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ABSTRACT

Resistance training has numerous advantages, including increased in muscle strength, endurance, and overall health. The goal of this study was to determine and compare the effect of 6 weeks of voluntary to failure resistance training on fasting blood glucose and power strength in overweight men who took part in one session per week (1TPW) or three sessions per week (3TPW) sessions per week. Fourteen overweight men age: 29 ± 9 years; weight: 80.7 ± 5.9 kg; height: 169.8 ± 5.6 cm; BMI: 27.9 ± 1.2 kg/m² were selected for this study. Each training session comprising nine exercises performed at 80 percent of one repetition maximum (1RM) to volitional failure. Fasting blood glucose and power strength were measured every week, beginning with the baseline. Paired sample t-test was used to compare the baseline and post-intervention outcome. The result showed a significant difference ($p < 0.05$) in fasting blood glucose and power strength for both groups. However, the 3TPW group had a greater improvement in terms of percentage in reducing fasting blood glucose and increasing power strength on overweight men. Group 1TPW fasting blood glucose decreased by 18% while group 3TPW decreased by 55.4%. Meanwhile, group 1TPW power strength increased by 14.2% compared to group 3TPW increased by 41%. There were significant differences between 1TPW and 3TPW resistance training on fasting blood glucose and power strength. In conclusion, training 1 time per week or 3 times per week are beneficial in reducing fasting blood glucose and increasing power strength. However, training three sessions per week resulted in greater increases in muscle strength and blood glucose compared to one session per week.

Keywords: resistance training, fasting blood glucose, power strength, training frequency

INTRODUCTION

Resistance training is a type of physical exercise that involves the use of resistance to improve muscular contraction, anaerobic endurance, and increase the size of skeletal muscles (Ismail et al., 2019). At the point when appropriately performed, resistance training can give massive useful advantages and improvement in overall body health. Lack of exercise can cause many health problems such as coronary heart disease, high cholesterol and obesity (Lai et al., 2018). Besides that, lack of resistance training can cause poor muscle strength which appears to be associated with an increased risk of type 2 diabetes (Phillips et al., 2005). Poor hand grip strength has also been linked to an increased risk of all-cause mortality as well as mortality from variety of health issues, including cardiovascular disease, cancer, respiratory disease and chronic obstructive pulmonary disease (Celis-Morales et al., 2018). It has recently been reported that exercise performed to voluntary failure will produce the same result on muscle mass and strength improvements regardless of the load at which exercise was performed (Mitchell et al., 2012). In fact, it had been demonstrated that there were differences in muscle mass and strength when comparing the one and three sets of failure for each exercise (Mitchell et al., 2012). However, research on the relationship between muscle mass and diabetes are still unclear, with some studies finding a link between type 2 diabetes occurrences and others finding no such link (Hong et al., 2017). Thus, the purpose of this study was to determine how different frequency sessions of resistance training with voluntary to failure affect blood glucose and power strength.

METHODS

Participant selection

A total of fourteen overweight men ($n=14$; age = 29 ± 9 years; height = 169.8 ± 5.6 cm; weight = 80.7 ± 5.9 kg) participated in this study. The inclusion criteria for the participant in this study are as follows: age 18-45 years old (Lai et al., 2018), BMI $> 25\text{kg/m}^2$ (Phillips et al., 2005), BP $< 140/90\text{mm/hg}$ (Celis-Morales et al., 2018). Not involved in any moderate-high intensity training in 2 years, and (Mitchell et al., 2012) healthy and Free from any injuries or serious disease (metabolic & cardiovascular).

Table 1 Demographic data between group 1TPW and group 3TPW

	Group 1	Group 2
Age (y)	27 ± 7	30.43 ± 10
Height (cm)	171.4 ± 6.65	168.3 ± 4.3
Weight (kg)	81.73 ± 7.11	79.73 ± 4.71
BMI (kg m^{-2})	27.8 ± 0.9	28.1 ± 1.44
Diastolic (mmHg)	81 ± 5.63	78.14 ± 6.04
Systolic (mmHg)	130.7 ± 9.4	118.43 ± 4.8

Data are mean \pm SD

Procedure

In the case of the present study, the potential participants were screened based on the defined criteria. The selected participants were required to complete the Physical Activity Readiness

Questionnaire (PAR-Q) (Nicholas A. Ratamess et al., 2009) and written informed consent was signed by each of the participants prior to the conduct of the test. The study was approved and carried out in accordance with the guideline established by the board of ethics committee Universiti Teknologi MARA (600-IRMI (5/1/6) REC/509/19). A follow-up familiarization session was held and to measure the participants fasting blood glucose level and power strength as a pre-test measurement. The participants were then divided into two groups: 1TPW and 3TPW. The participants were asked to complete 6 weeks of resistance exercise training with Group 1TPW undergoes one session per week with 60-minute duration whereas group 3TPW undergoes 3 sessions per week with 20 minutes duration for every session. 3 sessions or 1 session per week of the same exercises which is 1 set to failure at 80% of 1 repetition maximum (1RM). Each exercise session involved participants carrying out: leg press, bench press, leg extension, leg flexion, seated row, calf press, latissimus pull down, triceps curl and biceps curl.

RESULTS

Tables and Figures

Table 2: Group 1TPW

Variables	Baseline	Post - intervention	Percentage improvement (%)
Fasting Blood Glucose (mmol/L)	6.67 ± 1.66	5.66 ± 1.38	18
Power Strength (W)	1196 ± 92.28	1363 ± 80.60	14

A Paired Sample T-test was conducted to compare baseline and post-intervention for fasting blood glucose (FBG) and power strength (PS). Table 2 shows the variables fasting blood glucose and power strength for group 1TPW. There was a significant difference in the FBG baseline (M=6.67, SD=1.66) and FBG glucose post-intervention (M=5.66, SD=1.38); $t(df)=t, p=0.01$. This result suggests that doing resistance training once a week, will help to lower fasting blood glucose levels by up to 18%. Aside from that, there was a significant difference between PS baseline (M=1196, SD=92.28) and PS post-intervention (M=1363, SD=80.60); $t(df)=t, p=0.001$. According to the results, doing resistance training once a week increased PS by 14%.

Table 3: Group 3TPW

Variables	Baseline	Post - intervention	Percentage improvement (%)
Fasting Blood Glucose (mmol/L)	7.3 ± 1.19	4.7 ± 0.69	55
Power Strength (W)	1164.1 ± 162.83	1613 ± 287.20	39

Table 3 shows the variables FBG and PS for group 3TPW. There was a significant difference in the FBG baseline (M=7.3, SD=1.19) and FBG glucose post-intervention (M=4.7, SD=0.69); $t(df)=t, p=0.01$. This result suggests that doing resistance training 3 times a week, will help to lower fasting blood glucose levels by up to 55%. Apart from that, there was a significant difference between PS baseline (M=1164.1, SD=162.83) and PS post-intervention (M=1613, SD=287); $t(df)=t, p=0.001$. According to the results, doing resistance training 3 times a week increased PS by 39%.

DISCUSSIONS

The effect of six-week resistance training on fasting blood glucose (FBG) in both group

The study's finding revealed that there were differences in FBG in overweight men after 6 weeks of resistance training. Findings in the present study were consistent with the findings of (Umpierre et al., 2016) showed that resistance training consisting of six weeks of voluntary failure can improve the insulin and blood glucose reading. In this study case, there were two groups each representing the frequency of training per week (one time per week or three times per week). Both groups showed a significant improvement after 6 weeks of resistance training. However, training 3 times per week had shown a non-statistically better improvement of FBG. These results were similar to previous study done by Ismail et al., (2019) that stated resistance training with voluntary to failure consisting of six weeks held three times per week can result in improvement of insulin sensitivity and fasting blood glucose. Study done by Pina et al., (2019) had found out that 24 weeks of resistance training reduced blood glucose level. The study also suggests that resistance training induced changes in health markers regardless of the number of resistance training frequencies (2 and 3 times per week).

The effect of six-week resistance training on Power Strength (PS) in both group

The study's finding revealed that there were differences in PS in overweight men after 6 weeks of resistance training. Similar findings were found by Ismail et al., (2019) which discovers that 6 week of resistance training to failure with 3 sessions per week can improve strength. Past study by Ochi et al., (2018) also proved that the results suggest that three training sessions per week with two sets are recommended for untrained subjects to improve muscle strength while minimizing fatigue compared to one session per week with six sets. However, in this study training frequency of 1 time per week also showed a significant improvement from week to week. This result was similar to a reviewed paper done by Steele et al., (2019) which had discovered that a single set performed minimum 1 time and maximum 3 times per week was sufficient to induce significant 1RM strength gains. Hence, the training frequency of 1 time per week can still be applied especially for people who have limited time to do resistance training.

CONCLUSIONS

The results showed a significant improvement in post-intervention results for both groups in FBG and PS variables. There was no significant difference in training frequencies between one time per week and three times per week. However, three training sessions per week with two sets had shown greater non-statistically improvement for untrained subjects to improve muscle strength while minimizing fatigue compared to one session per week with six weeks of resistance training (Ochi et al., 2018) which was supported by study done by Ismail et al., (2019) stated that resistance training with voluntary to failure consists of six weeks held three times per week can result in 16% of improving insulin sensitivity, fasting blood glucose and strength. That being said, the training frequency of once per week cannot be ignored because it was the simplest model of training frequency designed for those with a busy lifestyle, time constraints, and limited time to engage in physical activities. According to Trost et al., (2002) the commitment time of exercise is widely regarded as the primary constraint to exercise participation. It was due to the frequency of the training also shown a drastic improvement

from baseline until post intervention of the study. Even though the improvement was not as good as 3 times per week of training frequency, it was still recommended to encourage people to undergo physical activity with the short and simplest model of resistance training with voluntary to failure and automatically can contribute to the wellness and well-being of the community.

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Authors' Contribution

Dzulkarnain, A., Haikal, M. & Stuart, G. conceived and planned the experiments. Dzulkarnain, A. and Haikal, M. carried out the experiments and data preparation. Azim, M. and Al Hafiz, A. planned and carried out the simulations. Azim, M. and Al Hafiz, A. contributed to the interpretation of the results. Dzulkarnain, A. and Haikal, M. took the lead in writing the manuscript. Azim, M., Al Hafiz, A. and Syahirah, A. provided critical feedback and helped shape the research, analysis, and manuscript.

Conflict of Interest Declaration

We certify that the article is the Authors' and Co-Authors' original work. The article has not received prior publication and is not under consideration for publication elsewhere. This research/manuscript has not been submitted for publication nor has it been published in whole or in part elsewhere. We testify to the fact that all Authors have contributed significantly to the work, validity and legitimacy of the data and its interpretation for submission to MJSSR.

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