

The Effect Of Weight Training On Muscle Strength, Muscle Endurance And Body Composition Among Overweight Individuals

Muhammad Nor Faiz Abd Aziz, Norhazira Abd Rahim, Nor Aijratul Mohammad Shalan, Nor Fazila Abd Malek & Ali Md Nadzalan

Abstract— Weight training is one of the training method that often been used to gain muscle strength and size. The aim of this study was to identify the effects of weight training on body mass index (BMI), muscle mass, body fat percentage, hand grip strength and maximal repetition of weight gain in overweight men. This study was conducted using experimental method through pre- and post-test. Body composition analyzer was used to measure BMI, fat percentage and muscle mass. Muscle strength was measured by using the maximum hand grip test while muscle endurance by using the maximum push-up test. The subjects of this study were consisted of 20 individuals (male, BMI 25.76 ± 1.35 , age 23.05 ± 2.14 years old). Weight training intervention was conducted 3 times per week for 4 weeks. The result shows there was a significant effect of weight training on maximum push-up repetition ($p = .000$, $p < .005$). However there were no significant effect of weight training on BMI ($p = .586$), mass muscle ($p = .163$), body fat percentage ($p = .659$) and maximum hand grip ($p = .179$). In conclusion, the 4-weeks weight training is able to increase the muscle endurance among overweight males. Therefore, it can be suggested that weight training as one of the strategy to improve muscle endurance among overweight males. For future study, it is suggested that the duration of the weight training intervention to be extended to obtain a significant effect.

Index Terms— Resistance training, Muscle strength, Muscle Endurance, Body Composition, Overweight

1 INTRODUCTION

OVERWEIGHT is defined as excess body fat or an abnormal amount of fat that can affect your health. The use of body mass index (BMI) is often used to identify measures of overweight or obesity for both sexes (men and women) and for various ages. However, this body mass index (BMI) should be considered a rough guide as it may not correspond to different levels of fat in different individuals. Furthermore, weight training or physical exercise is a healthy activity for everyone regardless of any age and gender. In addition, physical activity is any activity that enhances or maintains weight and overall health and well-being [1]. These activities are carried out for a variety of purposes, including promoting growth and expansion, preventing aging, strengthening the muscles and heart systems, strengthening sports skills, losing weight or endurance, as well as for fun. Physical training is not just for ordinary people but physical training is also used by athletes in sports. Usually athletes perform physical activities such as anaerobic or aerobic in order to improve their sports performance. The majority of the movements or actions produced in a competition must have the strength and endurance of the muscle to improve performance or to have the advantage of the opponent [2]. In addition, it is important that athletes or individuals who specialize in physical training especially in weight training should be aware of the effects of training through various training methods or models to improve muscle strength and body composition whether in terms of acute responses [3-5] or chronic adaptations [6], [7], [8], [9], [10], [11]. Muscle strength is an essential component of achieving optimum performance [12], especially exercises that affect large muscles such as the major pectoral, bicep, tricep

and even back muscles. In addition, the most commonly used bilateral training techniques are bench press, bent-over rolls and curl-ups. The purpose of this study was to identify the effect of weight training on body mass index, muscle mass, and body fat percentage and musculoskeletal fitness. Next, this exercise focuses on upper body exercises and the specific muscles studied are the major pectoral muscles, biceps, triceps and back muscles. Additionally, this study established a training program to identify the effectiveness of this weight training so that participants can adapt as well as to muscle development [13, 14].

2 METHODOLOGY

2.1 Participants

A total of 20 male students will be selected as participants in this study. Selection of the study participants was the use of objective sampling techniques. The study participants will be selected on the basis of inclusion and exclusion criteria including healthy male students, 21-24 years old, Body Mass Index (BMI) in the range 23.0-27.4, Study participants should be free of intelligence, and Not take any supplements throughout This study was conducted. However, the selection of participants will be eliminated if they have suffered muscle spasms in the last 2 years, are still in treatment or medical sessions, and have had body surgeries for the last 2 years.

2.2 Data Collection

This session required participants come to the lab to measure body composition using the Inbody 230 tool to measure body mass index (BMI), muscle mass, and body fat percentage. In addition, participants were measured using a dynamometer handgrip to measure their maximum grip and the participants also had to perform maximum pressures to determine their upper body strength. Next, for Inbody 230 body composition measurement the participants will need to stand upright on this device by removing the shoes and the accessories to avoid errors during the test. Accordingly, the participant should perform a maximum grip strength test using the Handgrip dynamometer. The participant should stand upright and hold the device at 90° hand position and not touch any part of the body. During this session participants need to attend the gym for 3 weeks a week for 4 consecutive weeks [12]. The exercises

- Muhammad Nor Faiz Abd Aziz, Master Candidate, Sultan Idris Education University, Malaysia
- Norhazira Abd Rahim, Senior lecturer, Sultan Idris Education University, Malaysia
- Nor Aijratul Mohammad Shalan, Senior lecturer, Sultan Idris Education University, Malaysia
- Nor Fazila Abd Malek, Master Candidate, Sultan Idris Education University, Malaysia
- Ali Md Nadzalan, Senior lecturer, Sultan Idris Education University, Malaysia

they will perform are bench press exercises, bent roll over, biceps curl and overhead tricep extension. During this loading exercise, participants had to make 60-70% 1RM (repetition maximum) of 3 sets with 10 repetitions of each set, participants having to rest for 1-2 minutes between sets [15] for the first and second weeks. Training will continue for up to 4 weeks and 1RM will be increased to 80% [16].

2.3 Statistical analysis

This study has two research questions that need to be answered. Both questions to determine whether there was a significant relationship between LD and squat and DL test scores were analyzed using SPSS (Statistical Package for Social Science) version 20.0. The obtained data are analyzed using Pearson Correlation. The Pearson product-moment correlation test is a type of bivariate analysis that involves two variables (IV and DV). In this study the researcher conducted a parametric test to determine whether the hypotheses that were constructed were acceptable or rejected and to identify the relationship between IV and DV with intervals or ratios. The Alpha value set in this study to find the significance level is 0.01.

3 RESULTS

Statistical analysis will be performed using the Statistical Package for the Social Sciences (SPSS) Version 23. Average overall score mean percentage of body fat, body mass index, muscle mass, skin thickness, maximum grip and maximum strength in upper body in the analysis using T-Test Two Tailed statistical test.

TABLE 1
PARTICIPANTS DEMOGRAPHIC

Demographic	Mean	Standard Deviation
Age	23.05	2.14
Weight (kg)	73.91	6.30
Height (cm)	170.5	6.43
BMI	25.76	1.35

Paired t-test analysis results were used to compare the mean BMI pre-test scores with the post-test BMI mean scores for male overweight individuals showing that the BMI mean score for pre-test (M = 25.76, SD = 1.35) was higher than the mean score Post-test BMI (M = 25.65, SD = 1.21). Thus, the study findings for this body mass index did not have a significant effect $t(19) = .554$, $p = .586$. However, there has a slight decrease of 1.2% on the BMI mean score on post-exercise test after weight training intervention during four weeks.

TABLE 2
BODY MASS INDEX SCORES ON PRE- AND POST- WEIGHT-TRAINING INTERVENTION.

Test	M	N	SD	t	Sig.(2-tailed)
Pre	25.76	20	1.35	.554	.586
Post	25.65	20	1.21		

Notes, a = significantly difference from conventional deadlift, $p < 0.05$

The findings on body fat percentage study showed no significant effect on pre- and post-test after four weeks of weight training conducted $t(19) = -.448$, $p = .659$. The results showed that the mean body mass score for the post-test (M =

24.55, SD = 4.50) was higher than the pre-test (M = 24.35, SD = 4.51). However, through the graph it can be seen that there is a slight change in the percentage of body fat in the post-test (M = 24.55) with the pre-test (M = 24.35). This indicates that although there was no significant effect on the study findings, there was still a slight increase of 0.9% fat in the post-test.

TABLE 3
FAT PERCENTAGE SCORES OF PRE-TEST AND POST- WEIGHT TRAINING INTERVENTION

Test	M	N	SD	t	Sig.(2-tailed)
Pre	24.35	20	4.51	-.448	.659
Post	24.55	20	4.50		

Notes, a = significantly difference from conventional deadlift, $p < 0.05$

Through paired t-test analysis, the results showed that the mean post-test muscle mass mean score (M = 33.6, SD = 4.09) was higher than the pre-test muscle mass mean score (M = 32.74, SD = 3.97). However, the results showed that there was no significant difference between pre-test (M = 32.74, SD = 3.97) and post-test (M = 33.6, SD = 4.09), $t(19) = -1.452$, $p = .163$. However, there was a slight increase in the post-test (M = 33.6, SD = 4.0) shown in table. 4. This indicates that the 4-week weight-training exercise had a slight effect on 2.6% of muscle mass

TABLE 4
MUSCLE MASS SCORE OF PRE AND POST-WEIGHT TRAINING INTERVENTIONS.

Test	M	N	SD	t	Sig.(2-tailed)
Pre	32.74	20	3.97	-1.452	.163
Post	33.60	20	4.09		

Notes, a = significantly difference from conventional deadlift, $p < 0.05$

Through paired t tests, the results of this study show the mean minimum handshake strength test scores of pre and post-test for overweight men. The mean score for the pre-test (M = 33.66, SD = 7.33) was lower than the post-test (M = 35.77, SD = 5.28). However, the results of this maximum hand grip did not show significant change in pre- and post-t test ($t(19) = -1.39$, $p = .178$). Although the sample did not show significant change, there was a slight increase in post-test (M = 35.77, SD = 5.28) as shown in table 5.

TABLE 5
SCORE OF TEST PRE AND POST-WEIGHT TRAINING INTERVENTION.

Test	M	N	SD	t	Sig.(2-tailed)
Pre	33.6650	20	7.33149	-1.399	.178
Post	35.7700	20	5.28494		

Notes, a = significantly difference from conventional deadlift, $p < 0.05$

The paired t test was performed, showing mean muscle endurance score (push-up) on pre- and post-test for overweight men. Results showed that the mean post-test mean score (M = 28.3, SD = 10.55) was higher than the pre-test (M = 21.9, SD = 11.41). This indicates that there is a significant effect on the mean score of the post-test compared to the pre-test after the four-week load training as shown in table 6.

TABLE 6
MAXIMUM ENDURANCE SCORE OF PRE AND POST TEST WEIGHT
TRAINING INTERVENTION

Test	M	N	SD	t	Sig.(2-tailed)
Pre	21.9000	20	11.41974	-6.377	.000
Post	28.3000	20	10.55362		

Notes, a = significantly difference from conventional deadlift, $p < 0.05$

4 DISCUSSION

Weight training is one of the most commonly used training methods to increase muscle mass and muscle strength, this study has been carried out to determine whether weight training can reduce body mass index (BMI), reduce fat percentage, increase muscle mass, increase grip strength and increase muscle endurance (push up). Previous studies that have studied the effects of weight training are beneficial to losing weight and gaining an ideal body such as a decrease in BMI [17], [18] a decrease in fat percentage [19], [18], [19], [20], [21], [22], increased muscle mass [2] [19], [23], an increase in the maximum strength of the forearm [19], [24], [25] [26] and an increase in repeat pressures [27], [28]. However, the findings of the weight training study showed no significant effect on body composition and maximum arm strength. Previous studies by [29], [30], [31] are in line with the findings of this study because of several factors and reasons why there is no significant effect on muscle mass in weight training. Factors that cause no significant effects are due to lack of exercise and weight training techniques as well as reduced neural response function and muscle metabolism, as well as no combination of weight training and dietary supplementation [29] In addition, the findings of this study of muscle mass also focus more on muscle strength than on increasing muscle mass [31]. Furthermore, the findings of this study of muscle mass also do not carry out aerobic (blood circulation) exercises which results in slow muscle mass growth [23]. Furthermore, previous studies [32], [33], [34], [35] are consistent and support the findings of this fat percentage study due to the small sample size [32], long breaks between sets (RMRs) [33], less experienced participants in load training [34] and less use of repeated sets [35] It is these factors that led to the finding that the percentage of fat was not significant in this study. In addition, the findings of previous studies [29], [36], [37] are consistent with the findings of this study because they had no significant effect on the maximum strength of the hand grip. The findings of this study are not significant due to lack of dietary control to improve muscle, short training period, and lack of training focused on hand grip. Finally, previous studies support the findings of this study as there are supporting components and advantages of tubular pressures after 4 weeks of weight training [27], [28], [38]. Furthermore, in this study the study of muscle endurance (push-up) was significant as there was muscle support in the abdomen, triceps, deltoids, and back muscles which caused participants to produce multiple repetitions of the push-ups after the intervention. In addition, participants also had the advantage of doing a push-up on the floor compared to the bench press holding the bar. Therefore, press the tube by placing your hands on the floor with less muscle in the arm than with the bench press.

5 CONCLUSION

In summary, the results of this study found that body mass index, muscle mass, fat percentage and maximum arm strength had no significant effect on short-term (4-week) weight training among overweight individuals. However, there was a significant effect on the maximum repetition of the push-up after the weight training intervention. Based on the findings of this study, this chapter has discussed in detail the possible reasons why such findings are found in studies based on support and relevance made from previous studies. In addition, the researchers found suggestions for improvement in future studies.

ACKNOWLEDGMENT

This study was part of research funded by Sultan Idris Education University

REFERENCES

- [1] Kylasov, A. and S. Gavrov, Diversity of sport: non-destructive evaluation. *Enc Life Support Syst*, 2011. 2: p. 462-91.
- [2] Núñez, F.J., et al., The effects of unilateral and bilateral eccentric overload training on hypertrophy, muscle power and COD performance, and its determinants, in team sport players. *PLoS one*, 2018. 13(3): p. e0193841.
- [3] Shazana, N., et al., Electromyographical analysis and performance during bench press exercise: The influence of self-talk. *International Journal of Recent Technology and Engineering* 2019. 8(1): p. 1279-1281.
- [4] Osman, N., et al., Electromyographic and Performance Analysis during Three Sets of Resistance Exercises among Untrained Women. *International Journal of Engineering and Advanced Technology*. 8(6): p. 1580-1582.
- [5] Nadzalan, A.M., et al., Muscle activation during unilateral and bilateral biceps curl exercises among trained men. *International Journal of Recent Technology and Engineering*, 2019. 8(3): p. 3381-3383.
- [6] Cayot, T.E., J.D. Lauver, and B.W. Scheuermann, The acute effects of bodyweight suspension exercise on muscle activation and muscular fatigue. *European journal of sport science*, 2017. 17(6): p. 681-689.
- [7] Nadzalan, A.M., et al., The effects of resistance training with different focus attention on muscular strength: Application to teaching methods in physical conditioning class. *International Journal of Innovative Technology and Exploring Engineering (IJITEE)*, 2019. 8(8): p. 16-19.
- [8] Firdaus, W., G. Kuan, and O. Krasilshchikov, The effects of using complex training method on muscular strength among male weightlifters. *Jurnal Sains Sukan dan Pendidikan Jasmani*, 2018. 7(1): p. 1-12.
- [9] Rahim, N.A., M.H. Hamzah, and N.A.A.M. Shalan, Kesan "sprint interval training"(SIT) ke atas indeks jisim tubuh dan peratusan lemak badan dalam kalangan individu berlebihan berat badan. *Jurnal Sains Sukan dan Pendidikan Jasmani*, 2018. 7(2): p. 22-31.
- [10] Iskandar, M.M., N.I. Mohamad, and S. Othman, Kesan latihan menggunakan tali dan tayar terhadap kecergasan kardiovaskular, kuasa puncak, dan komposisi tubuh. *Jurnal Sains Sukan dan Pendidikan Jasmani*, 2017. 6(1): p. 53-67.
- [11] Mahfudz, N.N., et al., The effects of HIIT on physical abilities among special education students. *International*

- Journal of Recent Technology and Engineering (JRTE), 2019. 8(1): p. 1276-1278.
- [12] Judge, L.W. and J.R. Burke, The effect of recovery time on strength performance following a high-intensity bench press workout in males and females. *International journal of sports physiology and performance*, 2010. 5(2): p. 184-196.
- [13] Wong, D.P., et al., Using bench press load to predict upper body exercise loads in physically active individuals. *Journal of sports science & medicine*, 2013. 12(1): p. 38.
- [14] Pekünlü, E. and O. Atalağ, Relationship between fatigue index and number of repetition maxima with sub-maximal loads in biceps curl. *Journal of human kinetics*, 2013. 38: p. 169-181.
- [15] Esco, M.R., Resistance training for health and fitness. *Medicine ACoS*, ed. American College of Sports Medicine. Indianapolis: American College of Sport Medicine, 2013: p. 1-2.
- [16] Mogharnasi, M., et al., Effects of upper-body resistance exercise training on serum nesfatin-1 level, insulin resistance, and body composition in obese paraplegic men. *Disability and health journal*, 2019. 12(1): p. 29-34.
- [17] Noormohammadpour, P., et al., Body Composition and Dietary Pattern of Iranian Male Soccer Players, a Large National Study. *Asian Journal of Sports Medicine*, 2019(In Press).
- [18] Hyatt, H.W. and A.N. Kavazis, Body Composition and Perceived Stress through a Calendar Year in NCAA I Female Volleyball Players. *International journal of exercise science*, 2019. 12(5): p. 433.
- [19] Tavares, Ó.M., et al., Body composition, strength static and isokinetic, and bone health: comparative study between active adults and amateur soccer players. *Einstein (São Paulo)*, 2019. 17(3).
- [20] Balachandran, A., et al., High-speed circuit training vs hypertrophy training to improve physical function in sarcopenic obese adults: a randomized controlled trial. *Experimental gerontology*, 2014. 60: p. 64-71.
- [21] MacDonald, C.J., H.S. Lamont, and J.C. Garner, A comparison of the effects of 6 weeks of traditional resistance training, plyometric training, and complex training on measures of strength and anthropometrics. *The Journal of Strength & Conditioning Research*, 2012. 26(2): p. 422-431.
- [22] Christensen, J.R., et al., Diet, physical exercise and cognitive behavioral training as a combined workplace based intervention to reduce body weight and increase physical capacity in health care workers-a randomized controlled trial. *BMC Public Health*, 2011. 11(1): p. 671.
- [23] Pallichuk, Y., et al., Determination of the interrelationships between the body composition of the young 18-19 year old men with the indicators of the cardiovascular system during physical education. *Journal of Physical Education and Sport*, 2018. 18: p. 1907-1911.
- [24] Selakovic, I., et al., Can early assessment of hand grip strength in older hip fracture patients predict functional outcome? *PloS one*, 2019. 14(8).
- [25] Moberg, L.L., et al., Association between VO₂max, handgrip strength, and musculoskeletal pain among construction and health care workers. *BMC public health*, 2017. 17(1): p. 272.
- [26] Huck, C.J., Effects of supervised resistance training on fitness and functional strength in patients succeeding bariatric surgery. *The Journal of Strength & Conditioning Research*, 2015. 29(3): p. 589-595.
- [27] Kotarsky, C.J., et al., Effect of Progressive Calisthenic Push-up Training on Muscle Strength and Thickness. *The Journal of Strength & Conditioning Research*, 2018. 32(3): p. 651-659.
- [28] Piotter, A., et al., Effect of Standard Push-Up and Perfect Push-Up™ Training on Global and Regional Body Composition and Muscle Endurance. *Missouri Journal of Health, Physical Education, Recreation & Dance*, 2015. 25.
- [29] Cebria i Iranzo, M.A., et al., Effects of Resistance Training of Peripheral Muscles Versus Respiratory Muscles in Older Adults With Sarcopenia Who are Institutionalized: A Randomized Controlled Trial. *Journal of aging and physical activity*, 2018. 26(4): p. 637-646.
- [30] Gondim, O.S., et al., Benefits of regular exercise on inflammatory and cardiovascular risk markers in normal weight, overweight and obese adults. *PLoS One*, 2015. 10(10): p. e0140596.
- [31] Santanasto, A.J., et al., Impact of weight loss on physical function with changes in strength, muscle mass, and muscle fat infiltration in overweight to moderately obese older adults: a randomized clinical trial. *Journal of obesity*, 2010. 2011.
- [32] Heinrich, K.M., et al., High-intensity compared to moderate-intensity training for exercise initiation, enjoyment, adherence, and intentions: an intervention study. *BMC public health*, 2014. 14(1): p. 789.
- [33] Willis, L.H., et al., Effects of aerobic and/or resistance training on body mass and fat mass in overweight or obese adults. *Journal of applied physiology*, 2012. 113(12): p. 1831-1837.
- [34] Otto III, W.H., et al., Effects of weightlifting vs. kettlebell training on vertical jump, strength, and body composition. *The Journal of Strength & Conditioning Research*, 2012. 26(5): p. 1199-1202.
- [35] Tomljanović, M., et al., Effects of five weeks of functional vs. traditional resistance training on anthropometric and motor performance variables. *Kinesiology: International journal of fundamental and applied kinesiology*, 2011. 43(2): p. 145-154.
- [36] Cummings, P.M., et al., Effects of Fat Grip Training on Muscular Strength and Driving Performance in Division I Male Golfers. *The Journal of Strength & Conditioning Research*, 2018. 32(1): p. 205-210.
- [37] Fragala, M.S., et al., Muscle quality index improves with resistance exercise training in older adults. *Experimental gerontology*, 2014. 53: p. 1-6.
- [38] van den Tillaar, R., Comparison of kinematics and muscle activation between push-up and bench press. *Sports medicine international open*, 2019. 3(03): p. E74-E81.