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EFFECTS OF THE VALSALVA MANEUVER ON POSTEXERCISE HYPOTENSION IN RESISTANCE TRAINED, COLLEGE AGE STUDENTS

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ABSTRACT

Krings JM, Skibness AK, Kasuboski JK. Effects Of The Valsalva Maneuver On Post-Exercise Hypotension In Resistance Trained, College Age Students, *Journal of Undergraduate Kinesiology Research.* 2007;2(2):19-24. **Purpose:** Compare the differences between "normal" breathing and the Valsalva maneuver and the effect they have on post-exercise hypotensive values of resistance trained, college aged males. **Methods:** Subjects consisted of 10 college aged, resistance trained males with an average age of 21.1 ± .567 years, an average height of 182.94 ± 8.74 cm, and an average weight of 89.97 ± 20.38 kg. Each participant was asked to perform a standard supine bench press, completing 3 sets of 8 repetitions at 80% of their 1 repetition maximum (1-RM) on two separate occasions. One session the subjects used "normal" breathing and in the other session they used the Valsalva maneuver. **Results:** There were significant differences ($p < .05$) between "normal" breathing and the Valsalva maneuver group. The "normal" breathing group showed a mean systolic blood pressure value of 119.8 mmHg, and a mean diastolic blood pressure value of 81.2 mmHg at 30 minutes post-exercise. The Valsalva maneuver group showed a mean systolic blood pressure value of 111.5 mmHg and a mean diastolic blood pressure value of 76.7 mmHg at 30 minutes post-exercise. In addition, the mean drop in systolic blood pressure between baseline and post-exercise measurements for the Valsalva maneuver was 8.3 mmHg. **Conclusion:** The findings of our study are important to exercise physiologists as it suggests that the Valsalva maneuver elicits a greater post-exercise hypotensive response than does "normal" breathing when performing a standard supine bench press.

Key Words: Blood Pressure, Weight Lifting, Cardiovascular response, Athlete, Ambulatory, Physiological response, Intensity.

INTRODUCTION

Resistance training is a form of exercise that can lead to an increase in muscle mass, improve body composition, increase bone mineral density, and improve balance (1). Both aerobic and resistance training exercises have been linked to a phenomenon called post-exercise hypotension, a subsequent decrease in both systolic and diastolic blood pressure for an extended period of time following a bout of exercise. One study found that the average drop was 20 mmHg in systolic blood pressure 30 minutes after both resistance training and aerobic exercise in recreationally active normotensive males (2). The study also found a marginal drop in diastolic blood pressure (less than 5 mmHg) after both training modalities (2). Resistance training has traditionally been performed with a "normal" breathing technique that is; inhaling on the eccentric portion of the lift and exhaling on the concentric portion of the lift. Normal breathing technique is usually prescribed to people that do not have much training experience or are hypertensive (5). Some experienced athletes choose to use a nontraditional breathing technique called the Valsalva maneuver, which is characterized as the forced expiration against a closed glottis (3). The Valsalva maneuver has been shown to dramatically increase blood pressure readings while it is being performed (4), and increase performance on resistance exercise (5).

The Valsalva maneuver has been widely criticized for its negative effect to the cardiovascular system stating that the implementation of this breathing technique may cause damage to this intricate system(5). This criticism has led many exercise professionals to insist their clients not perform the Valsalva maneuver. The purpose of this study was to determine the effects the Valsalva maneuver will have on post-resistance training blood pressure. It was hypothesized that using the Valsalva maneuver will have a greater effect on post-exercise hypotension than maintaining a normal breathing pattern throughout the duration of the resistance training session.

METHODS

Subjects

We selected 10 male subjects that were students at the University of Wisconsin – Eau Claire between the ages of 19 and 22. The subjects that were used in the study were required to have at least one year of weight training experience and could not suffer from any blood pressure disorders. Subjects were recruited as acquaintances of the testers and the other subjects were recruited through word of mouth. All subjects signed a letter of informed consent before the study and this study was approved by the institutional review board of the University of Wisconsin – Eau Claire.

Table 1. Characteristics of subjects (N=10).

	Mean ± SD
Age (yrs)	21.1 ± .567
Height (cm)	182.94 ± 8.74
Weight (kg)	89.97 ± 20.38
1-RM (kg)	95.68 ± 22.44

Instrumentation

For primary data collection, height and weight, height was measured using a Seca stadiometer (Model # 216; Hanover, MD). The subjects' weight was measured using a Detecto eye-level physician scale (Model # 439; Web City, MO). All time was kept using a Robic Multi-mode Chronograph 5-lap Memory stopwatch (Model # SC-505; Oxford, CT). The bench press used for all testing was a Magnum Fitness Systems (Model # M678; Milwaukee, WI). Finally blood pressure was measured using an American Diagnostic Corporation manual sphygmomanometer (Model # Diagnostix 752M; Hauppauge, NY).

Procedures

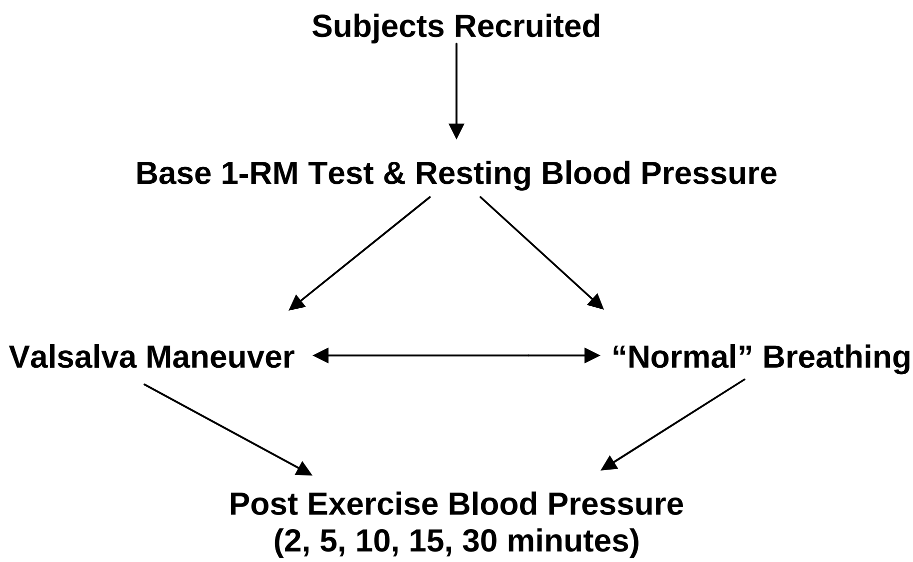

Figure 1. Flow chart of steps taken leading to results.

The subjects were asked to come in three times over a period of three weeks, at the same of day and time that they came in the previous week. Subjects were instructed to not use any stimulants and non-prescription drugs that might change blood pressure readings. They were also instructed not to perform any exercise prior to coming in for the day. The resting blood pressure readings were taken after the subjects had been sitting still in a chair for 15 minutes. During the first session, subjects were asked to perform a one repetition maximum (1-RM) test in order to figure out the amount of weight that was to be used for the work sets, which were 3 sets of 8 at 80% of 1-RM. The following 1-RM protocol was used (6):

1. Instruct the athlete to warm-up with a light resistance that easily allows 5-10
2. Provide a 1-minute rest period
3. Estimate a warm-up load that will allow the athlete to complete 3-5 repetitions by adding
    a. 10-20 lb (4-9 kg) or 5-10% for upper-body exercise or
    b. 30-40 lb (14-18 kg) or 10-20% for lower body exercise
4. Provide a 2-minute rest period
5. Estimate a conservative, near maximum load that will allow the athlete to complete 2-3 repetitions by adding
    a. 10-20 lb (4-9 kg) or 5-10% for upper-body exercise or
    b. 30-40 lb (14-18 kg) or 10-20% for lower body exercise
6. Provide a 2 to 4 minute rest period
7. Make a load increase
    a. 10-20 lb (4-9 kg) or 5-10% for upper-body exercise or
    b. 30-40 lb (14-18 kg) or 10-20% for lower body exercise
8. Instruct the athlete to attempt a 1-RM
9. If the athlete was successful, provide a 2 to 4 minute rest period and go back to step 7

   If the athlete failed, provide a 2 to 4 minute rest period, decrease the load by subtracting
    a. 5-10 lb (2-4 kg) or 2.5-5% for upper-body exercise or
    b. 15-20 lb (7-9 kg) or 5-10% for lower-body exercise

    AND then go back to step 8.

Continue increasing or decreasing the load until the athlete can complete one repetition with proper exercise technique. Ideally, the athlete's 1-RM will be measured within five testing sets.

Exactly one week after the 1-RM test, subjects came in to perform one of their work sets, at the same time of day as the previous week. Subjects were randomly assigned Valsalva maneuver and normal breathing. In order to make sure the subjects knew how to do the Valsalva maneuver, it was explained that it was similar to "holding your breath" on a heavy set of exercises. If that explanation did not suffice, a much cruder explanation involving constipation was provided. Normal breathing technique was described to the subjects as breathing in on the eccentric portion of the lift and breathing out on the concentric portion of the lift.

The work sets were 3 sets of 8 repetitions on the bench press using a load of 80% of the 1-RM that was tested in the first week. Subjects were given two minutes rest between the work sets. Immediately following the last work set, blood pressure was recorded using the manual sphygmomanometer and stethoscope. Blood pressure was measured immediately after, 2, 5, 10, 15, and 30 minutes after the last work set and subjects were instructed to stay seated in order to not cause any type of change in blood pressure readings. The following week, the subjects that performed normal breathing techniques were instructed to perform the Valsalva maneuver, and the subjects that performed the Valsalva maneuver the previous week were instructed to perform normal breathing technique.

Statistical Analyses

During the study we identified the independent variable as the implementation of the Valsalva maneuver while performing a normal supine bench press exercise, lifting at 80% of there 1-RM maximum for 3 sets of 8 repetitions. The dependent variable will consist of the subjects' post exercise blood pressure values. SPSS 14.0 (Chicago, IL) was used for all statistical analyses. Paired *t* tests were performed to compare mean differences in pre/post-exercise systolic/diastolic between groups (Valsalva vs. Normal breathing). Level of significance was referenced at $p<0.05$.

RESULTS

All 10 of our subjects completed both of their sessions successfully. The comparison of normal vs. Valsalva maneuver breathing techniques and their respective blood pressure responses are represented in table 2 below. A comparison of the baseline systolic blood pressure values and final systolic blood pressure values, show that there is a significant difference ($p< .05$) between the implementation of the Valsalva maneuver versus a "normal" breathing technique at 30min. There was also a significant difference ($p < .05$) between the baseline blood pressure values and the final measured values for both the "normal" breathing technique and the Valsalva maneuver suggesting that resistance training can elicit a post-exercise hypotensive response.

Table 2. Blood Pressure Data.

Blood Pressure Measurement Increments	Valsalva		Regular		SBP *t*	DBP *t*	SBP p value	DBP p value
	SBP Mean ± SD	DBP Mean ± SD	SBP Mean ± SD	DBP Mean ± SD				
Baseline	119.8 ± 8.1	79.3 ± 7.6	117.5 ±11.8	79.9 ± 9.7	0.673	-0.255	0.518	0.804
Post	133.8 ± 9.7	82.8 ± 12.5	133.3 ± 11.01	83.8 ± 14.12	0.202	-0.168	0.844	0.87
2 MIN	128.7 ± 7.86	80.8 ± 10.25	127.7 ± 8.81	83.9 ± 10.62	0.696	-0.738	0.504	0.479
5 MIN	124.1 ± 7.46	80.5 ± 9.69	123.3 ± 7.08	81.7 ± 10.26	0.39	-0.384	0.706	0.71
10 MIN	117.1 ± 10.02	77.9 ± 6.60	116.6 ± 9.04	81.4 ± 8.16	0.192	-1.564	0.852	0.152
15 MIN	113.9 ± 11.15	76.5 ± 10.10	115.6 ± 10.11	80.0 ± 6.39	-0.561	-1.29	0.588	0.229
30 MIN	111.5 ± 10.21	76.7 ± 9.28	119.20 ± 11.63	81.20 ± 11.00	-2.502	-1.588	0.034	0.147

DISCUSSION

The results of our study agree with our research hypothesis but only at the 30-min window. There were significant differences in post-exercise systolic blood pressure values, between the “normal” breathing sessions and the Valsalva maneuver sessions. The Valsalva maneuver elicited a greater drop in blood pressure values than did the “normal” breathing technique. We also found that resistance training alone elicited a post-exercise hypotensive response. This finding coincides with previous work done on resistance training and post-exercise hypotension. One such study noted a drop in systolic blood pressure of 20 mmHg 10 minutes after a 15 minute workout of unilateral leg press at 65% 1-RM (2). Our results can also be compared to studies done on aerobic training and hypotension. A study done on cycle ergometry found that at 15 minutes post-exercise, the average drop in systolic blood pressure was 14 mmHg for eight borderline hypertensive participants following a workout of 10 and 30 minutes at 70% VO2 peak (7). Another study done on cycle ergometry showed a decrease of 8 mmHg for systolic blood pressure at 5 minutes post-exercise, following a workout of 50 or 75% VO2 peak for ten normotensive participants (8). A study on resistance exercise intensity and hypotension did give some mechanisms as to what causes post-exercise hypotension in resistance training. In this study, 17 normotensive participants performed low intensity (40% 1-RM) and high intensity (80% 1-RM) resistance exercise. Systolic blood pressure dropped by 6 mmHg for the low intensity group and by 8 mmHg for the high intensity group. These drops were attributed to decreased cardiac output that is not balanced by systemic vascular resistance increase (9) Though we have found many studies to support the idea that hypotension occurs after either resistance exercise or aerobic training, we have found little to validate our findings on the Valsalva maneuver and post-exercise hypotension.

Assumptions

The most important assumption that we have is that our subjects were performing the Valsalva maneuver correctly, also that the 1-RMs and the correlating work loads were the correct value. Another rather important assumption was that our subjects followed the guidelines for our study. The last assumption that we must make lies in the reliability and precision of our equipment.

Limitations

Limitations of this study include being able to generalize the data collected to a larger population as well as the total number of subjects that we were able to utilize. Also, the amount of time to complete this study limited the number of participants who were able to complete our study. Time also restricted the amount of post-exercise blood pressure values we were able to measure. Lastly, a large limitation was the equipment available at our disposal. With an ambulatory blood pressure monitor we could have greatly increased the precision of our measurements as well as taken measurements during exercise.

Generalizability/Applicability

This study applies mainly to college aged, resistance trained males. Though, this data could be generalized to larger populations of normotensive resistance trained males. Further research should be done on various populations including resistance trained females and hypertensive groups. Another way to further generalize our findings would be to change the type of resistance exercise performed, the percentage of 1-RM utilized, and the number of repetitions performed.

CONCLUSION

After conducting our statistical analysis, we have found that performing the Valsalva maneuver elicits a greater drop in post-exercise blood pressure in college aged, resistance trained males. We have also found that resistance training alone can bring about a post-exercise hypotensive response in college aged, resistance trained males. With this in mind and little to oppose or confirm our study, we recommend that there be further research on the benefits of using the Valsalva maneuver as a feature of a strength training program.

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