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Comparison of the effect of three methods of cluster, drop set and pyramid resistance training on body composition and selected physical fitness parameters in male bodybuilders

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ABSTRACT

Introduction: Resistance training with different methods can have different effects on body composition and physical fitness factors of athletes. So that this study aimed to compare the effects of three resistance training methods—cluster sets, drop sets, and pyramid training—on body composition and selected physical fitness parameters in male bodybuilders.

Material & Methods: A semi-experimental design with pre-test and post-test measurements was used, involving three intervention groups. The statistical population included male bodybuilders aged 18 to 30 from Rasht, Iran, selected through convenience sampling. The training program of each group was implemented for 8 weeks and three sessions per week, and each group performed resistance training based on its own training method. Measurements of research variables including height, weight, body fat thickness, body mass index (BMI), waist-to-hip ratio (WHR), and some physical fitness factors were performed at the beginning and end of the training period using standard tools and validated tests. Data were analyzed using SPSS version 23, with statistical significance set at $p < 0.05$.

Results: The results related to body composition indicated a significant decrease in both weight and BMI in the drop set group ($p = 0.007$ for both) and the cluster training group ($p = 0.001$ and $p = 0.000$, respectively). In contrast, no significant changes were observed in the pyramid group. All three training methods led to significant increases in arm and thigh circumference: drop set ($p = 0.002$ for both), pyramid training ($p = 0.008$ and $p = 0.001$), and cluster training ($p = 0.000$ and $p = 0.003$). No significant changes in body fat percentage were observed in any group)P<0/05). Between-group comparisons of post-test results revealed no statistically significant differences across the five measured body composition variables. In terms of physical fitness, all groups demonstrated significant improvements in upper body strength ($p = 0.001$). For lower body strength, significant gains were found in the pyramid and cluster training groups ($p = 0.005$ for both), whereas the drop set group did not show a statistically significant change, and in post-test comparisons also revealed no significant differences in strength gains among the groups ($p > 0.05$).

Conclusion: The findings indicate that all three resistance training methods—drop set, cluster, and pyramid—produced similar effects on body composition and selected physical fitness parameters in male bodybuilders, with no significant differences between the groups.

Keywords: Resistance training, cluster training, drop set training, pyramid training, body composition, physical fitness.

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1. Introduction

Weight training is considered the most effective method for increasing muscular strength and hypertrophy. As a result, professional coaches and bodybuilders utilize advanced resistance training systems to enhance these specific factors. Therefore, achieving the most effective training methods is one of the primary goals of researchers in this field, providing a foundation for bringing athletes to their peak physical fitness(1)

"Body composition is considered one of the main components in the fitness and health profiles of individuals. Therefore, body composition evaluation should be considered as part of an individual's fitness profile, separate from weight measurement due to the strong correlation between health and body fat levels. Assessing body composition (especially measuring body fat percentage) is one of the essential components in the fitness profile according to (2)

Muscle morphological adaptation in response to resistance training, such as hypertrophy, has a strong correlation with the variables applied in the training protocol. These variables include intensity, rest periods between sets, speed, type of exercise, training program, number of weekly sessions, and training volume. Progressing overload through weight or repetitions can be used to increase strength and muscle hypertrophy in young men and women in early training stages (3). Volume and intensity of resistance training are considered two main factors in these workouts. Various methods are used to gradually increase the workload performed by the skeletal muscle, with the most common method being to increase resistance to perform repetitions (4). In fact, the strength increases at which the muscle operates can affect the amount of activity performed by the muscle. Another method of progressively increasing the workload is to increase the total training volume by increasing the number of repetitions, sets, or exercises performed in each training session; increasing the speed of repetitions, modifying the rest time between exercises, and changing the frequency of training(5)

"Recently, strength training systems such as the drop set and cluster set have attracted the attention of researchers and coaches compared to other training methods. Drop sets and pyramid training have similar results in terms of strength and hypertrophy gains. However, drop sets are a more time-efficient method and are more suitable for individuals with limited time for training (6). In the cluster training system, for instance, there are sets of 8 repetitions with 5 sets and rest periods of 15 to 30 seconds, and in the drop set training system, there are 3 to 5 sets where, for example, the weight is reduced twice during each set with repetitions ranging from 8 to 16. In pyramid training, the pyramid system is often referenced, which consists of three sets with repetitions of 8, 10, and 12(7).

Cluster training can lead to greater force increases due to the resynthesis of phosphocreatine during rest periods, with short rest times (5-20 seconds). Cluster sets allow you to showcase your creativity in executing exercises by manipulating intensity and volume (7). Also state that cluster training minimizes cumulative fatigue, maintains higher speeds in movements, and increases explosive strength. This method is very beneficial for athletes who need to generate high power or have limited time for training (8).

Pyramid training affects the quality of the exercise as repetitions decrease due to fatigue caused by the accumulation of lactic acid. Phosphocreatine reduction occurs as a result of continuous repetitions during sets, leading to increased utilization of muscle glycogen, and when lactic acid is produced, it causes a further increase in lactic acid concentration(9). Also, according to studies, these training protocols similarly lead to muscle hypertrophy in young individuals. Regarding different types of pyramid training methods, double pyramid resistance training is more effective than single pyramid methods for improving maximal strength, and it appears that this increase in maximal strength is due to neural mechanisms, as anthropometric factors do not change (10).

In the evaluation of various resistance training methods, Fink et al. (2018) found that six weeks of training, consisting of three sets of 12, 10, and 8 repetitions, increased and improved lower limb strength (11). In another study Sooneste et al. (2013) examined the effects of drop sets on muscle volume and hypertrophy in 16 young men with prior resistance training experience, using both drop set and reverse drop set methods, with results showing that performing drop sets in the long term can play a role in strengthening muscles and hypertrophy as well (12).also drop sets present an efficient strategy for maximizing hypertrophy in those with limited time for training (13). Angleri et al. (2018) compared the effects of pyramid training and drop sets on lower limb strength and quadriceps hypertrophy against pyramid training, reporting that 12 weeks of training three times a week significantly increased quadriceps muscle volume (14). Sabido et al. (2016) also studied the comparative effects of drop set and pyramid methods on upper body strength and hypertrophy, indicating that drop sets affected hypertrophy (15). In another study, Sødal et al. (2023) compared the impact of cluster training versus pyramid training on lower limb strength, showing that both training methods increased strength. Additionally, drop sets can effectively enhance muscle hypertrophy, but there was no significant difference between this method and pyramid training concerning muscle growth. However, drop sets require less time compared to pyramid training (13).

Another study analyzed the effects of pyramid resistance training against cluster training on increasing lower limb strength in back squats, showing that cluster training was more effective than pyramid training for strength gain (16). Tofano et al (2017) investigated the effects of pyramid resistance training versus cluster training over six weeks, stating that both training protocols led to strength increases, but the cluster training protocol showed a greater improvement in strength. In another study, the effects of drop set training on upper body strength were examined, demonstrating improvements in strength (17). Furthermore, drop set training, compared to pyramid training, promotes minor improvements related to strength, but hypertrophic adaptations between conditions are similar (18). Yazdani et al. (2017) compared the effects of cluster training on explosive strength and lower limb power in 18 female karate practitioners, and the results revealed that both training types increased fitness levels. In the areas of strength and explosive strength, no changes were observed in any group (19). Another study reviewing the effects of pyramid and reverse pyramid training on the strength, endurance, and muscle mass of wrestlers over 12 weeks with three sessions per week noted that both groups had similar changes in strength, endurance, and muscle mass(20)

Based on the previous studies reviewed, it appears that the obtained results regarding the effects of cluster training, drop sets, and pyramid training on muscle volume and strength are inconsistent(14, 21, 22). As mentioned, previous studies show a significant impact of cluster training and drop sets on muscle volume and strength compared to pyramid methods (21). Considering that bodybuilding is a sport requiring movements tailored to various goals with different intensities, and success in this discipline necessitates both muscular strength and volume alongside overall fitness, the potential positive impact of cluster and drop set resistance training in this discipline requires thorough investigation(14). On one hand, it seems that there has yet to be a comparison of these three training methods among bodybuilders. Therefore, the objective of the present research is to compare the effects of six weeks of cluster, drop set, and pyramid resistance training on body composition and certain fitness factors in male bodybuilders.

2. Methodology

2.1. Materials and methods

The aim of this study was to compare the effects of three resistance training methods—cluster sets, drop sets, and pyramid training—on body composition and selected physical fitness factors in male bodybuilders.

2.2. Participants

Therefore, the current research is semi-experimental in nature, utilizing a pre-test and post-test design with quantitative data collection, and falls under the category of applied research. All stages of the study were conducted in Rasht City, at the Sports Science Laboratory of the Islamic Azad University, Rasht Branch. In this semi-experimental study, participants were randomly selected from volunteer male bodybuilders aged 18 to 30 from a selected gym in Rasht city. Participants had no history of musculoskeletal disorders and possessed between 2 to 4 years of training experience. The training period lasted six weeks, with three sessions per week. Inclusion criteria included willingness to participate, completion of a health consent form, and absence of musculoskeletal conditions) For example, the absence of a musculoskeletal disease or disorder). Exclusion criteria again included any injuries preventing continued training and specific patterns of absence from sessions. The exclusion criteria for subjects included injury to the extent that they were unable to continue training, missing two consecutive sessions, or missing three alternating sessions of training. Based on these criteria, 30 volunteers were selected and randomly assigned into three groups: the cluster resistance training group, the drop set resistance training group, and the pyramid resistance training group. This study was conducted in accordance with the ethical guidelines of Islamic Azad University (Ethics ID: IR.IAU.RASHT.REC.1398.026). All targeted research variables were measured before and after the training intervention between 4 and 6 PM.

2.3. Measurements

Instruments: The research instruments included a measuring tape with an accuracy of 1 millimeter for measuring the participants' height, hip circumference, and waist circumference; a digital scale manufactured by Beurer (Germany) for measuring body weight with an accuracy of 0.1 kilograms; and a SAEHAN caliper made in South Korea for measuring subcutaneous fat thickness in three areas: the abdomen, chest, and thigh.

Research Procedure: Ten days prior to the implementation of the training protocol, the volunteers participated in an orientation session designed to familiarize them with the study’s procedures, as well as to explain its objectives, benefits, and potential drawbacks. Following this session and after obtaining informed consent, body composition assessments—including height, weight, body fat thickness, BMI, and WHR—were conducted.

In this study, participants’ height and weight were measured with high precision. Height was measured using a standard wall-mounted stadiometer, with participants standing barefoot, heels, buttocks, and shoulders touching the wall, and their posture kept straight. Weight was measured using a calibrated digital scale while participants wore minimal clothing. Body Mass Index (BMI) was then calculated by dividing weight (in kilograms) by the square of height (in meters).

To assess body fat thickness, a skinfold caliper was used at standard anatomical sites, including the triceps, subscapular, and suprailiac regions. Each site was measured three times, and the average value was recorded as the final result. The waist-to-hip ratio (WHR) was determined by measuring the waist circumference at its narrowest point and hip circumference at its widest point, using a flexible, non-stretchable measuring tape without applying excessive pressure. All measurements were performed by a trained individual under standardized conditions to ensure the accuracy and reliability of the data.

Subsequently, physical fitness tests were carried out over the course of one week. These assessments were repeated 48 hours after the final training session. After selecting the participants, they were randomly assigned into three groups: the cluster resistance training group, the drop set resistance training group, and the pyramid resistance training group. The training program lasted six weeks, with three sessions held each week..

2.4. Intervention

Cluster Training: The cluster training protocol consisted of eight sets of four repetitions, performed at 75% of one-repetition maximum (1RM). There was a 60-second rest interval between sets and a 15-second intra-set pause after every four movements within each set. Each session included four upper-body exercises and three lower-body exercises. The sequence of exercises began with multi-joint (compound) movements, followed by single-joint (isolation) exercises. Additionally, upper and lower body exercises were alternated throughout the session. This protocol was based on the method described by Samson et al (2018)(7). as illustrated in Table 1.

Drop Set Training: The drop set training was structured such that each session included six exercises, with three sets per exercise. Each set was performed to the point of muscular failure, using sequential loads of 80%, 60%, and 40% of one-repetition maximum (1RM). Short rest intervals were taken between intensity drops. After reaching failure at each intensity level, the load was reduced by approximately 20%. The rest interval between sets was 60 seconds. Each training session consisted of six exercises, listed sequentially in Table 1, based on the protocol described by Schoenfeld et al (2017)(23)

Pyramid Training: The pyramid training in this study was conducted using a reverse pyramid system. This method consisted of three sets at 75% of one-repetition maximum (1RM), with repetitions arranged in descending order: 12, 10, and 8 reps. Rest intervals were set at 60 seconds between sets and 90 seconds between exercises. Each training session included six exercises—four targeting the upper body and three for the lower body—performed in the sequence presented in Table 1. This protocol follows the model proposed by Samson et al (2018) (7).

Table 1. *Training Program*

PROGRAM	WEEK	NUMBER OF MOVES	NUMBER OF SETS	REPETITION	REPEAT REST TIME BETWEEN SETS (SEC)	REST TIME BETWEEN MOVEMENTS (SEC)	REST INTERVALS BETWEEN SETS (SEC)	REST INTERVALS BETWEEN MOVEMENTS	INTENSITY (% 1RM)
CLUSTER	1	7	7	4	15	60			75
CLUSTER	2	7	7	4	15	60			75
CLUSTER	3	7	7	4	15	60			75
CLUSTER	4	7	7	4	15	60			75
CLUSTER	5	7	7	4	15	60			75
CLUSTER	6	7	7	4	15	60			75
DROP SET	1	6	3	Until exhaustion	60		5-8		80, 60, and 40 respectively
DROP SET	2	6	3	Until exhaustion	60		5-8		80, 60, and 40 respectively
DROP SET	3	6	3	Until exhaustion	60		5-8		80, 60, and 40 respectively
DROP SET	4	6	3	Until exhaustion	60		5-8		80, 60, and 40 respectively
DROP SET	5	6	3	Until exhaustion	60		5-8		80, 60, and 40 respectively
DROP SET	6	6	3	Until exhaustion	60		5-8		80, 60, and 40 respectively
PYRAMID	1	6	3	12, 10, 8			1, 1, 1	75	
PYRAMID	2	6	3	12, 10, 8			2, 2, 2	75	
PYRAMID	3	6	3	12, 10, 8			3, 3, 3	75	
PYRAMID	4	6	3	12, 10, 8			4, 4, 4	75	
PYRAMID	5	6	3	12, 10, 8			5, 5, 5	75	
PYRAMID	6	6	3	12, 10, 8			6, 6, 6	75	

2.5. Statistical Methods

To analyze the data, the normal distribution of variables was first assessed using the Shapiro-Wilk test. For within-group comparisons across the three study groups, the paired t-test was used. To evaluate variance homogeneity in the pre-test and to examine between-group differences in the post-test, one-way analysis of variance (ANOVA) was employed (based on the calculated differences between pre- and post-test scores).

All statistical analyses were conducted using SPSS software version 26, and charts were created using Microsoft Excel 2020.

3. Results

The descriptive statistics for the variables—including age, height, body composition (weight, BMI, waist circumference, WHR, arm circumference, thigh circumference, body fat percentage), and physical fitness variables (upper-body strength and lower-body strength)—are presented separately for each study group in Table 2.

Table 2. *Description of the variables of age, height, body composition, and physical fitness of the subjects by study groups (n=10)*

Variable	Time of Measurement	Drop Set Training Group	Pyramid Training Group	Cluster Training Group
	Pre-test	20/3±62/24	96/2±10/24	33/3±60/25
Age (years)	Pre-test	92/6±37/177	07/7±70/176	27/6±40/180
Height (cm)	Pre-test	79/7±87/80	97/7±40/79	99/6±90/83
Weight (kg)	Post-test	94/7±62/81	91/7±80/79	07/7±85/84
	Pre-test	75/0±64/25	78/0±36/25	95/0±74/25
BMI (kg/m2)	Post-test	83/0±88/25	65/0±49/25	90/0±03/26
	Pre-test	04/6±37/76	86/6±70/82	13/6±90/83
Waist circumference (cm)	Post-test	04/6±37/76	18/7±70/82	13/6±90/83
	Pre-test	63/7±62/87	44/7±60/92	66/6±70/97
Hip circumference (cm)	Post-test	63/7±62/87	44/7±60/92	66/6±70/97
	Pre-test	02/0±87/0	02/0±89/0	05/0±86/0
WHR (ratio)	Post-test	02/0±87/0	02/0±89/0	05/0±86/0
	Pre-test	08/4±12/38	37/5±20/37	54/4±80/38
Arm circumference (cm)	Post-test	13/4±25/39	36/5±05/38	26/4±95/39
	Pre-test	23/5±00/58	08/9±30/60	16/8±40/66
Thigh circumference (cm)	Post-test	46/5±12/59	20/9±40/61	92/7±25/67
	Pre-test	90/0±93/12	81/0±54/12	75/0±92/12
Fat percentage (%)	Post-test	92/0±01/13	68/0±63/12	74/0±89/12
	Pre-test	27/15±75/109	58/19±50/101	54/24±50/120
Upper body strength (kg)	Post-test	56/14±87/116	88/17±40/104	31/24±30/124
	Pre-test	67/21±75/128	67/17±80/111	73/31±50/137
Lower body strength (kg)	Post-test	79/28±12/147	12/17±10/117	

Based on the obtained results, the Shapiro-Wilk test indicated that all variables followed a normal distribution ($p > 0.05$). Also, the evaluation of homogeneity of variances indicated that the data related to the variables in question had homogeneity of variance.

To compare between-group differences in the post-test for body composition variables, the difference between pre-test and post-test values was first calculated. Then, one-way analysis of variance (ANOVA) was performed, and the results are presented in Table 3.

Table 3. *Results of one-way analysis of variance test to evaluate between-group changes in body composition variables at post-test (number in each group = 10 people)*

Variable		Sum of variances	Degrees of freedom	Mean squares	F	Significant
Weight	Between groups	1/51	2	0/75	1/54	0/23
	Within groups	13/22	27	0/49		
	Total	14/74	29			
BMI	Between groups	0/13	27	0/06	1/40	0/26
	Within groups	1/26	27	0/04		
	Total	1/39	29			
Arm circumference	Between groups	0/46	2	0/23	0/67	0/51
	Within groups	9/27	27	0/34		
	Total	9/74	29			
Thigh circumference	Between groups	1/01	2	0/50	0/80	0/45
	Within groups	17/02	27	0/63		
	Total	18/04	29			
Fat percentage	Between groups	0/07	2	0/03	0/61	0/54
	Within groups	1/64	26	0/06		
	Total	1/72	28			

The results of the one-way ANOVA indicated that there were no significant differences among the three intervention groups regarding the assessed body composition variables, including weight, BMI, arm circumference, thigh circumference, and body fat percentage (p > 0.05). This suggests that all three training methods had approximately the same level of impact.

To evaluate within-group changes in body composition variables in each study group, the paired t-test was used—given the normal distribution of the data. The results of these analyses are presented in Table 4.

Table 4. *Results of paired t-test to assess within-group changes in body composition variables (number in each group = 10 people)*

Variable		Sum of variances	Degrees of freedom	Mean squares	F	Significant
Weight	Between groups	51/1	2	75/0	54/1	23/0
	Within groups	22/13	27	49/0		
	Total	74/14	29			
BMI	Between groups	13/0	27	06/0	40/1	26/0
	Within groups	26/1	27	04/0		
	Total	39/1	29			
Arm circumference	Between groups	46/0	2	23/0	67/0	51/0
	Within groups	27/9	27	34/0		
	Total	74/9	29			
Thigh circumference	Between groups	01/1	2	50/0	80/0	45/0
	Within groups	02/17	27	63/0		
	Total	04/18	29			
Fat percentage	Between groups	07/0	2	03/0	61/0	54/0
	Within groups	64/1	26	06/0		
Variable	Total	72/1	28	Mean squares	F	Significant

The results of the within-group analysis for body composition variables revealed significant increases in weight, BMI, arm circumference, and thigh circumference in both the drop set and cluster training groups (p < 0.05). Additionally, a statistically indifferent in arm and thigh circumference was observed in the reverse pyramid training group (p < 0.05). However, changes in weight and BMI were not statistically significant in the pyramid training group (p > 0.05).

Overall, the findings suggest that all three training methods—drop set, pyramid, and cluster—led to significant improvements in arm and thigh circumference. Moreover, drop set and cluster training (excluding pyramid training) also significantly increased weight and BMI. Nevertheless, the between-group comparison of post-test results did not show any significant differences in any of the assessed body composition variables.

Therefore, it can be concluded that there are no statistically significant differences among the three training methods—drop set, cluster, and reverse pyramid—regarding their effects on selected body composition indicators in male bodybuilders.

To compare between-group differences in the post-test for physical fitness variables, the difference between pre-test and post-test values was calculated, followed by one-way ANOVA analysis. The results are presented in Table 5.

Table 5. *Results of one-way analysis of variance test to evaluate between-group changes in physical fitness variables at post-test (number = 30 subjects)*

Variable		Sum of variances	Degrees of freedom	Mean squares	F	Significant
Upper body strength	Between groups	86/74	2	43/37	08/2	14/0
	Within groups	60/485	27	98/17		
	Total	46/560				
Lower body strength	Between groups	40/658	2	20/329	49/1	24/0
	Within groups	30/5962	27	82/220		
Variable	Total	70/6620	29	Mean squares	F	Significant

Table 6. *Results of the paired t-test to evaluate within-group changes in physical fitness variables (number in each group = 10 people)*

Variable	groups	Mean	t	Degrees of freedom	Significant	Confidence Interval % Higher Bound	Confidence Interval % Lower Bound
Upper body strength	Drop set training	-7/20	-4/57	9	0/001	-3/63	-10/76
	Pyramid training	-3/90	-3/18	9	*0/01	-1/13	-6/66
	Cluster training	-3/80	-3/19	9	*0/01	-1/10	-6/49
Lower body strength	Drop set training	-15/70	-0/68	9	*0/07	2/00	-33/40
	Pyramid training	-5/30	-4/57	9	0/005	-2/04	-8/55
	Cluster training	-6/30	-3/69	9	*0/005	-2/43	-10/16

To evaluate within-group changes in physical fitness variables among the study groups, the paired t-test was used, considering the normal distribution of the data. The results of these analyses are presented in Table 6.

The results of the one-way ANOVA showed that there were no significant differences among the three intervention groups in the assessed physical fitness variables, including upper-body and lower-body strength ($p > 0.05$).

The within-group analysis of physical fitness variables revealed that both pyramid and cluster training methods led to significant improvements in upper-body and lower-body strength ($p < 0.05$). For the drop set training, a significant improvement was observed in lower-body strength ($p < 0.05$), while the increase in upper-body strength was not statistically significant ($p > 0.05$).

Overall, the findings indicate that all three training methods—drop set, pyramid, and cluster—resulted in significant gains in lower-body strength. Additionally, pyramid and cluster training methods were effective in significantly improving upper-body strength. However, the between-group comparison in the post-test did not show any significant differences in upper-body or lower-body strength. Therefore, it can be concluded that there are no statistically significant differences among the three training methods—drop set, cluster, and pyramid —regarding their effects on certain physical fitness parameters in male bodybuilders.

4. Discussion

The results indicated an increase in arm and thigh circumference in all three study groups. Body weight and BMI significantly decreased in the drop set and cluster groups, while the changes in the reverse pyramid traditional training group were not statistically significant. No significant change in body fat percentage was observed in any of the study groups. The analysis of between-group differences revealed no statistically significant differences in any of the evaluated body composition variables in the post-test. Therefore, it appears that all three training methods had a relatively similar effect on body composition variables.

The present study's findings align with those of Ribeiro et al. (2016), Angleri et al. (2017), Mohammadi et al. (2018), Yazdani et al. (2017), and Samson et al. (2018). Ribeiro and colleagues (2018), in a study comparing the effects of drop-set and traditional pyramid training systems on the strength and muscle mass of older women, demonstrated that both training systems were similarly effective in promoting positive adaptations in muscular strength and hypertrophy in the elderly(24). Angleri et al. (2017) compared the effects of Crescent Pyramid (CP) and Drop Set (DS) resistance training with traditional resistance training on dynamic strength (1-RM), cross-sectional area (CSA), pennation angle (PA), and fascicle length (FL). Results showed that all three training methods led to similar improvements in strength, hypertrophy, and muscle architecture, with no significant advantage of CP or DS over the traditional method(14).

Mohammadi et al. (2018) investigated the effects of traditional, pyramid, and reverse pyramid resistance training on strength, endurance, and muscle mass in wrestlers over 12 weeks, with three weekly sessions. Thirty participants were divided into three experimental groups of ten, compared to a control group. Upper body strength was assessed using one-repetition maximum (1RM) tests for biceps curls and jump squats. The results indicated similar improvements in strength, endurance, and muscle mass across both experimental groups(25).

Yazdani et al. (2017) evaluated the comparative effects of a cluster training system on lower body strength in 18 female karate practitioners over nine weeks. The study consisted of three stages focusing on fitness, strength, and explosive power, with the strength protocol applied during the second and third stages. All participants were tested three times—before the study and before the second and third stages—for strength and explosive power. Exercises during the strength phase included squats and jump squats at 80%, 45%, and 25% of 1RM, performed for five repetitions across three to five sets. The results indicated that drop-set training led to improvements in physical fitness; however, no significant changes were observed in strength or explosive power in any of the groups ($p<0.05$)(19).

Samson et al. (2018) conducted a study comparing the effects of cluster versus traditional training systems on lower body strength. Thirty-two men were randomly assigned to two groups of 16 each and trained for seven weeks, with three sessions per week. Each session consisted of eight sets of three repetitions, with 15 seconds rest between sets. The training included half squats, bench press, standing barbell calf raises, leg curls, and shoulder press. A 10-minute warm-up and a 10-minute cooldown including static stretching of upper and lower limbs were performed in each session. Results showed a significant improvement in strength in the cluster training group(7).

However, the findings of the present study contradict those reported by Antonio et al. (2017), Tufano et al. (2016), and Hansen et al. (2011). Antonio and colleagues compared the effects of cluster versus traditional pyramid resistance training on lower body strength in men. The program included eight weeks of strength training followed by three weeks of hypertrophy-focused training, conducted twice weekly. The results revealed that cluster training had a greater effect on enhancing lower body strength compared to traditional pyramid training.

Tufano et al. (2017) investigated the effects of traditional versus cluster resistance training on lower body strength, focusing specifically on the back squat. In this study involving trained men, participants performed three sets of 12 repetitions at 60% of their one-repetition maximum (1RM), four times per week. Rest periods were two minutes between sets for the traditional group and 30 seconds for the cluster training group. The findings demonstrated that cluster training led to greater improvements in strength than the traditional approach(17).

In another study, Hansen and colleagues compared the responses of cluster and traditional training protocols on lower body strength over an eight-week period. The cluster training regimen included front squats and barbell glute bridges in weeks 1–2 (five sets of six reps at 80% to 90% 1RM), back squats in weeks 3–4 (five sets of six reps progressing to three reps at 90% 1RM), box squats and bridges in weeks 5–6 (five sets of six reps progressing to two reps at 95% 1RM), and jump squats and bridges in weeks 7–8 (three sets of three reps at 80% to 85% 1RM). Results showed strength gains in both groups, but cluster training produced a greater increase in participants' strength compared to the traditional method.

The differences in the results obtained in the present study compared to previous research can be attributed to variations in training duration, the number of weekly sessions, and exercise intensity. Additionally, the fitness level of the study population may have also influenced the outcomes.

Regarding the physiological mechanisms behind hypertrophy, it can be stated that the most significant factor in inducing hypertrophy is metabolic stress. Metabolic stress resulting from physical activity arises from the accumulation of metabolites—especially lactate, phosphate, and hydrogen ions. In this context, muscle hypoxia caused by resistance training may enhance metabolite production, thereby potentially contributing to hypertrophic adaptations. However, the idea that hypoxia directly influences the integrity of contractile proteins and thus stimulates hypertrophy remains unclear.

Other factors that may affect anabolism include calcium and electrolytes. Supporting the notion that exercise induces metabolic stress, it has been observed that moderate-intensity training—commonly used by bodybuilders and recognized as the intensity associated with the highest metabolite accumulation—can result in greater metabolic buildup than higher intensities.

Typically, bodybuilders aiming for muscle hypertrophy perform 6 to 12 repetitions per set with relatively short rest intervals, as noted by (1)

Overall, based on the results obtained, it appears that all three training methods had relatively similar effects on improving body composition variables—including weight, BMI, arm circumference, thigh circumference, and body fat percentage—as well as strength-related changes, including upper body and lower body strength.

One of the limitations of this study is the sample size, as well as factors such as gender, uncontrollable variables like heredity, individual differences, and the level of motivation among participants. Future research is recommended to more precisely examine the effects of gender and to include a larger and more diverse sample population, allowing for better control of additional variables. Moreover, extending the training duration and assessing its impact on individuals with varying training backgrounds could lead to more comprehensive and practical results.

5. Conclusion

The findings indicate that all three resistance training methods—drop set, cluster, and pyramid—produced similar effects on body composition and selected physical fitness parameters in male bodybuilders, with no significant differences between the groups.

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