.

___ 2. ___ 3. ___ 4.

___ 5. ___ 6. ___ 7.

Do you have a family history of heart disease? [heart attack, bypass surgery, angioplasty or sudden death prior to the age of 55 (father or brother) or 65 (mother or sister)] Have you smoked cigarettes in the past 6 months? Do you know if your blood pressure is typically 140/90 or more? Do you take blood pressure medication?

Do you know if your LDL cholesterol is more than 130, or if your HDL cholesterol is less than 40? If you don't know your LDL, do you know if you total cholesterol is more than 200? Do you know if your fasting glucose is more than 100? What is your height and weight? [determine if BMI is > 30]

Do you usually obtain at least 30 minutes of moderate intensity physically activity most days of the week? [A "No" answer is a risk factor]

II. Symptoms

___ 1. ___ 2. ___ 3. ___ 4. ___ 5. ___ 6. ___ 7. ___ 8.

Do you ever have pain or discomfort in your chest or surrounding areas? (i.e., ischemia) Do you ever feel faint or dizzy? (Other than when sitting up rapidly)□Do you find it difficult to breathe when you are lying down or sleeping?□Do your ankles ever become swollen? (Other than after a long period of standing)

Do you ever have heart palpitations, or an unusual period of rapid heart rate?□Do you ever experience pain in your legs? (i.e., fragmented claudication)□Has a physician ever said you have a heart murmur? (If yes, has he/she said it is OK, and safe for you to exercise?) Do you feel unusually fatigued or find it difficult to breathe with usual activities?

III. Other

___ 1.

___ 2. ___ 3. ___ 4.

Do you have any of the following diseases? Heart disease, peripheral vascular disease, cerebrovascular disease, chronic obstructive pulmonary disease (emphysema or chronic bronchitis) asthma (chronic), interstitial lung disease, cystic fibrosis, diabetes mellitus, thyroid disorder, renal disease, or liver disease□(For women) Do you think you may be pregnant?□Are you taking any medications, such as blood pressure medication, that would affect your heart rate?□Do you have any problem that might make it difficult for

you to do strenuous exercise?

Eligible for study if: Is between 18-35 years old, has no more than 1 risk factor from section I, has none of the symptoms in section II, and answers “No” to all questions in section III.

Note: For individuals who do not know their blood glucose or blood lipid values, the ACSM assumes they have those risk factors if they are males over 44 years of age or females over 54 years of age, and assumes they do not have those risk factors if they are younger. Since all subjects in the current study will be 35 years old or less, if they do not know their blood values they will be assumed to not have those risk factors.

Health History Questionnaire

Please answer the following questions to the best of your ability. For the following questions, unless otherwise indicated, circle the single best choice for each question. As is customary, all of your responses are completely confidential and may only be used in group summaries and/or reports. All information collected is subject to the Privacy Act of 1974. If you have any physical handicaps or limitations that would require special assistance with this questionnaire, please let your trainer know. This form is in accordance with the American College of Sports Medicine guidelines for risk stratification when followed correctly by your trainer. Your trainer should be certified with a national organization in order to use these forms correctly.

Name:_____ Ht.:_____ Wt.:_____

Gender:_____ Age:_____ Birthdate:_____

Address: _____

City:_____ State:_____ ZIP:_____ Phone:_____

Emergency Contact:_____ Phone: _____

Personal Physician:_____ Phone:_____

E-mail:_____

1. Have you ever had a definite or suspected heart attack or stroke? .....Yes No
2. Have you ever had coronary bypass surgery or any other type of heart surgery? .....Yes No
3. Do you have any other cardiovascular or pulmonary (lung) disease (***other than*** asthma, allergies, or mitral valve prolapse)? .....Yes No
4. Do you have a history of: diabetes, thyroid, kidney, liver disease. .....Yes No **(circle all that apply)**
5. Have you ever been told by a health professional that you have had an abnormal resting or exercise (treadmill) electrocardiogram (EKG)? .....Yes No
6. If you answered YES to any of Questions 1 through 5, please describe:

_____

_____

_____

_____

CURRICULUM VITA

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EDUCATION

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May, 2013

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