UNIVERSITI PUTRA MALAYSIA

EFFECTS OF COMBINED WEIGHT AND CHAIN VERSUS COMBINED WEIGHT AND ELASTIC BAND TRAINING ON BODY COMPOSITION, MUSCULAR STRENGTH AND ENDURANCE AMONG UNTRAINED MALES IN IRAN

AMIR BAHRAM KASHIANI

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By

AMIR BAHRAM KASHIANI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

August 2018

Dedicated With Love
To
My Kind Father, Ahmad
&
My Beloved Mother, Fatimah
For Their Endless Love, Support and
Sacrifices

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

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August 2018

Chair: Associate Professor Soh Kim Geok, PhD
Faculty: Educational Studies

Several studies have shown a positive association between variable resistance training and improvement of body composition and muscular performance. However, the most effective method of variable resistance training to improve body composition and muscular performance in untrained individuals remains unclear. The objective of this study was to examine the effects of two methods of variable resistance training on body composition, maximal muscular strength and endurance among untrained male adults. Fifty healthy untrained males (age: 21.5 ± 1.95 years old) were selected randomly and assigned into three groups: combined weight and chain (WC), combined weight and elastic band (WE), and free-weight (CG). All three groups completed 24 weeks of upper and lower body high intensity resistance training (70-90% of one-repetition maximum) with three-four sets for two-three times per week. Approximately 65% of the resistance was provided by free-weights and 35% of the resistance was provided by chains and elastic bands (assessed at the top of the range of motion) for the WC and WE groups, respectively. Depended variables involving body composition, maximal muscular strength and maximal muscular endurance using bioelectrical impedance analyser, one-repetition maximum, and maximum repetitions to muscular fatigue were measured, respectively in pre-test, post-test 1 (week 6), post-test 2 (week 12), post-test 3 (week 18) and post-test 4 (week 24). Significance level was set at $P < 0.05$. No differences existed among all groups at baseline for depended variables. A mixed model ANOVA with repeated measurements analysis revealed that body fat mass (FM) and body fat free mass (FFM) decreased and increased, respectively significantly from pre-test values in all groups ($P = 0.001$), but there were no differences in FM and FFM among the groups ($P = 0.23$ and $P = 0.35$, respectively). In the WE and WC groups, maximal muscular strength and endurance were significantly greater than CG group during and after the intervention. Finally, in the WE group, maximal muscular strength were significantly greater than WC group only in post-test 4 (chest press: 56.02 ± 3.3

vs. 52.64 ± 4.9 kg, overhead press: 41.91 ± 2.8 vs. 38.23 ± 3 kg, and squat: 104.26 ± 6.2 vs. 96.47 ± 6.6 kg), and maximal muscular endurance were significantly greater in the WE group compared to the WC group in post-tests 3 and 4 (Post-test 3 = chest press: 18.58 ± 1.2 vs. 16.64 ± 1.5 repetitions, overhead press: 15.82 ± 0.9 vs. 14.52 ± 1 repetitions, and squat: 20.05 ± 0.8 vs. 18.11 ± 1.6 repetitions. Post-test 4 = chest press: 20.47 ± 1.5 vs. 17.82 ± 1.5 repetitions, overhead press: 17.58 ± 1.1 vs. 15.52 ± 1.1 repetitions, and squat: 21.82 ± 0.9 vs. 19.29 ± 1.4 repetitions). The results of this study show that variable resistance training has a slightly better effect than free weight to improve body composition, in particular, WE variable resistance training has a better effect significantly to improve upper and lower body muscular strength and endurance during and after 24 weeks of variable resistance training among untrained male adults in Iran.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

KESAN GABUNGAN BERAT DENGAN RANTAI DAN GABUNGAN BERAT DENGAN GETAH ELASTIK BAGI PEMBOLEH UBAH LATIHAN RINTANGAN TERHADAP KOMPOSISI BADAN, KEKUATAN OTOT DAN KETAHANAN DALAM KALANGAN LELAKI TIDAK TERLATIH DI IRAN

Oleh

AMIR BAHRAM KASHIANI

Ogos 2018

Pengerusi: Prof Madya Soh Kim Geok, PhD
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Terdapat beberapa kajian yang telah menunjukkan ada kaitan antara latihan jenis pelbagai rintagan dengan peningkatan komposisi badan dan juga prestasi otot. Walau bagaimanapun, cara yang paling efektif bagi latihan pelbagai rintangan untuk meningkatkan komposisi badan dan prestasi otot dalam kalangan individu yang tidak bersukan adalah masih tidak jelas. Objektif kajian yang dijalankan bertujuan untuk mengkaji kesan dua kaedah latihan pelbagai rintangan pada komposisi badan, kekuatan maksimal otot dan daya tahan antara lelaki yang tidak bersukan. Lima puluh lelaki cergas yang tidak bersukan (umur 21.5 ± 1.95 tahun) telah dipilih secara rawak dan dibahagikan kepada tiga kumpulan: kombinasi bebanan dan rantaian (WC), kombinasi bebanan dan band sendat (WE), dan tanpa bebanan (CG). Ketiga-tiga kumpulan telah menghabiskan latihan rintangan (70%-90% satu kali repetisi berat kemampuan maksimum, 1RM) berintensiti tinggi bagi atas badan dan bawah badan dengan kadar repetisi sebanyak tiga sehingga empat set sebanyak tiga sehingga empat kali seminggu. Lebih kurang 65% rintangan yang diaplikasikan adalah bebas daripada penggunaan bebanan untuk kumpulan-kumpulan WC dan 35% rintangan adalah daripada rantaian dan band senat (diukur semasa pergerakan berada di posisi yang paling beban) untuk kumpulan-kumpulan WE. Dengan menggunakan penganalisis impedansi bioelektrik, komposisi badan, kekuatan otot maksimal dan daya tahan diukur, maksimum repetisi adalah satu kali, dan maksimum repetisi sehingga otot menjadi letih diukur semasa pra-ujian, sesi selepas ujian 1 (minggu ke-6), sesi selepas ujian 2 (minggu ke-12), sesi selepas ujian 3 (minggu ke-18) dan sesi selepas ujian 4 (minggu ke-24). Tahap signifikasi yang ditetapkan adalah pada $P < 0.05$. Tidak ada perbezaan perbandingan asas yang wujud untuk pembolehubah bagi semua kumpulan. ANOVA yang terdiri daripada ulangan analisis pengukuran menunjukkan jisim berat badan (FM) menurun dengan ketara dan jisim bebas lemak badan (FFM) meningkat dengan ketara bagi nilai pra-ujian oleh semua kumpulan ($P = 0.001$), tetapi tidak ada perbezaan bagi FM bagi kumpulan ($P = 0.23$) dan FFM bagi kumpulan ($P = 0.35$). Bagi kumpulan WE dan WC,

kekuatan maksimal otot dan daya tahan adalah jauh lebih tinggi berbanding dengan kumpulan CG semasa dan selepas tempoh latihan yang ditetapkan. Akhir sekali, bagi kumpulan WE, kekuatan maksimal otot dan daya tahan adalah jauh lebih tinggi berbanding dengan kumpulan WC hanya untuk sesi selepas ujian 4 (chest press: 56.02 ± 3.3 vs. 52.64 ± 4.9 kg, overhead press: 41.91 ± 2.8 vs. 38.23 ± 3 kg, dan squat: 104.26 ± 6.2 vs. 96.47 ± 6.6 kg), dan daya tahan maksimal otot adalah jauh lebih tinggi bagi kumpulan WE berbanding dengan kumpulan WC untuk sesi selepas ujian 3 dan 4 (Sesi selepas ujian 3 = chest press: 18.58 ± 1.2 vs. 16.64 ± 1.5 ulangan, overhead press: 15.82 ± 0.9 vs. 14.52 ± 1 ulangan, dan squat: 20.05 ± 0.8 vs. 18.11 ± 1.6 ulangan. Sesi selepas ujian 4 = chest press: 20.47 ± 1.5 vs. 17.82 ± 1.5 ulangan, overhead press: 17.58 ± 1.1 vs. 15.52 ± 1.1 ulangan, dan squat: 21.82 ± 0.9 vs. 19.29 ± 1.4 ulangan). Dapatan kajian ini telah membuktikan latihan jenis pelbagai rintangan membawa sedikit kesan yang lebih baik berbanding dengan latihan jenis bebas rintangan dalam meningkatkan komposisi badan, Khususnya kumpulan WE untuk latihan pelbagai rintagan mempunyai kesan drastik dalam meningkatkan kekuatan otot dan daya tahan bahagian atas dan bawah badan semasa dan selepas 24 minggu latihan pelbagai rintangan untuk lelaki dewasa yang tidak menjalani latihan di Iran.

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May blessing be upon all of you!

I certify that a Thesis Examination Committee has met on 09 August 2018 to conduct the final examination of Amir Bahram Kashiani on his thesis entitled "Effects of Combined Weight and Chain versus Combined Weight and Elastic Band Training on Body Composition, Muscular Strength and Endurance among Untrained Males in Iran" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Doctor of Philosophy.

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This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Doctor of Philosophy.

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LIST OF ABBREVIATIONS

1RM	1 Repetition Maximum
BIA	Bioelectrical Impedance Analyser
BMI	Body Mass Index
FM	Body Fat Mass
FFM	Body Fat Free Mass
MR	Maximum Repetitions
VRT	Variable Resistance Training
WC	Combined Weight and Chain
WE	Combined Weight and Elastic Band
WHO	World Health Organization

CHAPTER 1

INTRODUCTION

1.1 Background

Resistance training is a highly popular and frequently applied form of physical activity, carried out for the purpose of enhancing skeletal muscle health, improve body composition and general functionality (Naimo, 2011). Chronic resistance training results in significant strengthening of muscles due to a range of morphological and neurological adaptations (Hayes & Cribb, 2008; Naimo, 2011). Resistance training has become a popular recreational mode of exercise for many untrained and trained individuals. It is considered an integral component to build strength, promote muscle endurance and improve body composition (Hayes & Cribb, 2008; Naimo, 2011). Besides improving the strength and endurance of muscles, lowering body fat and also avoiding obesity, resistance training can lead to a diverse range of benefits that will enhance the health both mentally and physically (Adnan, Kadir, Yusof, Mazaulan, & Mohamed, 2014). Acute training variables that influence building strength, promotion of muscle endurance and enhancement of body composition include the selection of training method, frequency of exercise and the resistance used or training intensity. But the most important training variable is training method (Naimo, 2011).

Strength and conditioning professionals often strive to find new methods of increasing strength, endurance and improving body composition in traditional resistance training (Bellar, Muller, & Barkley, 2011). Using weights has been supported to be both popular and effective in enhancing strength and muscular endurance. During training with weights or weight-machines the amount of resistance on the joints is constant throughout the exercise, thus resulting in skeletal muscles undergoing variable resistances. Moreover, when using isokinetic machines the resistance is variable during the completion of exercise, hence the change in muscle and nerves adaptability to the exercise (Berning & Coker, 2004; Simmons, 1999). One way to achieve such a goal is to attach elastic bands or chains along with weights which are recently in use by trainers and athletes.

Currently, resistance training involving the attach of elastic bands and chains with weights is being widely recognised and has become increasingly popular to enhance muscular power and strength among athlete but not among untrained people (Ghigiarelli et al., 2009; Larson et al., 2007). The additional methods of increasing the resistance during a traditional resistance training are to add elastic band or chains resistance. These methods have been applied to traditional lifts and have been evaluated for the bench press and squat exercises (Bellar et al., 2011). Based on the results of the studies, it can be hypothesised that the inclusion of elastic tension or chains resistance to traditional resistance training might produce further neural adaptation that may result in increased muscular strength and endurance (Bellar et al., 2011; Ghigiarelli, 2006; Stevenson, Warpeha, & Dietz, 2010). These methods are

called “variable resistance training” (VRT), which improve maximal strength, the rate of force development, coordination between antagonist and synergist muscles, and the recruitment of motor units. Theoretically, VRT can improve body composition, muscular strength and endurance in untrained individuals, however, the beneficial effects of long-term VRT on body composition and muscular endurance in untrained individuals are more controversial (Naderi, Kazemzadeh, & Banaiifar, 2014; Soria-Gila, Chirosa, Bautista, Baena, & Chirosa, 2015).

Muscular contractions are typically divided into two fundamental types: isotonic (dynamic) and isometric (static). An isotonic contraction is a form of contraction whereby the muscles produce different forces against a constant resistance. Two forms of isotonic contraction exist, concentric and eccentric. The concentric phase of an isotonic muscular contraction involves the muscle shortening in the process of contraction, whereas eccentric phase of an isotonic contraction pertains to the muscle lengthening in the process of generating force against resistance. An isometric contraction is a static contraction whereby the muscles produce force against an immovable object but the muscle is neither lengthened noir shortened in process of contraction. However, an isokinetic movement refers to the speed of muscle contraction which stays constant during the whole range of motion (Esmaelzadeh-Toloee, 2011). This outcome in muscular contraction is at every joint angle throughout the total range of movement (Zatsiorsky & Kraemer, 2006).

An elastic band produces an isokinetic contraction but chain produces an isotonic contraction and both provide variable resistance (Bellar et al., 2011). Elastic band and chain training transform a free weight dynamic exercise into a form of VRT, which the resistance in VRT is not constant (Fleck & Kraemer, 2014; Ghigiarelli, 2006; Kraemer et al., 2009; Newton et al., 2002). With the start of the concentric phase of the exercise, elastic band and chain amplify the resistance. On the other hand, they increase the velocity of performance in the eccentric phase and gradually decrease the resistance in this phase which as a useful stimulus enhances the muscle adaptability leading to concentric contractions (Adnan et al., 2014; Bosco & Komi, 1979).

Variable resistance training offers an extra eccentric loading component that does not exist in traditional weight training (Hortobagyi et al., 2000). When a lifter commences the descent to the floor in the squat exercise with weight in combination of chains, the barbell is lowered and more chain links are placed on to the floor, which decreases the total weight of the load. When ascending or at the concentric phase of the lift, more chain links are lifted off the floor and add resistance progressively throughout the lift (Ghigiarelli, 2006).

But an elastic band produces isokinetic contraction and isokinetic system controls speed so that the speed is constant throughout the range of motion. In theory, if isokinetic training properly applied, the individual is able to achieve maximal muscle contraction at all points within the range of motion (White, 2011; Wilmore, Costill, & Kenney, 2008). Because skeletal muscle produces different amounts of force at different joint angles, isokinetic system matches the force generated by the muscle at each joint angle by controlling speed and causes better improvement in muscular

function (White, 2011). Specifically, elastic bands are reported to provide greater peak force output due the increase in the velocity of eccentric muscle contraction from the elastic bands pulling the barbell downward at the start of the eccentric phase (Anderson, 2005; Cronin, Mcnair, & Marshall, 2003; Wallace, Winchester, & McGuigan, 2006). Eccentric training can implemented in using elastic bands and chains (Bobbert, Huijing, & Schenau, 1987; Cronin et al., 2003; Doan, Newton, & Marsit, 2002).

In theory, a VRT system provides a reduced level of resistance at the point when the muscle is mechanically disadvantaged (at the lowest point of the lift) and a higher level of resistance at the point when the angle joint can produce the maximum force (at the peak of the movement) is believed to be advantageous (White, 2011). A further issue to consider is that elastic bands increase resistance in a curvilinear manner, whereas chains do so linearly because of their different physical and mechanical properties (Soria-Gila et al., 2015).

The most crucial conditions to improve strength are total use of the motor units and the muscle fibres, which would be possible when the muscle is taken to the point of momentary muscular failure in the training, to enable full and more effective stimulation to occur with VRT (Adnan et al., 2014). Variable resistance training may show gains in reversible strength, which is described as "the ability to produce a force against the weight in the opposite direction of a lift" (Zatsiorsky & Kraemer, 2006).

Also, a decrease in body fat mass (FM) due to resistance training has been observed in many studies (Sillanpää et al., 2009; Sipila & Suominen, 1995), and the majority of studies demonstrate that subjects who are not trained show better performance than those who are trained in percentage of body fat reduced as well as body fat free mass (FFM) induction while causing some decrease in the level of intramuscular fat due to resistance training (White, 2011). Resistance training combined with elastic band and chain can raise energy demands by increasing the FFM and increasing metabolically active tissue. It is well accepted that this method of training has been widely recognised to significantly affect body composition (White, 2011).

There is even more substantial proof to support the advantages of VRT, and results have been promising (Wallace et al., 2006), but the most effective method between elastic band and chain is not discovered yet. There are few studies that have compared both of combined weight and chain (WC) and combined weight and elastic band (WE) with each other (Ebben & Jensen, 2002; Ghigiarelli, 2006). The background of using elastic band shows that most of them are used especially for rehabilitative purposes. In addition, certain resistance training methods have been developed for some sports and it has been used for regaining strength in recent years (Stevenson et al., 2010). Likewise, despite the WE training, a few researches have used WC training on muscular function results, because the heavy nature of chains has prevented researchers from studying the effects of WC training interventions specially on untrained subjects (Ebben & Jensen, 2002; Ghigiarelli, 2006).

Although the effectiveness of VRT remains unclear among untrained people, recent studies have shown increases in muscular strength and maximum force production among trained population (Anderson, Sforzo, & Sigg, 2008; Wallace et al., 2006; Winters, 2006), and it would seem that VRT has both acute and long-term effects in trained lifters (Bellar et al., 2011). While recent VRT studies have suggested benefits to trained populations, there is much more interesting in this study to elucidate the efficacy of VRT on untrained population for longer duration because VRT commercially advertised and anecdotally utilized by novice lifters (T. Shoepe, Ramirez, Rovetti, & Kohler, 2011).

Regardless of what has been mentioned above, not many investigations have been conducted to support the effectiveness of the best method of VRT (Ghigiarelli, 2006). In a study by Colado, Garcia-Masso, Pellicer, Alakhdar, Benavent, and Cabeza-Ruiz (2010) the diverse resistance in exercises using elastic band, chain and free-weights which were investigated over a period of seven weeks showed that there is no difference in using them interchangeably. But in some studies it was found that training with attached elastic bands to weights produced better results compared to using weights only (Conlin, 2002; Naderi et al., 2014). Also, in another study of Colado and Triplett (2008) they examined the usage of elastic band and reported that there is no distinguishable difference in this way although at the beginning of the study there were more physiological superiorities like strength.

Although each of the previously VRT published studies was conducted in athletes for short durations (Anderson et al., 2008; Ghigiarelli et al., 2009; McCurdy, Langford, Ernest, Jenkerson, & Doscher, 2009; Rhea, Kenn, & Dermody, 2009), according to the importance of VRT training, it is necessary that a study be done to ascertain whether combined weight and elastic band, and combined weight and chain variable resistance training could improve muscular performance and body composition in untrained individuals for longer duration and which one of them could be more effective, as there is little and uncertain evidence of their relationships.

1.2 Statement of the Problem

Today's lifestyle patterns are increasingly responsible for many harmful health effects on individuals. Lack of physical activity, smoking, poor nutrition and stress have been determined to be the main risk factors for public health, resulting in a range of physical abnormalities such as overweight and muscular weakness (Wessel et al., 2004). Overweight and muscular weakness are among the major physical abnormalities in the world today (WHO, 2009).

A world health organization (WHO) (2009) report, indicates that behavioural risk factors like lack of physical activity is responsible for approximately 70% of overweight and muscular weakness. Overweight and muscular weakness are common abnormalities in Iran. Physically active individuals have been reported to have better body composition in comparison with inactive individuals, regardless of the obesity considerations (Franks, Ekelund, Brage, Wong, & Wareham, 2004; Wessel et al., 2004;

WHO, 2009). According to the WHO (2005) 60% of those in 15 to 25-year old age group in Iran were found to be physically inactive and increasing with age. A study performed in Iran revealed that 54% of male adults were physically inactive (Kelishadi et al., 2005). A great number of individuals in Iran are beginning to do resistance training to combat muscular weakness and overweight but most of them stop the training or turn to using illegal ergogenic aids because of lack of progression in muscular strength and body composition (Brzezianska, Domanska, & Jegie, 2014; Yager & O'Dea, 2014).

Nowadays, there has been much research done to identify effective and cost-effective ways to prevent physical inactivity, overweight and muscular weakness (WHO, 2009). Resistance training is one of the crucial measures proposed for preventing and even treating overweight and muscular weakness (Janssen & Jolliffe, 2006; P. D. Thompson et al., 2003). Variable resistance training, as a method of resistance training, may produce better results more quickly and may improve compliance with stipulated exercise programme (Bellar et al., 2011). Theoretically, VRT needs to be taken into consideration as portable training methods to increase maximum force production and improving body composition that relates to overweight. Such information could benefit individuals who wish to combat overweight and muscular weakness (Colado et al., 2012; Ghigiarelli et al., 2009).

A limitation of traditional resistance training is that a significant part of the lift consists of a phase when the speed of the bar is slowed down before attaining zero velocity on completion of the concentric movement (Elliot, Wilson, & Kerr, 1989). Additionally, to prevent injury a lifter has to take care to stop the bar at the end of the concentric movement (Cronin et al., 2003). But elastic band and chain in the concentric phase of the exercise and together with the start of the easier part of the exercise, amplify the resistance and they increase the velocity of performance in the eccentric phase and gradually decrease the resistance in this phase. Eccentric loading is believed to have an association with greater upper body strength and endurance (Doan et al., 2002).

Studies that have compared WC and WE with each other, studied the strength of athletes in use of shorter duration of training (seven – eight weeks) than typical resistance training period studies (Ebben & Jensen, 2002; Ghigiarelli, 2006). In conclusion, the results were unclear as to whether the improvements in strength were specifically due to the treatment or to the general conditioning adaptation of the athlete subjects. Whereas untrained individuals response to short duration of resistance training effects better and quickest than athlete people, the American College of Sport's Medicine (ACSM) and training researches suggested a training period as long as minimally 10 weeks with frequency of 1 – 2 days weekly and at ≥70% of 1RM intensity for untrained individuals to achieve a sufficient level of changes in muscular function (Anderson, 2005; Chodzko-Zajko et al., 2009; Cronin et al., 2003; Ebben & Jensen, 2002; Ghigiarelli, 2006; Wallace et al., 2006; White, 2011). This was despite the fact that most of the training studies employed weekly training with frequency of three days (Hunter et al., 2001; Naderi et al., 2014; Rhea, Alvar, Ball, & Burkett, 2002).

There are also very few studies of VRT focusing on developing and improving muscular endurance and body composition other than strength (Ghigiarelli et al., 2009; Martins et al., 2015; Selig et al., 2004; Thiebaud et al., 2013). Almost all of the VRT studies examined effects of VRT on muscular strength (Anderson et al., 2008; Bellar et al., 2011; Colado et al., 2010; Ebben & Jensen, 2002; Ghigiarelli, 2006).

As stated above, studies have shown that regular resistance training and improvement of muscular function are closely associated. The results of VRT, in the majority of cases, suggest that it achieves better results than traditional resistance training for strength, force and velocity (Ebben & Jensen, 2002; Wallace et al., 2006), but VRT results are still unclear regarding muscular endurance and body composition which have important relation with overweight and muscular weakness, and further investigation about effects of VRT on muscular endurance and body composition is needed.

This study is a long duration study that compared combined weight and chain versus combined weight and elastic band variable resistance training on body composition, upper and lower body muscular strength and endurance among untrained males. The aim of this research is to determine whether a unique way of weightlifting will achieve better body composition and increased muscular performance in untrained adults.

1.3 Objectives of the Study

1.3.1 General Objective:

The main objective of this study is to evaluate the effects of 24 weeks combined weight and chain versus combined weight and elastic band variable resistance training on body composition, upper and lower body muscular strength and endurance among untrained males in Iran.

1.3.2 Specific Objectives

1. Experiment the effect of 24 weeks combined weight and chain versus combined weight and elastic band variable resistance training across baseline, post-test 1, post-test 2, post-test 3 and post-test 4 on body composition among untrained males in Iran.

2. Experiment the effect of 24 weeks combined weight and chain versus combined weight and elastic band variable resistance training across baseline, post-test 1, post-test 2, post-test 3 and post-test 4 on upper and lower body muscular strength among untrained males in Iran.

3. Experiment the effect of 24 weeks combined weight and chain versus combined weight and elastic band variable resistance training across baseline, post-test 1, post-test 2, post-test 3 and post-test 4 on upper and lower body muscular endurance among untrained males in Iran.

1.4 Questions of the Study

General Question

The main question of this study is: are there effects of 24 weeks combined weight and chain versus combined weight and elastic band variable resistance training on body composition, upper and lower body muscular strength and endurance among untrained males in Iran?

The specific questions associated with the first objective are:

1. Is there any effect of 24 weeks combined weight and chain versus combined weight and elastic band variable resistance training across baseline, post-test 1, post-test 2, post-test 3 and post-test 4 on body composition (body fat mass) among untrained males in Iran?

2. Is there any effect of 24 weeks combined weight and chain versus combined weight and elastic band variable resistance training across baseline, post-test 1, post-test 2, post-test 3 and post-test 4 on body composition (body fat free mass) among untrained males in Iran?

The specific questions associated with the second objective are:

3. Is there any effect of 24 weeks combined weight and chain versus combined weight and elastic band variable resistance training across baseline, post-test 1, post-test 2, post-test 3, and post-test 4 on upper body muscular strength (chest press) among untrained males in Iran?

4. Is there any effect of 24 weeks combined weight and chain versus combined weight and elastic band variable resistance training across baseline, post-test 1, post-test 2, post-test 3, and post-test 4 on upper body muscular strength (overhead press) among untrained males in Iran?

5. Is there any effect of 24 weeks combined weight and chain versus combined weight and elastic band variable resistance training across baseline, post-test 1,

post-test 2, post-test 3, and post-test 4 on lower body muscular strength (squat) among untrained males in Iran?

The specific questions associated with third objective are:

6. Is there any effect of 24 weeks combined weight and chain versus combined weight and elastic band variable resistance training across baseline, post-test 1, post-test 2, post-test 3, and post-test 4 on upper body muscular endurance (chest press) among untrained males in Iran?

7. Is there any effect of 24 weeks combined weight and chain versus combined weight and elastic band variable resistance training across baseline, post-test 1, post-test 2, post-test 3, and post-test 4 on upper body muscular endurance (overhead press) among untrained males in Iran?

8. Is there any effect of 24 weeks combined weight and chain versus combined weight and elastic band variable resistance training across baseline, post-test 1, post-test 2, post-test 3, and post-test 4 on lower body muscular strength (squat) among untrained males in Iran?

1.5 Hypotheses of the Study

General Hypothesis

The main hypothesis of this study is to evaluate whether there are significant effects of 24 weeks combined weight and chain versus combined weight and elastic band variable resistance training on body composition, upper and lower body muscular strength and endurance among untrained males in Iran.

The specific null hypotheses associated with the first objective are:

1. H0: There is no significant effect of 24 weeks combined weight and chain versus combined weight and elastic band variable resistance training across baseline, post-test 1, post-test 2, post-test 3 and post-test 4 on body composition (body fat mass) among untrained males in Iran.

2. H0: There is no significant effect of 24 weeks combined weight and chain versus combined weight and elastic band variable resistance training across baseline, post-test 1, post-test 2, post-test 3 and post-test 4 on body composition (body fat free mass) among untrained males in Iran.

The specific null hypotheses associated with the second objective are:

3. H0: There is no significant effect of 24 weeks combined weight and chain versus combined weight and elastic band variable resistance training across baseline, post-test 1, post-test 2, post-test 3, and post-test 4 on upper body muscular strength (chest press) among untrained males in Iran.

4. H0: There is no significant effect of 24 weeks combined weight and chain versus combined weight and elastic band variable resistance training across baseline, post-test 1, post-test 2, post-test 3, and post-test 4 on upper body muscular strength (overhead press) among untrained males in Iran.

5. H0: There is no significant effect of 24 weeks combined weight and chain versus combined weight and elastic band variable resistance training across baseline, post-test 1, post-test 2, post-test 3, and post-test 4 on lower body muscular strength (squat) among untrained males in Iran.

The specific null hypotheses associated with third objective are:

6. H0: There is no significant effect of 24 weeks combined weight and chain versus combined weight and elastic band variable resistance training across baseline, post-test 1, post-test 2, post-test 3, and post-test 4 on upper body muscular endurance (chest press) among untrained males in Iran.

7. H0: There is no significant effect of 24 weeks combined weight and chain versus combined weight and elastic band variable resistance training across baseline, post-test 1, post-test 2, post-test 3, and post-test 4 on upper body muscular endurance (overhead press) among untrained males in Iran.

8. H0: There is no significant effect of 24 weeks combined weight and chain versus combined weight and elastic band variable resistance training across baseline, post-test 1, post-test 2, post-test 3, and post-test 4 on lower body muscular strength (squat) among untrained males in Iran.

1.6 Significance of Study

Overweight and muscular weakness are common abnormalities in Iran (WHO, 2009). A study performed in Iran revealed that 54% of male adults were physically inactive (Kelishadi et al., 2005), and a great number of individuals in Iran are beginning to do resistance training to combat muscular weakness and overweight but most of them stop the training or turn to using illegal ergogenic aids because of lack of progression in

muscular strength and body composition (Brzezianska et al., 2014; Yager & O'Dea, 2014).

Theoretically, VRT needs to be taken into consideration as portable training methods to increase maximum force production and improving body composition that relates to overweight. Such information could benefit individuals who wish to combat overweight and muscular weakness (Colado et al., 2012; Ghigiarelli, 2006). It is imperative to identify additional resistance training programmes among untrained males; such as VRT and study the effect of these exercise programmes on muscular performance and body composition. Furthermore, the legitimacy of the VRT programme for improvement of muscular performance and body composition would determine a viable option to initiate activity in a population that was previously sedentary, widening the options of accessible physical activity and motivating individuals to participate in activities that have been suggested to be beneficially healthy. The precise mode of musculoskeletal adaptations of VRT in comparison with the traditional method is not fully understood, but an essential understanding of the phenomenon does exist. By finding out the most effective method of variable resistance training in improving muscular performance and body composition, the weight trainers can gain the significant advantage of muscular function by performing VRT. In addition, it can be introduced as a safe method to the Ministry of Health, Ministry of Sport, health centres and fitness institutes.

This study endeavours to offer the required information on the effect of VRT on body composition, muscular strength and endurance among untrained males. The present study will examine the effects of 24 weeks combined weight and chain versus combined weight and elastic band variable resistance training on body composition, upper and lower body muscular strength and endurance among untrained males in Iran.

1.7 Delimitations

This research only examined and studied some male participants. This was probably because of some cultural limitations in Iran and also because most of the reports have shown that the VRT was being used by males (Bellar et al., 2011; Cronin et al., 2003; Ghigiarelli et al., 2009). Participants were studying in a fitness gym which is under supervision of the Ministry of Sport and located in Tehran, Iran. Only participants' body composition, upper and lower body muscular strength and endurance which are important variables for untrained individuals' health would be measured. The training program and protocol used in this study was based on standard protocols but it was appropriate for this study and it's not suggested to apply it for abroad training researches.

1.8 Limitations

Certain variables outside of the laboratory control exist which could affect the results (i.e. genetics, motivation levels, and muscular soreness and overall fatigue). Genetic

factors apparently have a strong influence on how people respond to the exact resistance training protocol. Also some of untrained individuals may perceive a sub-maximal effort instead of perceiving a maximal effort during training because of different motivation levels and/or muscular soreness and overall fatigue with resistance training (Naimo, 2011; Otto & Carpinelli, 2006). But motivation levels of untrained individuals will be increased with exact and complete explanations about advantageous effects of particular physical activity in the beginning of the study (Otto & Carpinelli, 2006). Muscular soreness occurs when a muscle is stretched and microfilaments of the muscle will damaged temporarily due to performing resistance training, but muscular soreness usually disappear within a few sessions of resistance training (Wilmore et al., 2008). In order to control the effects of limitations in this study, before starting the intervention, the participants were given a briefing that explained the advantages of exercise training programme.

1.9 Definition of Terms

This section provides the definitions of key terms used in this study.

Combined weight and chain

Terminology: Adding a chain along with weights to the barbell. Combined weight and chain transforms a free weight, dynamic exercise into a VRT (Bellar et al., 2011; Ghigiarelli, 2006).

Operational: A bunch of chains linked to each side of a barbell. In this study, six chains consisting of "training chains" (two on each side), two are considered as "support chains" (one on each side) and two quick links were used. The two support chains are attached to the training chains to the barbell. The attached chains are lowered to the ground when performing work sets. When a lifter commences the descent to the floor in the process of performing WC training, the barbell is lowered and additional chain links accumulate on to the floor, reducing the overall weight of the load. As the bar is lifted or during the concentric portion of the lift, extra chain links are lifted from the floor and resistance is increased throughout the lift. The highest muscle force is generated at the peak of the lift while at the lowest point of the movement; muscle force generation is also at its lowest.

Combined weight and elastic band

Terminology: Adding elastic band along with weights to the barbell. Combined weight and elastic band similar to WC, provides an alternative method to change the resistance throughout the range of motion during exercise (Ghigiarelli et al., 2009).

Operational: The elastic bands are anchored at the bottom of the barbell to provide greatest possible tension at the peak of the lift while the least tension is at the lowest point of the lift. The attachment of elastic bands to the barbell and anchoring the elastic bands to the floor gives highest possible tension because the elastic bands are pulled tight at the peak of the lift. For example, as the lifter commences the descent to the floor in performing a squat exercise, the tension of the elastic bands will decrease the total barbell load. Elastic bands progressively add overall resistance during the concentric part of each repetition. On the other hand, during the eccentric part of each repetition, resistance gradually decreases in line with the descent. In this research, elastic bands resistance at various lengths were assessed and resting length of elastic bands also were measured. Measurements were recorded in centimetre. This was repeated with all elastic bands, to compile a chart of tensions (in kg) for several relevant band lengths (41 - 225 cm). Since the elastic bands were looped under the specific exercise equipment and attached to the barbell, the elastic bands were long enough to provided adequate tension throughout the lift.

Variable resistance training

Terminology: A VRT offers lower resistance at the point when the muscle is mechanically disadvantaged (at the bottom of the lift) and greater resistance at the point when the angle joint can generate the maximum muscular force (at the peak of the movement) (Ghigiarelli, 2006).

Operational: The inclusion of elastic band tension or chain resistance in traditional resistance training is called variable resistance training (Bellar et al., 2011; Naderi et al., 2014). Variable resistance training can be executed in two ways: (1) By adding the load of chain on the barbell or (2) by adding the elastic band on the barbell (Ghigiarelli, 2006). This research used the both ways of executing VRT in order to compare the both methods to explore the most effectiveness method of VRT on improving body composition and muscular function.

Body composition

Terminology: Body composition is defined as the percentages of FM and FFM in the body. Analysing the body composition can be beneficial to determine the ideal weight for overall health (Esmaelzadeh-Toloee, 2011).

Operational: This research used the definition referring to measurement of FM and FFM by Bioelectrical Impedance Analyser (BIA) (T- SC-330 MA, USA).

Muscular strength

Terminology: The greatest possible force or tension produced by a solitary muscle or groups of related muscles is referred as muscular strength (White, 2011).

Operational: This study measured the upper and lower body muscular strength of chest press, overhead press and squat exercises by One Repetition Maximum (1RM) test.

Muscular endurance

Terminology: It is the ability of a muscle or group of muscles to continuously exert force against resistance (White, 2011).

Operational: This study measured the upper and lower body muscular endurance of chest press, overhead press and squat exercises by Maximum Repetitions to Muscular Failure (MR) test.

Untrained participants

Terminology: Untrained participants refer to individuals who do not perform any form of exercise (Naimo, 2011).

Operational: Throughout this study the term "untrained participants" refers to individuals who have no previous experience performing resistance training within at least the past two years. The subjects of this study are untrained Iranian males (18 – 24-year old) who were volunteers in a fitness gym between, November 2016 and May 2017 and the gym is supervised by Iran Ministry of Sport.

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