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Original Research Article

The Effects of High-Load and Low-Load Resistance Training on Muscle Mass and Affective Response in Untrained College Students

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ABSTRACT

Background/Purpose: A larger proportion of the U.S population, including college-aged adults, does not meet the physical activity guidelines, in particular, at least two days per week of muscle-strengthening exercises of all seven major muscle groups. Despite the increased risk for developing sarcopenia later in life, finding ways to begin incorporating resistance training (RT) into young adults' lives remains challenging. Therefore, the purpose of the study was to investigate the affective response (enjoyment) and maximal strength (1RM) Low-Load (40%1RM (40% of their 1RM from testing)) vs. High-Load (75%1RM (75% of their 1RM from testing)) RT among novice college students. **Methods:** Ten university students (18-22 years of age) underwent initial testing that included arms and legs lean body mass (LBM) measured via dual-energy X-ray absorptiometry (DXA)and maximal strength tests for trap bar, bench press, leg press, and cable row. Participants were randomly assigned to Low-Load or High-Load group and engaged in resistance training, twice a week for six weeks for a total of 12 sessions. Weights were increased by 5% every 2 weeks. After 12 sessions were completed, arms and legs LBM, 1RM for the four exercises, and enjoyment scores were assessed. **Results:** Two-way repeated measures ANOVA indicated no significant Time (Pre-Test vs. Post-Test) and Group (Low-Load vs. High-Load) effects on LBM in arms and legs *(p* > .05). There was a significant Time effect on 1RM Trap Bar, Bench Press, Leg Press, and Cable Row exercises. However, no Group effects for all exercises. Paired sample t tests indicated, for Low-Load group**,** there were no significant differences in enjoyment scores between sessions. For the High-Load group, there was a significant decrease in enjoyment from Session 2 to each subsequent Session (*p* < .05). **Conclusions:** Findings of the study suggest that, for novice college students, Low-Load resistance training may be optimal to maintain levels of exercise enjoyment while increasing maximal strength over time.

KEY WORDS: Affective Response, High-load, Lean Muscle Mass, Low-load, Resistance Training

Introduction

One of the most significant health concerns among the U.S. adult population the inability to meet physical activity (PA) guidelines. Research has shown that while 50% of adults meet aerobic exercise guidelines, less than one third meet ACSM resistance training guidelines.[10] The recommended amount of resistance training that the American College of Sports Medicine (ACSM) recommends is 2 days/week per major muscle group, 8-12 reps at an intensity of 60-70% of their one rep max (1RM), with 2-3 sets focused on multi-joint exercises and a variety of equipment used. Lack of resistance training and PA can lead to depression, anxiety, and poor quality of life in young adults. Regular exercise can improve bone density, cardiovascular health, and reduce the risk of chronic diseases such as diabetes and heart disease. From a study looking at PA levels amongst college-age students (18-25 years of age), it was found that 54% of undergraduate students reported being inactive[2]. College is a transformative time in young adults' lives that can be critical to creating habits for physical activity to avoid health problems later in life[4].

Some key facilitators to muscle strengthening are progressive overload, where you gradually increase the stress on your muscles over time, and psychological factors, such as affective response, which reflects how enjoyable the exercise feels. Williams et al., 2008[16] looked at the affective response and was tracked based on future participation in exercise in a group of previously sedentary adults. This was a free-living study with a sample size of 37, while 31 reported future activity time in their own personal lives when training at a moderate intensity level. Adherence in relation to perceived intensity levels as measured by the rate of perceived exertion scale, as it can inform exercise programming based on 1 RM percentage[16]. When intensity is accurately prescribed for inactive adults, adherence can be positively influenced, leading to improved affective response and future exercise habits[16]. The concept of high-load resistance training versus low-load has been introduced in the literature before by Schoenfeld et al., 2017[12], and colleagues. High-load resistance training can be defined as effort that is greater than 60% of an individual's 1 RM, while low-load resistance training is effort that is less than or equal to 60% of their 1 RM. Low-load resistance training can be qualified as endurance, while high load is qualified as strength training. In a systematic review, 21 studies were looked at. It was found that gains in 1 RM were found in high load training versus low load, while no significant changes were found for isometric strength between high and low load resistance training. There was a trend favoring high load in changes in muscle hypertrophy, but overall, they were similar between the two groups with no significance found[12].

In a similar study, it was found that resistance training is commonly prescribed at a load of around 70% of an individual's 1 RM to have significant strength increases as well as body fat decreases. This study looked at whether the percent of the 1 RM really mattered for increases in strength in untrained women in high-load versus low-load resistance training. The researchers found that significant increases in upper and lower body strength happened regardless of the training load, whether that be 30% 1RM or 80% 1RM. They found no changes in body composition[5] . When compared to other studies that looked at resistance training in the same aspect, they found that there were greater strength increases in high-load training versus low-load training[12]. Throughout the studies, it was consistently found that high load resistance training has greater increases in muscle mass and muscular hypertrophy, while low load resistance training had greater increases in muscular endurance[12]. In the last study looked at, participants were well-trained young men who were randomly assigned to a low-load or high-load resistance training group. The overall strength improved more with high load resistance training, while upper body muscular endurance improved to a greater extent using low load resistance training. Additionally, it was found that low-load training should be utilized to maximize muscle hypertrophy, while high-load training should be utilized to maximize strength gains[13]. The Schoenfeld 2015[13] article is controversial compared to other studies because most other studies found that high-load training had greater increases in muscle mass and muscle hypertrophy. In the studies above, there were multiple differences in exercise parameters. In Schoenfeld 2017[12], high load was defined as greater than or equal to 60% 1RM, while low load was less than or equal to 60% 1RM. In the Dinyer 2019[5] study, low load was 30% 1RM, while high load was 80% 1RM. There was also a difference in the study time, with Dinyer 2019[5] study being 12 weeks long, while Schoenfeld 2015[13] study was 8 weeks long. There are plenty of reasons for variety in the research, considering these studies were all done with different parameters.

There is some evidence on high load versus low load resistance training on muscle mass, yet none of the studies examined the affective response to load-specific resistance training (e.g., high load at 75% 1RM and low load at 40-50% 1RM), particularly in the a group of young adults with no prior resistance training experience whose exercise adherence is typically low. .

Therefore, the purpose of this study was to compare the affective response to low-load versus high-load resistance training among college-aged students unaccustomed to RT. It was hypothesized that low load group would show a greater affective response compared to high-load group. Secondarily, high load group would show a greater increase in muscle mass compared to low load group.

Methods

Subjects

The university email directory was used to recruit clients, with emails being sent to 731 students. In addition, 218 students were informed about this research project in lectures. From recruitment, there were 10 participants recruited. Participants can only be college students between the ages of 18 to 25 years who are classified as inactive by the American College of Sports Medicine guidelines. An individual was considered physically inactive if they engage in less than 30 minutes of exercise per day on at least 3 days per week for 3 months. Participants medical clearance if they have a known cardiovascular, metabolic, or renal disease that is asymptomatic. Participants with no CV, metabolic, or renal disease are allowed to participate with no medical clearance. Participants are also excluded if they might be pregnant, pregnant, or planning to become pregnant. We reached out to 731 people via the email directory, and most that we reached out could not participate due to already meeting ACSM guidelines of physical activity. There were no participants who had to be denied the screening. The average age of participants was 19.4±1.3 years old. 75%

of participants were female, with the average weight of all participants being 72.2±21.59 kg and height of 170.14 ±6.21cm. After being approved by the Institutional Review Board, informed consent was obtained from all participants prior to participation.

Instrumentation and testing

Segmental fat free mass

A Dual-Energy X-Ray Absorptiometry (DXA) scan was necessary to obtain the body composition and muscle mass of participants. The DXA that was being utilized was the GE Healthcare Lunar Prodigy unit, and Encore was the software to analyze scanned data to obtain the outcome measures. The GE headquarters are located in Chicago, IL. The Smith-Ryna 217 article measured the validity and reliability of the DXA scan using the four-compartment model, separating the body into fat, water, mineral, and protein components. The study compared DXA and BodPod from a sample of 40 subjects that underwent identical testing. It was found that the DXA scan was a valid and reliable method of estimating the four-compartment body composition. Another study, Lohman et al., 2019, looked at which position, either supine-supine or supine-prone, was better for total body measurements in DXA scans. The body composition factors looked at were lean mass, fat mass, bone mineral density, and bone mineral content. It was found that body composition can be more accurately measured in the supine-supine position, as supine-prone slightly increased measurement errors and weakened reproducibility. Reproducibility ensures that the DXA scan was a reliable measure. Qualified investigators administered the DXA scan tests.

Resistance Training Enjoyment Scale

To measure adherence components, a physical activity enjoyment scale (PACES) was being used. After every resistance training session, participants will utilize the PACES scoring that indicates their affective response they are having to exercise. The PACES scale was being used at the end of each exercise session, totaling 12 survey per participant over the 6 weeks. The PACES survey consists of a 1 to 7 scale, with 1 indicating positive feelings and 7 indicating negative feelings. Kendzierski and DeCarlo (1991) were the version used and has a 0.93 internal consistency indicating strong reliability. With the PACES scale, there were certain scores of items that needed to be flipped due to the negative feelings associated with the question. Some examples included, “I feel bored”, “I am very frustrated by it”, and “I felt as though I would rather be doing something else”. Participants who reported a higher PACES score reflected greater enjoyment of the study, while lower scores indicated reduced enjoyment.

Procedures

The initial session was an hour long, located in the exercise physiology laboratory. After the informed consent was signed, the participants then filled out a health history questionnaire to gather the participants' medical and lifestyle information to ensure they were eligible for the study. The participants were informed that there would be 14 total sessions, all located in the McPhee Physical Education Center. The first and fourteenth sessions consist of a DXA scan and 1 RM testing. There are 6 weeks of workouts, with the participants coming 2 times per week. Prior to the pre-testing participants could not exercise before getting their DXA scan done. An ID number was then assigned to the participant after completing both forms. The next step in the initial session was to do a DXA scan of the participant's body. This took 6-12 minutes to complete, depending on body composition, followed by a printed sheet of the participants' body composition. The last step in the initial session was to find the participant's 1 RM for bench press, leg press, trap bar deadlift, and seated row.

Initial Testing

The participants start off with a 5–7-minute warmup of arm circles, hip circles, body-weight squats, leg swings, and jumping jacks. For bench press and leg press, a 3-5 rep max was used to calculate the 1 RM, while seated row and trap bar deadlift are true 1 RM tests. Following the warmup, the participant started on the trap bar deadlift. The proper form and cues were demonstrated, then the participant performed 5 repetitions with no weight to ensure proper form was maintained. Following the warmup weight, the participant rested for one minute, then completed another set of 3 to 5 repetitions with 5-10% more weight added for seated row, and 10-20% added for trap bar deadlift. A 2-minute rest period was allowed, then the participant was instructed to perform 2 to 3 repetitions with an additional 5-10% added weight for seated row, and 10-20% added weight for trap bar deadlift. After successfully performing this, participants took a 2–4-minute rest, followed by adding 5-10% more weight for the seated row, and 10-20% more weight for the trap bar deadlift. The participant was then instructed to perform one repetition. If the participant easily completed one repetition, we repeated the previous step until they completed one repetition with no repetitions in reserve (RIR). The same procedure was followed for bench press and leg press, stopping when the participants completed 3-5 repetitions. After the testing for those 4 exercises (all done in the same order) were completed, a 5–7-minute cooldown consisting of a standing quadricep stretch, hamstring stretch, seated butterfly stretch, chest stretch, and cross-body stretch was completed. Following the testing, the Physical Activity Enjoyment Scale (PACES) was explained, but not taken until after their first RT session. This survey will evaluate the emotional response the participant has to exercise and will be completed after every workout session.

1RM Calculations

After this first session, the 1 RMs were calculated from the equations for bench press and leg press. The groups were then split into high load and low load groups by the flip of a coin. The high load group consisted of 5 sets of 3 repetitions at 75% of their 1 RM, while the low load group consisted of 2 sets of 8 repetitions at 40% of their 1 RM.

Intervention sessions

The next 12 sessions, 2 days per week for 6 weeks, for each of the participants were held in the weight room. The participants started with a warmup of arm circles, jumping jacks, leg swings, hip circles, and bodyweight squats. The participants then performed the 4 exercises depending on which group they were in, high-load or low-load. The first exercise was trap bar deadlift, followed by bench press, leg press, then seated row, reminding the participant of the proper form and cues for each. After every workout session, the participants completed the PACES survey, asking questions about their enjoyment level during the workout. Every two weeks, the weight will increase by 5% for each group. After the participants' 2 sessions were completed each week, they are reminded to schedule their 2 sessions the following week. This was to help with adherence to our workout program and keep their workouts consistent. The fourteenth session will consist of the same steps from the first session - DXA scan and 1 RM testing to see how much muscle mass they have gained, and how much their strength has improved.

Design/Statistical Analysis

This study was an experimental design using a pretest-posttest randomized group design. There are two experimental groups which are high-load resistance training and low-load resistance training. This study consists of two independent variables; the first was whether the participant was assigned to either the high-load or the low-load group. The second independent variable was the time, which was based off the pre-testing data done before session 1 and post-testing data after session 12.

The statistical method that was be used to determine our hypothesis was a two-way repeated measures the analysis of variance (ANOVA) comparing the pretest and posttest data along with time. This consists of four 1 RM data and fat-free mass in the left and right arms and legs of each participant. The significance level of the two-way repeated measures ANOVA was set to 0.5 significance and utilizes the software IBM SPSS version 31.0. For the survey data for the affective response, the study also utilized two-way repeated measures ANOVA within the Qualtrics survey web software. This analysis used a significance level of 0.5 and compared data from post-workout session one as the pre-test data and post-workout session 12 as the post-test data. This analysis of survey data compared the affective responses of both groups, high-load and low-load.

Results

Using an alpha of .05, the two-way repeated measures ANOVA indicated Time (Pre-Test vs. Post-Test) and Group (Low-Load vs. High-Load), there was no significant group effect of lean muscle mass in legs, $F(1,8) = 0.82$, $MSE = 0.57$, $p = .391$. and $F(1,8) = 0.13$, $MSE = 21.49$, $p = .731$, respectively. In addition, no significant interaction effect was examined, $F(1,8) = 0.78$, $p = .402$. Time and Group there was no significant group effect of lean muscle mass in arms, $F(1,8) = 0.47$, $MSE = 0.01$, $p = .061$. $F(1,8) = 0.31$, $MSE = 4.22$, $p = .596$, respectively. In addition, no significant interaction effect was examined, $F(1,8) = 3.20$, $p = .112$. Refer to Figures 1 and 2 for descriptive statistics of lean mass of legs and arms by Time and Group and Table 1.

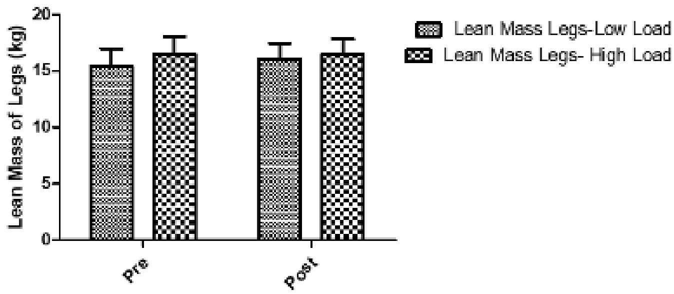

Figure 1. Pre and Post Lean Mass of Legs.

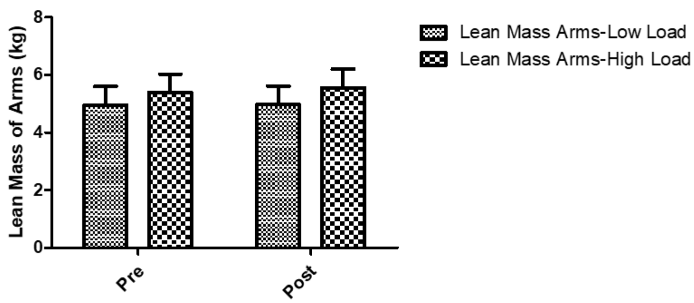

Figure 2. Pre and Post Lean Mass of Arms.

There was a significant Time effect on 1RM Trap Bar, $F(1,8) = 19.41$, $MSE = 57.48$, $p = .002$. Group had no significant effect $F(1,8) = 0.54$, $p = .484$. There is not a significant interaction effect, $F(1,8) = 0.16$, $p = .699$. For 1RM Bench Press, Time was a significant group effect, $F(1,8) = 9.23$, $MSE = 7.43$, $p = .016$; however, group did not have a significant effect, $F(1,8) < .001$, $MSE = 489.61$, $p = .987$. There was no significant interaction effect, $F(1,8) = 1.84$, $p = .212$. For 1RM Leg Press, Time was a significant group effect, $F(1,8) = 14.70$, $MSE = 481.82$, $p = .005$; however, group had no significant, $F(1,8) = 1.19$, $MSE = 2232.72$, $p = .679$. There was no significant interaction effect, $F(1,8) = 1.19$, $p = .308$. For 1RM Cable Row, Time was a significant group effect, $F(1,8) = 33.91$, $MSE = 5.53$, $p < .001$; however, group had no significant group effect, $F(1,8) = .034$, $MSE = 172.18$, $p = .852$. There was no significant interaction effect, $F(1,8) = 0.42$, $p = .536$. Refer to Figures 3-6 for illustrations of changes in maximal strengths for 4 exercises by Group and Time. Refer to table 3 for all 1RM statistics.

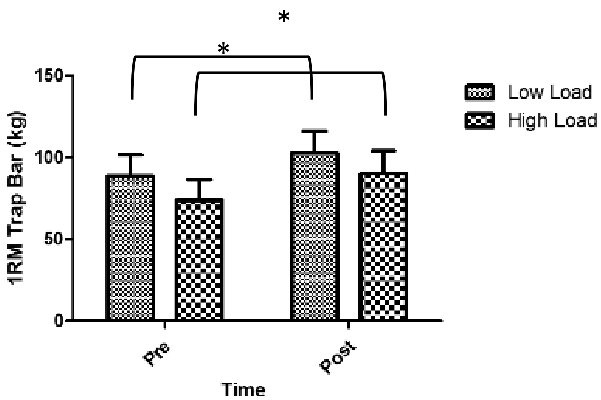

Figure 3. 1RM Trap Bar Pre and Post Test.

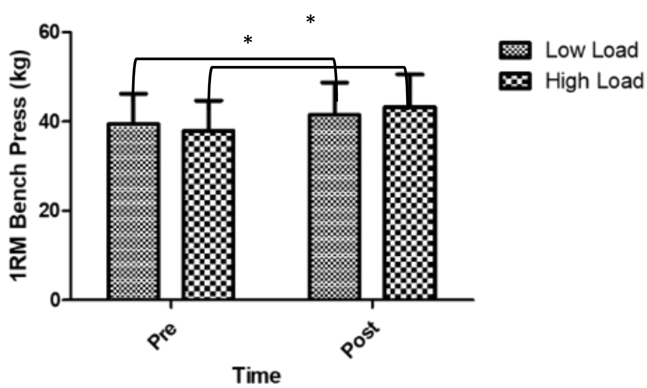

Figure 4. 1 RM Bench Press Pre and Post Test.

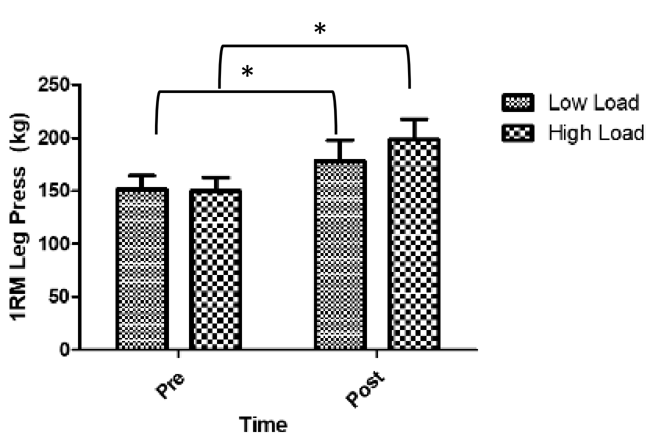

Figure 5. 1RM Leg Press Pre and Post Test.

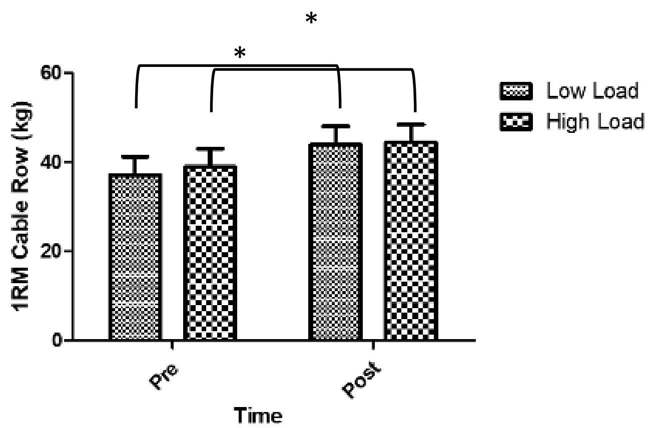

Figure 6. 1RM Cable Row Pre and Post Test.

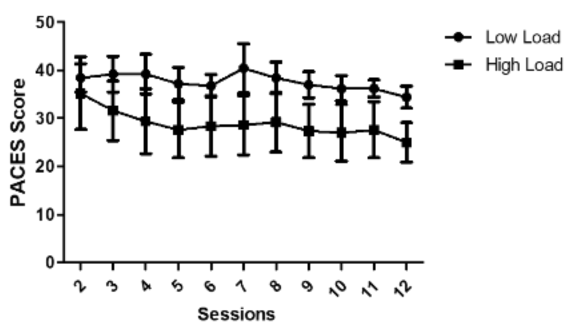

Figure 7. PACES Scores across 12 sessions.

In terms of Enjoyment Scores, data were split by group assignment and employed paired samples tests to examine the changes in scores across the 12 sessions. The results indicated, for Low-Load group**,** there were no significant differences in enjoyment scores between sessions. For High-Load group**,** there was a significant decrease in enjoyment from Session 2 to each Session, $p < .05$. See Table 2 for descriptive statistics of PACES scores from Session 2 through Session 12 and Figure 7 for the illustration of the changes in PACES scores by groups. Refer to figure 7 and table 2.

Table 1.
Pre and Post Lean Mass in Legs and Arms by Groups

				95% Confidence Interval	
Training	Time	Mean	Standard Error	Lower Bound	Upper Bound
Lean Mass Legs (kg)					
Low Load	Pre	15.43	1.56	11.83	19.04
	Post	16.04	1.40	12.80	19.27
High Load	Pre	16.47	1.56	12.86	20.06
	Post	16.48	1.40	13.24	19.71
Lean Mass Arms (kg					
Low Load	Pre	4.95	0.65	3.45	6.46
	Post	4.97	0.65	3.47	6.46
High Load	Pre	5.38	0.65	3.88	6.89
	Post	5.56	0.65	4.06	7.05

Table 2.
PACES Scores across Training Sessions by Groups

Session	Low Load		High Load	
	Mean	SD	Mean	SD
2	38.40	6.54	35.20	16.84
3	39.20	8.32	31.60	13.87
4	39.20	9.23	29.40*	15.03
5	37.20	7.60	27.60*	12.97
6	36.80	5.22	28.40	14.03
7	40.40	11.42	28.60*	13.83
8	38.40	7.37	29.20*	13.88
9	37.00	6.08	27.40	12.42
10	36.20	5.93	27.00*	13.21
11	36.20	3.96	27.6	13.05
12	34.40	5.13	25.00	9.17

Note: * Indicates significant difference compared to session 2 at p value of <.05

Table 3.
Descriptive Statistics for Strength Tests by Group and Time

	Time	Mean	Standard Error	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
1-RM Trap Bar Deadlift (kg)					
Low Load	Pre	88.90	12.79	59.41	118.40
	Post	102.51*	13.77	70.77	134.26
High Load	Pre	73.94	12.79	44.44	103.43
	Post	90.27*	13.77	58.52	122.01
1-RM Bench Press (kg)					
Low Load	Pre	39.41	6.79	23.75	55.07
	Post	41.46*	7.30	24.63	58.29
High Load	Pre	37.92	6.79	22.26	53.58
	Post	43.27*	7.30	26.44	60.10
1-RM Leg Press (kg)					
Low Load	Pre	151.41	12.77	121.97	180.85
	Post	178.35*	19.49	133.41	223.30
High Load	Pre	149.80	12.77	120.36	179.25
	Post	198.13*	19.49	153.18	243.07
1-RM Cable Row (kg)					
Low Load	Pre	37.20	4.06	27.84	46.55
	Post	44.00*	4.37	33.93	54.07
High Load	Pre	39.01	4.06	29.65	48.36
	Post	44.45*	4.37	34.38	54.53

*Indicates significant difference compared to pre at p value of <.05

Discussion

The objective of this study was to examine whether high load or low load resistance training would show a greater affective response and a greater increase in muscle mass. It was hypothesized that low load resistance training would show a greater affective response compared to high load resistance training sessions throughout the 6 weeks, and that high load resistance training would have a greater increase in muscle mass than low load. Results indicated that low load resistance training had a better affective response; however, there were no changes in the level of muscle mass between high load and low load groups. These findings state that low load resistance training is better for affective response, while the load percentage does not matter for the untrained population. This is all relevant information because less than one third of the population meets the ACSM resistance training guidelines at 2 days/week per major muscle group, 8-12 reps at an intensity of 60-70% of their one rep max (1RM), with 2-3 sets focused on multi-joint exercises and a variety of equipment used[10].

1RM

The results indicate that there were significant differences in both the high-load and low-load groups for 1RM between pre-tests and post-tests. These findings suggest that in all four exercises, trap bar deadlift, bench press, leg press, and cable row, both high-load and low-load resistance training can be beneficial for the untrained population. A factor that could impact the results of the 1-RM data could be the testing procedure and becoming more familiar with participants at the end, compared to the beginning, due to being untrained.

Previous literature has examined whether the percentage of 1 repetition maximum (1RM) matters when it comes to exercising and strength benefits. High-load-resistance training and low-load resistance training can each offer their own particular benefits to the trained and untrained population. The concept of high load resistance training versus low load resistance training has been introduced in the literature by Schoenfeld et al., 2017[12]. It was found that gains in 1 RM were found more in the high-load training groups versus the low-load training group. However, Dinyer et al., 2019[5] looked at if the percentage of the 1 RM really mattered for increasing strength in untrained women utilizing high load versus low load resistance training. It was found that significant increases in upper and lower body strength happened regardless of training load, whether that be high or low.

Lean Mass

Our results indicate that there was no significance in the pre and posttests for lean mass for arms and legs. This could be because the study was only 6 weeks long, and there was not enough time for muscle to fully develop in response to the training. Our study procedure also did not direct participants to follow any form of dieting so nutrient intake could be a limiting factor for lean muscle mass improvements.

The relationship between high versus low load resistance training and lean mass changes has been examined in previous research. Resistance training can lead to increased lean mass on your body, and having more lean mass produces many health benefits. These benefits include improved bone density, cardiovascular health, and reduced risk of chronic diseases such as diabetes and heart disease[2]. From previous literature, Schoenfeld et al., 2017[12] states that there was a trend favoring high load resistance training in changes in muscle hypertrophy, but overall, they were similar between the two groups (high load versus low load) with no significance found.

PACES

The results indicate that the low-load group showed no significant differences in enjoyment scores between sessions 2 and 12. In contrast, the high-load group demonstrated consistent enjoyment across the intervention period. These findings suggest that low-load training elicits that individuals unaccustomed to resistance training begin at low load, to maintain their enjoyment level. According to Williams et al. (2008)[16], exercise adherence in inactive adults can be positively influenced when intensity of exercise is appropriately prescribed. Tailored intensity prescription can enhance affective responses, which may, in turn, improve future exercise habits.

Given the significant improvements in 1RM for the trap bar, bench press, leg press, and cable row over the 12 training sessions—as well as the significant differences in PACES scores between low-load and high-load conditions—our findings indicate that low-load training elicits a substantially more positive affective response and higher enjoyment. These results help address the existing gap in the literature regarding affective responses across different training loads[9]. The implications of this study can be applied broadly by clinicians, practitioners, and coaches to inform training decisions and program design. When implementing RT into someone's training regimen or lifestyle, professionals can now confidently prescribe low-load RT to improve people's affective response. By prescribing an RT program that is low load can increase the person's level of enjoyment, which theoretically would improve their adherence. Improving a person's adherence, they will drastically see improvement in their strength, muscle mass, and overall physical fitness. This can change how exercise is prescribed for a large range of clinical populations. Knowing this information, untrained college students can be informed of what type of RT is deemed more enjoyable, while still increasing muscular strength. Future research studies can continue to verify the validity of our findings but increase the number of participants. By increasing the number of people who go through the protocol, we can gain a better understanding of affective response and an increase in muscle mass regarding high-load and low-load RT.

Given the results indicated, for the Low-Load group**,** there were no significant differences in enjoyment scores between sessions. We can conclude that low-load resistance training has a higher affective response than high-load. In addition, there were no significant group effect of lean muscle mass in legs. In addition, no significant interaction effect was examined. Time and Group were not significant group effect of lean muscle mass in arms. From this, we conclude that there was no significant connection between muscle mass gain and low-load and high-load. There was a significant Time effect on 1RM Trap Bar. For 1RM Cable Row, Time had a significant group effect. For 1RM Leg Press, Time had a significant group effect. Given this statistical data, there is significant data indicating that there was an increase in 1RM strength for the trap bar, bench press, cable row, and leg press. In conclusion, low-load resistance training has a much higher affective response, which theoretically increases exercise adherence.

Strengths/Limitations

A strength of the study was that both groups received significant benefit regarding their 1-RM increases. The body composition testing was done using the DXA scan, which is an accurate measure contributing to the strength of the study. A limitation of the study was the lack of a control group. Not having a control group to compare against both experimental groups leave comparisons to be made based on how effective low load and high load resistance training is for untrained individuals. The sample size is also a limitation within the study due to only having 10 participants and two of them being male, which impacts the diversity of conclusions that can be drawn and data interpretation. Outside factors like diet, sleep, and activity levels also can be considered a limitation due to participants not adhering to the training protocol or having deficits that could impact results. Although participants met requirements for activity level to confirm they are untrained, the diet and sleep portion was not addressed. There was also a limitation regarding the 1-RM percentage having to be lowered from 85% to 75% for the high load group due to difficulty. This then impacted the weight calculations, which resulted in untraditional sets and reps to make up for the deficit of weight addition or subtraction.

Conclusion

This study found significance in many factors. Both the high-load and low-load resistance training groups had significant increases in 1 RM from pretest to posttest. Additionally, it was found that participants in the low-load training group had a higher enjoyment of exercise, which was indicated by a higher PACES score. However, the lean mass between high load and low load resistance training was not significant. These findings suggest that low load resistance training may be beneficial for beginners due to higher exercise enjoyment, which could produce more adherence, while still producing strength gains comparable to high load resistance training.

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ADDRESS FOR CORRESPONDENCE

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References

1. American College of Sports Medicine, Liguori, G., Feito, Y., Fountaine, C., & Roy, B.A. (2021). *ACSM'S guidelines for exercise testing and prescription 11th Edition.*
2. Bailey, C. P., Lowry, M., Napolitano, M. A., Hoban, M. T., Kukich, C., & Perna, F. M. (2023). Associations between college/university physical activity requirements and student physical activity. *Research Quarterly for Exercise and Sport*, *94*(2), 485–492.
3. Carpinelli, R. N. (2011). Assessment of one repetition maximum (1RM) and 1RM prediction equations: Are they really necessary? *Medicina Sportiva, 15*(2), 91–102.
4. de Santana, E. E. S., Neves, L. M., de Souza, K. C., Mendes, T. B., Rossi, F. E., da Silva, A. A., de Oliveira, R., Perilhão, M. S., Roschel, H., & Gil, S. (2023). Physically inactive undergraduate students exhibit more symptoms of anxiety, depression, and poor quality of life than physically active students. *International Journal of Environmental Research and Public Health*, *20*(5), 4494.
5. Dinyer, T., Byrd, M., Garver, M., Rickard, A., Miller, W., Burns, S., Clasey, J. & Bergstrom, H. (2019). Low-load vs. high-load resistance training to failure on one repetition maximum strength and body composition in untrained women. *Journal of Strength and Conditioning Research, 33* (7), 1737-1744.
6. Fisher, J., Steele, J. & Smith, D. (2017). High- and low-load resistance training: Interpretation and practical application of current research findings. *Sports Medicine,* 47, 393–400.
7. Focht, B.C. (2007). Perceived exertion and training load during self-selected and impacted-intensity resistance exercise in untrained women. *Journal of Strength and Conditioning Research 21*(1), 183-187.
8. Mullen, S.P., Olson, E.A., Phillips, S.M. *et al.* Measuring enjoyment of physical activity in older adults: invariance of the physical activity enjoyment scale (PACES) across groups and time. *International Journal of Behavioral Nutrition and Physical Activity,* 8, 103 (2011).
9. Pekmezi, D., Jennings, E., & Marcus, B. H. (2009). *ACSM's Health & Fitness Journal*, *13*(2), 16–21 (2011).
10. Phillips, S. M., Ma, J. K., & Rawson, E. S. (2023). *The Coming of Age of Resistance Exercise as a Primary Form of Exercise for Health*. *ACSM's Health & Fitness Journal*,27(6), 19–25.
11. *Physical Activity—Healthy People 2030 | odphp.health.gov*. (n.d.). Retrieved March 12, 2025, from https://odphp.health.gov/healthypeople/objectives-and-data/browse-objectives/physical-activity
12. Schoenfeld, B. J., Grgic, J., Ogborn, D., & Krieger, J. W. (2017). Strength and hypertrophy adaptations between low- vs. high-load resistance training: A systematic review and meta-analysis. *Journal of Strength and Conditioning Research*, *31*(12), 3508–3523.
13. Schoenfeld, B. J., Peterson, M. D., Ogborn, D., Contreras, B., & Sonmez, G. T. (2015). Effects of low- vs. high-load resistance training on muscle strength and hypertrophy in well-trained men. *The Journal of Strength & Conditioning Research*, *29*(10), 2954.
14. Schoenfeld, B. J. (2010). The Mechanisms of muscle hypertrophy and their application to resistance training. *Journal of Strength and Conditioning Research, 24*(10), 2857-2872.
15. Weakley, J., Schoenfeld, B. J., Ljungberg, J., Halson, S. L., & Phillips, S. M. (2023). Physiological responses and adaptations to lower load resistance training: Implications for health and performance. *Sports Medicine*, 9(28).
16. Williams, D. M., Dunsiger, S., Ciccolo, J. T., Lewis, B. A., Albrecht, A. E., & Marcus, B. H. (2008). Acute affective response to a moderate-intensity exercise stimulus predicts physical activity participation 6 and 12 months later. *Psychology of Sport and Exercise*, *9*(3), 231–245.