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Comparative Study on Multi-Joint and Single-Joint Exercises in Bodybuilding Economics

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Abstract
Introduction. A relevant aspect of bodybuilding is that each person wants to improve muscle mass, or remove adipose tissue and build muscle, but this can only be done through a specific training program. **The purpose** of this current research is to make a comparative study between MJ and SJ exercises, and to see if through specific training routines, the subjects can achieve the proposed objectives, muscular hypertrophy or weight loss. **Methods.** The study was carried out on a number of 30 subjects divided in two groups with specific trainings methods. To obtain specific results, we will develop 2 training routines, one routine for hypertrophy based on multi-joint exercises, and one for weight loss based on single-joint exercises. These training structures will be consistent with the specific objectives, in terms of load used, number of repetitions and rest break. **Results.** Following the experiment, we recorded a series of significant results, regarding the HMM group, respectively the DM group. The most representative increases were recorded in the chest muscle from HMM group, with an increase of 5.86%. The smallest increase was on the chest on DM group, -2.57%, and in the thighs the highest of -4.15%. **Conclusions.** The hypothesis works to confirm, this allows us to affirm that it is possible as through a predetermined program with multi-joint exercises, and a program with single-joint exercises combined with cardio routines, subjects accumulate muscle mass, or lose weight by reducing the perimeters of body segments, to reach the desired physical shape.

Keywords : bodybuilding, multi-joint exercises, single-joints exercises

Introduction

In general, it is common to classify bodybuilding exercises as multi-joint (MJ) or single-joint (SJ), depending on how many joints are involved in the movement. Some authors suggest that SJ exercises promote greater muscle hypertrophy because they are easier to be learned and therefore have less reliance on neural factors than MJ exercises (Rutherford, O. M., and colab. 1986, Chilibeck, P. D and colab. 1998).

On the other hand, some authors recommend an emphasis on MJ exercises for maximizing muscle strength, assuming that MJ exercises are more effective than SJ exercises because they enable a greater magnitude of weight to be lifted (Kraemer, W. J and colab. 2008, American College of Sports Medicine, 2009). Exist many opinions for these claims because are limited from the lack of studies comparing muscle hypertrophy and strength gains between SJ and MJ exercises.

Joint exercises are the best way to get your entire body fully functional and physicaly fit for the activities of daily life and not only (National Institute on Aging, 2020). Compound exercises, also known as multi-joint, are one form of these exercises, and if we list a few multi-joint exercises that we can perform, they would be : step-ups, lunges, leg presses, dead lifts, push-ups and squats (Fitday.com). Each of these exercises applies stress to different muscles: step-ups exercise, engage the lower body muscles, leg presses increased muscle growth to the quadriceps, hamstrings, calves and glutes due to the heavier resistance involved, dead lifts increase muscular mass in both the lower and upper body, push-ups increase muscular mass in the chest, shoulders, back and triceps and squat exercises can vary but generally focus on the quadriceps, hamstring, calves and glutes (Healthline.com). As a generalization, exercises that by their nature involve pulling, pushing, or kneeling using gravitational force itself, are called compound exercises (Nuffieldhealth.com). Practically, each of these exercises applies stress to different muscles (Fitday.com).

An important aspect of multi-joint exercise and good food indgestion, is that it triggers muscle hypertrophy. Schoenfeld B. J. (2010) consider that three major factors are emphasized in the conventional hypertrophy model: mechanical tension, metabolic stress, and muscle damage . Also, muscle hypertrophy occurs when muscle protein synthesis exceeds muscle protein breakdown and results in positive net protein balance in cumulative periods (Damas, F., and colab. 2018).

Single-joint exercises (SJ), help us to build and maintain a strong and healthy body. These exercises are also known as isolation exercises. Isolation exercises are also called exercises for definition or for a low fat physique, they are those exercises of monoarticular type, which involve in the actual movement a single muscle group, because the participation of other muscle groups is limited. Gentil. P., and colab, (2015), consider that the weights used in these exercises are less than to the multi-joint(MJ) exercises. As we said about multi-joint exercises and muscle group involved, isolation exercises include : the leg curl, biceps curl, quadriceps extension, wrist curl and front raise and many other examples. On the other hand, weight machines are often used to undertake these exercises.

As basic principles specific to weight loss training to achieve muscle quality, are the following : a correct and strict diet, meals should not be high in calories but rich in protein, combined aerobic and anaerobic workouts, additional appropriate to the goal (those that support the weight loss).

We recommended to perform some form of aerobic exercises at least maybe two or three times a week, for a minimum of 25 minutes per session. However, on days when a cardio workout of more than 25-30 minutes will take place, combined with a workout with isolation exercises, and strict diet, in time, will generate a decrease in weight, but also an increase in muscle quality.

Methods

Thirty-teen young men (N=30), without prior bodybuilding training experience, were divided into two groups (HMM group; N=15, and DM group; N=15). Both groups trained four days a week, for a period of twenty-four weeks.

The HMM group performed only MJ exercises(e.g. bench press, bent-over row, squat, deadlift), and the DM group, performed SJ exercise(e.g. biceps curl, lateral raise, leg extension) program combined with cardio for at least 20 minutes(e.g treadmill, cycle ergometer), twice a week for weight loss. The training period took the form of 2on / 1off, for example, two days of training, one day of rest, and a free weekend. In these twenty-four weeks, the subjects had 3 phases of evaluations (initial, intermediary and final). The subjects were measured from an anthropometric point of view in all three phases to see if the routines were successful..

To be accepted in this research, participants should be at least 18 years of age, have not been participating in any bodybuilding training program over the past six months and be free of health problems that could be aggravated by the experimental procedures (Gentil, P, and colab., 2015).

To be included in the analysis, the participants had to attend at least 80% of the training sessions (Gentil, P., & Bottaro, M. 2013).

The anthropometric measurements of perimeters from the three test stages, were performed with a mechanical thalliometer for the circumference.

Statistical analysis

The usual statistical indicators were used : the average (M), and standard deviation (SD). We used the SPSS program. The experiment was performed on two samples with two different objectives. Both groups were considered a control samples at the initial testing, and the final one was considered an experimental samples.

Results

The obtained data from both groups, with the best results on specific muscle area after the 3 stages of testing are presented in Table no.1, and Table no. 2. It is noticeable that, all two research groups are not unitary regarding the anthropometric measurements, and represent the averages obtained after twenty-four weeks of training according to the requirements established in the current study. This is a result of the fact that in the same group different somatic types are found. From each group, there were subjects who responded very well to training and had a very good evolution, especially in the first two tesing stages, but also subjects who registered a slower progress due to various causes.

We chose to present the most exponential results from the somatic point of view of 3 muscle groups (chest, back and thighs), obtained during the 3 tests performed in different periods. These data represent the results obtained from training based on compound exercises for muscle hypertrophy and on the other hand, results obtained from training with isolation exercises for the oxidation of adipose tissue and the increase of muscle quality.

Discussions

From an analytical point of view, the results obtained summarize the fact that the training routines gave results in both groups involved in the research. The proof that the experiment goes on an ascending path, are the anthropometric measurements periods called initial, intermediate and final testing, shown in Fig.1 and Fig. 2, where we can follow the dynamics of the results.

Table 1. The data with the evolution of measurements from 3 tests at the level of the targeted muscle groups (HMM).

		Initial Test - Perimeter of chest muscles (cm)	Intermediar Test - Perimeter of chest muscles (cm)	Final Test - Perimeter of chest muscles (cm)	Initial Test - Perimeter of back muscles (cm)	Intermediar Test - Perimeter of back muscles (cm)	Final Test - Perimeter of back muscles (cm)	Initial Test - Perimeter of thigh muscles (cm)	Intermediar Test - Perimeter of thigh muscles (cm)	Final Test - Perimeter of thigh muscles (cm)
Subject	**B.I**	113.0	115.0	119.2	118.0	119.2	122.0	59.0	60.0	61.0
	C.C	104.0	107.3	113.0	120.0	124.2	127.0	58.0	60.0	61.0
	C.L	97.5	99.7	105.0	103.0	105.0	110.6	57.0	58.0	59.5
	D.A	105.0	107.6	110.2	110.0	116.0	120.5	58.0	59.7	61.0
	D.S	104.5	106.2	109.0	111.5	115.5	119.0	58.0	59.2	60.3
	G.A	104.0	105.0	109.0	120.0	122.5	124.0	58.0	59.6	62.0
	G.D	99.5	102.3	108.4	102.0	104.1	107.6	50.0	52.0	54.0
	J.R	104.0	105.0	106.7	115.0	117.0	118.5	55.0	56.2	57.0
	M.I	102.0	105.6	107.2	115.0	119.0	121.0	52.0	53.5	55.0
	M.M	103.0	106.0	107.2	112.0	114.3	117.0	53.0	54.2	56.0
	P.G	116.0	118.0	119.5	106.5	109.0	111.2	61.0	61.9	62.4
	P.O	96.0	99.2	103.0	101.0	104.2	108.2	48.0	50.0	51.5
	S.O	101.5	104.8	108.8	110.0	114.7	117.3	56.0	57.6	59.0
	T.C	103.5	106.5	108.8	120.0	122.3	124.5	58.0	59.2	60.6
	V.F	98.0	102.3	104.0	100.0	110.7	112.0	50.0	51.5	52.0
	Mean	103.4	106.0	109.3	110.9	114.5	117.4	55.4	56.8	58.2
	SD	5.314624925	4.974458573	4.779968121	7.138593966	6.654951612	6.142916943	3.887709572	3.700347474	3.640617425

Table 2. The data with the evolution of measurements from 3 tests at the level of the targeted muscle groups (DM).

		Initial Test - Perimeter of chest muscles (cm)	Intermediar Test - Perimeter of chest muscles (cm)	Final Test - Perimeter of chest muscles (cm)	Initial Test - Perimeter of back muscles (cm)	Intermediar Test - Perimeter of back muscles (cm)	Final Test - Perimeter of back muscles (cm)	Initial Test - Perimeter of thigh muscles (cm)	Intermediar Test - Perimeter of thigh muscles (cm)	Final Test - Perimeter of thigh muscles (cm)
Subject	**B.B**	103.0	102.3	101.0	134.0	132.5	131.0	56.5	55.8	55.0
	C.A	107.0	105.0	104.0	128.0	127.2	125.0	59.5	58.0	57.5
	C.M	101.5	100.0	99.7	110.0	105.4	103.0	57.6	55.0	54.0
	C.R	105.0	104.0	102.0	112.0	109.0	107.0	61.7	60.0	59.4
	D.D	107.5	103.5	101.6	125.0	123.0	119.0	56.3	55.0	54.0
	H.L	103.5	102.0	100.3	120.0	117.0	115.0	58.0	56.0	55.2
	I.C	104.5	102.0	101.0	120.0	116.0	112.0	55.8	54.1	53.8
	M.V	116.0	115.0	114.0	137.5	136.0	132.0	61.5	61.0	60.0
	O.A	110.0	109.2	108.0	135.0	134.1	132.0	52.0	51.6	51.0
	P.D	104.0	103.0	102.3	120.0	118.0	114.0	57.8	56.9	55.0
	R.C	103.0	102.0	100.0	112.0	110.0	109.6	59.6	58.8	56.2
	R.N	104.5	103.0	101.0	111.5	110.0	109.4	67.8	66.0	63.1
	S.D	104.0	102.5	100.0	110.0	109.0	108.0	51.5	50.0	49.7
	T.I	104.0	103.8	102.1	115.0	114.5	112.0	55.9	54.3	53.8
	V.B	105.0	103.0	102.0	120.0	118.0	115.0	55.9	54.7	53.9
	Mean	105.5	104.0	102.6	120.7	118.6	116.3	57.8	56.5	55.4
	SD	3.570714214	3.639701715	3.761078873	9.391612266	9.866383522	9.496064348	3.996331651	3.925957572	3.432783127

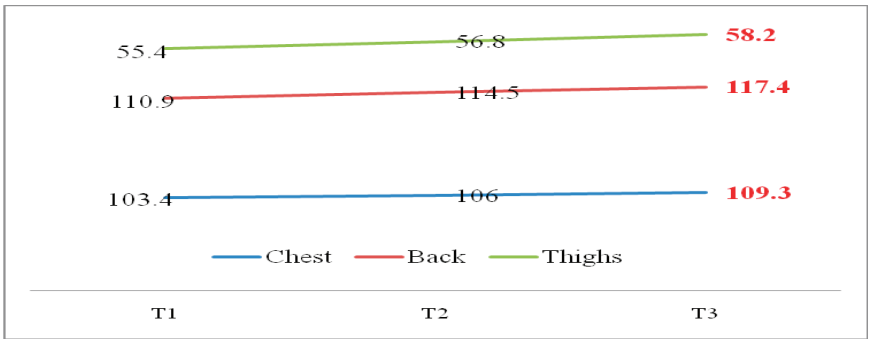

Fig. 1. Graph of the evolutions of the perimeters averages, to the HMM group during the 24 weeks of specific training.

The data obtainet in Fig.1, show that after 24 weeks of compound exercises, correlated with a proper diet and an adequate rest period, the subjects registered a muscular hypertrophy. We exposed the most representative increases during the 3 stages of tests, as in the Table no. 1, and which are expressed in centimeters and represent the increase in muscle perimeters.

Fig. 2. Graph of the evolutions of the perimeters averages, to the DM group during the 24 weeks of specific training.

The data obtained in Fig. 2 show that after 24 weeks of single-joint exercises and cardio training, correlated with a proper diet and an adequate rest period, the subjects registered a decrease in somatic perimeters, through the oxidation of adipose tissue and acquired a superior muscle quality.

Although, group homogeneity was not our target in research from the beginning, because it is very difficult to find volunteer subjects with the same body proportions, we wanted to find out if through compound or isolation exercises, the average perimeter of muscle groups can change on the novice subjects.

With the passage of time, subjects will evolve as a level of training, and for this, they will need new training plans and an update of the food plan, reported per envidid, somatic type, and objective.

Subjects should strive to have a balanced sports life, without too many deviations, because the results will be minimal, compared to those who strive to have a much better extrasport lifestyle.

Finally, we can state, as a result of the analyzes performed on the collected data, that the trainings based on multi-joint and single-joint exercises can bring changes on the body perimeters.

Conclusions

Following the experimental research using compound and isolation exercises, we recorded a series of data on the progress of the subjects from an anthropometric point of view. These results were noted at the perimeters of the muscle groups, selected for research from the initial testing.

Our opinion is that the use of multi-joint exercises, but also single-joint exercises used systematically and consciously, depending on the objectives of the subjects, brought a number of positive results.

Regarding the dynamics of the results recorded by the subjects, regarding the anthropometric dimensions, at the level of different muscle groups, we consider that their purpose has been achieved, in a large share, because the measurements made at the somatic

level certainly help us to we highlight this fact. In the HMM group, the subjects recorded increases from a somatic point of view and in the DM group, the subjects obtained a diminution in the perimeters of the segments, which was due to decreased adipose tissue. The results of the 3 tests of the HMM and DM group were due to the fact that the subjects were novices, and due to the strict training program, nutrition and rest, the increase in muscle mass was much more accessible.

Through the usual use of exercise and proper nutrition, we noticed in subjects an increase in mental state through good mood, but also a good physical fitness through increases in muscle mass and muscle definition, which results in the fact that sports regardless of how is practiced, brings benefits, increases health, well-being, develops us harmoniously and beautifully.

We consider the fact that through this paper, we managed to demonstrate the role of compound and isolation exercises in bodybuilding, related to ordinary people who want a change in their life in sports by increasing muscle mass and muscle definition.

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