INFLUENCE OF LOW, MEDIUM AND HIGH INTENSITY OF RESISTANCE TRAINING ON MUSCULAR HYPERTROPHY, AND SELECTED HEALTH RELATED FITNESS VARIABLES AMONG UNDERWEIGHT MALES

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ABSTRACT:

Introduction: Underweight (UW) individuals face lot of problems in increasing muscle size and also increasing body weight and fitness levels. Resistance training (RT) plays a very important role in increasing hypertrophy of the muscles one and all in general. (ACSM, 2009) stated that the resistance exercise for healthy adults provides program design recommendations for muscle hypertrophy [3]. The purpose of this study is to find out the influence of low, Medium and high intensity of (RT) on the muscular hypertrophy and selected health related fitness variables among the underweight males. Method: A group of (N=40) subjects was selected randomly to participate in this study. The age of the participants was in the range of 18-24 years, (RT) program was employed for 12 weeks, two days in a week, 45 minutes of training per session. The subjects were segregated into two groups namely Group-A (n=20, experimental group), Group –B (n=20 control group). The (RT) was employed on experimental group. Control group was not given any above mentioned special training program. The tests (pre and post) considered for this study was health related fitness variables are as follows; body composition, muscular strength, muscular endurance, Flexibility and cardio-vascular endurance. And test for muscular hypertrophy i.e. (neck, shoulders, chest, arms, waist, hips, thigh and calf); To compare the mean differences from pre to post test, mean, standard deviation, and t-test was computed by the help of statistica software. Results & Discussion: 12 weeks of training protocol had revealed significant performance from pre to posttest among the subjects with regard to the selected fitness variables and presented by percentages i.e. BMI (4.45%), bench press (35.12%), sit-ups test (22.34%), sit & reach test (26.83%), and 12 min run & walk test (26.94%). Furthermore the muscular hypertrophy was enhance among the underweight students i.e. Neck (2.61%), shoulder (2.95%), chest (6.75%), arms (10.43%), waist (8.23%), thighs (11.15%), calves (4.08%); and lastly hip circumference by (3.33%) had shown reduction in size from pre to post test. Conclusion: It is concluded that the influence of training had shown significant performance among the (UW) students with regard to the selected fitness test i.e. (BMI), bench press, sit-ups test, sit & reach test and 12 min run & walk
test. Furthermore the selected muscular hypertrophy of the (UW) students i.e. Neck, shoulder, chest, arms, waist, thighs, calves circumference had shown increased in the muscular size and hip circumference had shown reduction in size from pre to post test.

KEY WORDS ; Underweight, BMI, Hypertrophy, Fitness

INTRODUCTION

Underweight (UW) individuals face lot of problems in increasing muscle size and also increasing body weight and fitness levels. Resistance training (RT) plays a very important role in increasing hypertrophy of the muscles one and all in general. Mostly bodybuilders concern about increasing overall size of the muscles from neck to calf. For increasing of the size of the muscles; technique, proper diet and rest is essential. Earlier mostly research studies focus only on overweight and obese personals and (UW) subjects were neglected in the past and there is very few research studies had been done on underweight category.

Muscle hypertrophy is pursued by the many recreational lifters who aim to develop their physiques to the fullest. As a result the maximization of muscle mass has far reaching implications to a variety of populations associated with sports and health. In untrained subjects, muscle hypertrophy is virtually nonexistent during the initial stages of resistance training, with the majority of strength gains resulting from neural adaptations [24]. (ACSM, 2009) stated that the resistance exercise for healthy adults provides program design recommendations for muscle hypertrophy [3]. Moreover, it becomes progressively hard to increase lean muscle mass as one gains training experience, heightening the significance of proper routine design. Hypertrophy of the muscles can be obtained through a wide range of weight training program [4]. Generally, bodybuilders do training with moderate loads and fairly short rest intervals that induce high amounts of metabolic stress and usually the power lifters train with high-intensity loads and lengthy rest periods between the sets. Moreover both the groups were known to display remarkable muscularity [26]. The conventional of exercise-induced hypertrophy subsequent with the effect of traditional (RT) program results from an increase of sarcomeres and myofibrils [25]. A serial increase in sarcomeres results in a given muscle length corresponding to a shorter sarcomere length [29]. In particular, bodybuilders tend to display a greater proliferation of fibrous endomysial connective tissue and greater glycogen content compared to power-lifter athletes [22]. Even though sarcoplasmic hypertrophy is often described as non-functional, it is plausible that chronic adaptations associated with its effects on cell swelling may mediate subsequent increases in protein synthesis that lead to greater contractile growth. A number of researchers have opined the possibility that increases in cross-sectional area may be at least partly because of an increase in number of fibre’s [2]. Reliably with the principle of specificity, proper manipulation of training variables is essential for maximizing exercise induced muscle hypertrophy. Particularly, mechanical overload increases muscle mass while unloading results in atrophy [11]. Interestingly, each training variable impacts the hypertrophic response with respect to the physiological variables previously discussed. Load \ Intensity has been shown to have a significant impact on muscle hypertrophy and is arguably the most important exercise variable for stimulating muscle growth [10]. Moreover the Intensity is normally expressed as a percentage of IRM and equates to the number
of reps that can be performed with a given weight. Reps can be classified into 3 basic ranges: low (1–5), moderate (6–12), and high (15+). Each of these repetition ranges will involve the use of different energy systems and tax the neuro-muscular system in different ways, impacting the extent of the hypertrophic response. The use of high reps has generally proven to be lower to moderate and lower repetition ranges in eliciting increases in muscle hypertrophy [5]. In the lack of artificially induced ischemia (i.e., occlusion training), a load less than approximately 65% of 1RM is not considered sufficient to promote substantial hypertrophy [23]. Moreover a set can be defined as the number of repetitions performed consecutively without rest, whereas exercise volume can be defined as the product of total reps, sets, and load performed in a training session. High-volume, multiple-set protocols have consistently proven superior over single set protocols with respect to increased muscle hypertrophy [21, 30]. It is not clear whether the hypertrophic superiority of higher-volume workloads is the product of greater total muscle tension, muscle damage, metabolic stress, or some combination of these factors. Higher-volume, body-building style programs that generate significant glycolytic activity have been consistently proven to elevate acute testosterone levels to a greater extent than low-volume routines [17,16]. Schwab et al. [27] showed that testosterone did not significantly increase during squat performance until after completion of the fourth set, indicating a clear benefit of multiple-set routines in this regard. Higher-volume programs also have been shown to mediate the acute release of GH, particularly in routines designed to heighten metabolic stress [15]. Earlier research shows multiple-set protocols elicit greater GH responses than single set protocols [6]. To maximize muscular hypertrophy, evidence exists that volume should be gradually increased over a given per-iodized cycle, culminate in a brief period of overreaching. Overreaching can be defined as a planned, short-term increase in volume and/or intensity intended to improve performance (10). However earlier studies had shown that overtraining is more a result of excessive volume than intensity [9,13]

The purpose of this study was to find out the influence of low. Medium and high intensity of (RT) on the muscular hypertrophy and selected health related fitness variables among (UW) males.

The following are the objectives of this study;

1. To design an effective (RT) program for (UW) males
2. To supervise, implement and administer the Training programs on the (UW) males
3. To find out the influence of (RT) on (UW) participants on the Muscular hypertrophy and selected health related fitness variables.
4. To find out the performance between the two groups i.e., (experimental group and control group).
5. Results will be analyzed for advising recommendation

METHODS

The tests considered for this study was muscular hypertrophy (neck, chest, arms, forearms, thighs, calves, hips, waist, and shoulder’s); health related fitness variables are as follows, body composition, muscular strength, muscular endurance, Flexibility and cardio-vascular endurance. BMI of subjects was find out by weight (kgs), height (meters), with the help of electronic weighting machine and stadiometre respectively, and calculated with the help of simple calculation (weight in kgs/ height in (m)2). Selected fitness variables were tested at the stadium by the help of standard sports equipment. The data was collected for pre and posttest and recorded. For analyzing the data from pre to post test the following statistical tools were considered, mean, standard deviation, and t-test, with the help of statistica software.

Selection of Subjects
To achieve the purpose of this study a group of 40 (UW) students was selected randomly from the King Fahd University of Petroleum & minerals, Saudi Arabia. The age of the selected participants was between 18 to 24 years. The selected participants was up to BMI of 18.5 were considered for this study and segregated into two groups namely (RT) group (N=20), and control group (N=20). (RT) group (N=20) is considered to employ on the underweight participants for 12 weeks, weekly 2 times, 45 minutes of training per session respectively. Control group was without specific training for 12 weeks, weekly 2 times and 45 minutes of per session. The low, medium and high intensity of resistance training was employed on experimental group. Control group was not given any above mentioned special training program.

Selection of Variables

At the outset keeping all the background in the mind the following thoughtfulness is made with regard to feasibility criteria, availability of instruments, and the relevance of the variables of the present study, the following variables were consider for this study. During this study the literature was reviewed. The various scientific literatures pertaining to the strength training, exercises on selected variables from books, journals, periodicals, research papers and online was reviewed.

Instrument Reliability

Standard equipment’s were used to assess the dependent variables. Body composition was found out by the help of Body mass index (BMI). The selected fitness variables were tested by the standard instrument at the Department of Physical Education. The measurements of the body circumference were taken in centimeters with the help of steel tape for the accuracy for the following body parts namely: (neck, chest, arms, thighs, calves, hips, waist, and shoulders.

Below Table-1, shows the details of Dependent and Independent Variables

| Dependent Variables | Sl. no | Selected Health Related Fitness Variables |
|---------------------|--------|-------------------------------------------|
| Body composition    | 1      |                                           |
| Muscular strength   | 2      |                                           |
| Muscular endurance  | 3      |                                           |
| Flexibility         | 4      |                                           |
| Cardio–vascular     | 5      |                                           |
| endurance           |        |                                           |

| Independent Variables |   |                                           |
|-----------------------|---|-------------------------------------------|
| Resistance training   | 1 | group                                     |
| Control group         | 2 |                                           |

Orientation of the Subjects

The testers had explained the purpose of this study to the subjects. The doubts of the participants were addressed and the key advices were given to the subjects pertaining to attendance, their active participation during the training program for 12 weeks.

Ethical Considerations

The project was approved by the Physical Education Department, KFUPM and Deanship of the Scientific research Committee (DSR), KFUPM. The students were explained about the purpose of this research and taken their consent. The privacy of their results was guaranteed. The test was done in accordance with the Code of Ethics of the Helsinki.
Below table-2, shows the details of selection of Test for selected fitness variables & muscular hypertrophy

| S.no | Selected Fitness Variables | Test                           | Unit of measurements          |
|------|----------------------------|--------------------------------|-------------------------------|
| 1    | Body composition           | BMI                            | Weight in kgs \ Height in M2  |
| 2    | Muscular strength          | Bench press                     | 1 RM (KGS)                    |
| 3    | Muscular endurance         | Sit-ups (30 seconds)            | Repetitions (score)           |
| 4    | Flexibility                | Sit and reach test              | Cms                           |
| 5    | Cardio-vascular endurance  | 12 min run and walk test        | Digital watch                 |

**Muscular Hypertrophy**

| S.no | Measurements of important body parts circumferences (Cir) | Neck circumference (cir), shoulder cir, chest cir, Arm cir, waist cir, hip cir, thigh cir, & calves cir | Centimeters |
|------|-----------------------------------------------------------|---------------------------------------------------------------------------------------------------|-------------|

Below Table-3, shows the details of the Training Program

| Sl.no | Description                                                                 | Program targets                      |
|-------|-----------------------------------------------------------------------------|--------------------------------------|
| 1     | Total training program                                                      | 12 weeks                             |
| 2     | Weekly                                                                      | 2 times                              |
| 3     | Training per session                                                        | 45 min                               |
| 4     | Resistance Training (group-1) low, medium and high intensity of training program | 10 exercises                          |
| 5     | Control group (group -2) Control group had not given any above mentioned special training program | 10 exercises                          |
| 6     | Test (Test was conducted before and after the 12 weeks of training program) | Pre and post test                    |
| 7     | The program was based on                                                   | FITT principle                       |
RESULT AND DISCUSSION

Analysis of the data pertaining to the experimental and control group for the selected fitness variables and muscular hypertrophy among the (UW) students from pre to post test is presented in the below table-4.

Below table-4, shows the analysis of data for the selected fitness variables & muscular hypertrophy among the (UW) students from pre to post test

| Selected Fitness variables | Groups N=20 | Pre-test | Post test | P Value |
|---------------------------|------------|----------|-----------|---------|
|                           |            | Mean     | S.D       | Mean    | S.D    |          |
| Body Mass Index           | Experimental | 17.53    | 0.86      | 18.31   | 1.49   | 0.01*    |
|                           | Control    | 17.55    | 2.17      | 17.85   | 0.35   | 0.55     |
| Bench Press (1 Max Rep)   | Experimental | 34.60    | 9.23      | 46.75   | 8.31   | 0.00*    |
|                           | Control    | 34.35    | 6.65      | 34.70   | 6.33   | 0.86     |
| Sit –ups test (30 sec)    | Experimental | 23.5     | 4.59      | 28.75   | 3.49   | 0.00*    |
|                           | Control    | 23.7     | 4.37      | 23.90   | 4.41   | 0.89     |
| Sit and reach test        | Experimental | 21.80    | 6.99      | 27.65   | 6.83   | 0.01*    |
|                           | Control    | 23.70    | 7.84      | 23.85   | 7.64   | 0.95     |
| 12 min run and walk test  | Experimental | 1485.0   | 297.84    | 1885.0  | 184.3  | 0.00*    |
|                           | Control    | 1480.0   | 289.46    | 1483.5  | 287.1  | 0.97     |
| Neck circumference        | Experimental | 34.52    | 1.26      | 35.42   | 1.34   | 0.03*    |
|                           | Control    | 35.27    | 1.13      | 35.40   | 0.99   | 0.71     |
| Shoulder circumference    | Experimental | 103.90   | 2.95      | 106.97  | 4.47   | 0.01*    |
|                           | Control    | 106.02   | 4.64      | 106.20  | 4.47   | 0.90     |
| Chest circumference       | Experimental | 79.71    | 8.09      | 85.09   | 4.38   | 0.01*    |
|                           | Control    | 81.88    | 9.44      | 82.05   | 9.44   | 0.96     |
| Arm circumference         | Experimental | 26.47    | 2.15      | 29.23   | 3.04   | 0.00*    |
|                           | Control    | 27.22    | 1.98      | 27.35   | 1.95   | 0.84     |
| Waist circumference       | Experimental | 70.50    | 7.38      | 76.30   | 9.48   | 0.03*    |
|                           | Control    | 72.35    | 9.02      | 72.65   | 9.01   | 0.92     |
| Hip circumference         | Experimental | 90.40    | 4.62      | 87.39   | 8.69   | 0.17     |
|                           | Control    | 92.15    | 5.82      | 92.45   | 5.67   | 0.87     |
| Thigh circumference       | Experimental | 44.65    | 3.34      | 49.63   | 7.06   | 0.00*    |
|                           | Control    | 47.75    | 6.32      | 47.95   | 6.16   | 0.91     |
| Calf circumference        | Experimental | 32.83    | 3.17      | 34.17   | 4.13   | 0.25     |
|                           | Control    | 34.37    | 4.06      | 34.4    | 4.07   | 0.95     |
This is evident from the above data analysis that the influence of training on selected fitness variables and muscular hypertrophy is significant and had showed improved performance among the participants of experimental group from pre to post test in the following variables i.e. BMI (P<0.01), bench press (p<0.00), sit-ups test (p<0.00), 12 minutes run and walk test (p<0.00), and increase in the muscle girth and significant in the following; neck (p<0.03), shoulder (p<0.01), chest (p<0.01), arm (p<0.00), waist (p<0.03), thigh (p<0.00), calf (p<0.05) and lastly hip girth had showed not significant (p<0.17).

Below table-5 shows the Percentages with regard to selected fitness variables and muscular hypertrophy from pre to posttest among the (UW) students

| VARIABLES               | PERCENTAGES | INCREASE / DECREASE |
|-------------------------|-------------|---------------------|
| BMI                     | 4.45 %      | Increase            |
| Bench Press             | 35.12 %     | Increase            |
| Sit-Ups test (30 sec)   | 22.34 %     | Increase            |
| Sit & reach test        | 26.83%      | Increase            |
| 12 min run & walk test  | 26.94%      | Increase            |
| Neck circumference      | 2.61%       | Increase            |
| Shoulder circumference  | 2.95%       | Increase            |
| Chest circumference     | 6.75%       | Increase            |
| Arm Circumference       | 10.43%      | Increase            |
| Waist Circumference     | 8.23 %      | Increase            |
| Hip Circumference       | -3.33 %     | Decreased           |
| Thigh Circumference     | 11.15%      | Increase            |
| Calf Circumference      | 4.08 %      | Increase            |

The 12 weeks of training protocol had revealed significant performance from pre to posttest among the (UW) students with regard to the selected fitness variables and presented by percentages i.e. BMI (4.45%), bench press (35.12%), sit-ups test (22.34%), sit & reach test (26.83%), and 12 min run & walk test (26.94%). Furthermore the muscular hypertrophy was enhance among the underweight students i.e. Neck (2.61%), shoulder (2.95%), chest (6.75%), arms (10.43%), waist (8.23%), thighs (11.15%), calves (4.08%); and lastly hip circumference by (3.33%) had shown reduction in size from pre to post test.
DISCUSSION
The purpose of this study was to find out the influence of low, medium and high intensity of (RT) on the selected health related fitness variables among (UW) males.

For maximizing muscle hypertrophy among (UW) students’ needs systematic training, sensible approach, by starting the program with low intensity of training to adjust and go to the next level. The key findings of this current study were significant performance was revealed among the underweight students with regard to the training protocol from pre to post test on the selected fitness test i.e. Body mass index (BMI), bench press (1 maximum repetition), sit-ups test for 30 seconds, sit & reach test in centimeters, and 12 min run & walk test. Furthermore the selected anthropometric circumference of the (UW) students i.e. Neck, shoulder, chest, arms, waist, thighs, calves circumference had shown increased in the muscular size and hip circumference had shown reduction in size from pre to post test.

It was assumed that the low, medium and high intensity will be the sensible training approach for (UW) students. (UW) students cannot be exposed to the medium or high intensity exercise directly. This training protocol is very much suitable because safely they can reach from low to medium and lastly to the high intensity level and also these (UW) students they are very comfortable in doing this training without any hazels. During this training period not a single participant had got injury or received any other type of complaint.

Similarly in one of the earlier study split body routine is done with multiple exercises are performed for a specific muscle group in each session and may help to take advantage of the hypertrophic response [20]. In short duration training, however, hypertrophy begins to become the leading factor, with the upper extremities shown to hypertrophy before the lower extremities [24,28]. Earlier study of (Gonzalez. R, 2011) revealed that the (RT) influence in greater performance in the upper body and lower body muscle strength and waist girth (p=0.008), [12]. In this earlier study of (Adams et al 1992), (RT) program can enhance power performance, [1]. Crewther B, et al. (2005) investigated study pertaining on the effect of (RT) program on strength and power performances and find significant improvement [7]. (Kraemer & et al, 2002) had reported that the (RT) helps in athletic performance i.e. Muscular hypertrophy, strength, power, and endurance [19]. Earlier study of Cheema BS, & et al (2014), investigates Robust evidence from randomized controlled trials indicates that progressive (RT) can induce skeletal muscle hypertrophy and increase muscular strength and health related quality of life outcomes in men
and women [8]. This is evident that the two day (RT) in a week is also beneficial for the (UW) students in improving muscular hypertrophy and enhancing fitness level. Our research was limited by a lack of studies directly investigating on underweight students and pertaining to the training low, medium and high intensity protocol.

CONCLUSION

It is concluded that the influence of training had shown significant performance among the (UW) students with regard to the selected fitness test i.e. (BMI), bench press, sit-ups test, sit & reach test and 12 min run & walk test.

Furthermore it is also concluded that the selected muscular hypertrophy of the (UW) students i.e. Neck, shoulder, chest, arms, waist, thighs, calves circumference had shown increased in the muscular size, and hip circumference had shown reduction in size from pre to post test. Lastly Control group had not shown any changes from pre to post test.

Thus, the low, medium, and high intensity of training program is more appropriate and specially suits and fit to the UW students. This training can be employ by the trainers, coaches and physical education teachers at schools, colleges, universities and gyms.

RECOMMENDATION

1. It is recommended that the further research can be done on three day training or four day training or five day training protocol on the (UW) students.
2. Related research can be done with the intervention of a diet program.
3. This is recommended to the coaches and Physical Education faculty members to employ the low, medium and high intensity training protocol on (UW).
4. Similar studies can be done on different age groups and different gender.

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