



THE EFFECT OF TRAINING WITH SINGLE AND DOUBLE WEIGHT MACHINES AND EQUIPMENT ON THE MAXIMUM STRENGTH OF THE MUSCLES INVOLVED IN ACHIEVEMENT THE BENCH PRESS FOR ADVANCED POWERLIFTERS

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ABSTRACT

Background. Maximal strength is influenced by several aspects including muscular coordination ability to produce force rapidly and adaptations to specific loads. Weight machines and resistance exercise equipment are popular training modalities among national and international elite-level teams. However, there is a paucity of evidence related to single and double weight machine exercise training in increasing maximal strength among advanced powerlifters. **Objectives.** The aim of the study was to determine and compare the effects of single weight machine and weight training using equipment on maximal muscle strength and bench press performance among advanced powerlifters. **Method.** The study used an experimental-equivalent groups design with pretest–posttest measures. Twenty-four advanced male powerlifters, aged 23–30 years, were recruited from Diwanayah powerlifting team as participants. Sampling was done using stratified random sampling according to the competitors’ weight. Participants were assigned randomly to either the single-weight machine training group (n = 8), double-weight machine training group (n = 8), or control group (n = 8). The control group continued the coach’s regular training program throughout the study. Each intervention group trained three times per week for 8 weeks. Assessment of maximal muscle strength and bench press performance was conducted pre- and post-intervention. **Results.** Results revealed significant improvements in maximal strength and bench press performance in both experimental groups in comparison to the control group. There was a significantly greater increase in maximal strength performance using double weight machines than single weight machines. **Conclusion.** Resistance exercise programs using single and double weight machines enhanced maximal strength and bench press performance among advanced powerlifters. Findings provide evidence-based recommendations regarding strength training specificity among elite powerlifting competitors and support increased accuracy when programming by training modality.

Keywords; single weights, double weights, maximum strength, bench press, powerlifters.



A. INTRODUCTION

The continuous development of modern training methods has helped many athletes achieve record-breaking results in numerous sporting events. The variety of training equipment and tools has a significant impact on increasing athlete development because the design and manufacture of these devices are based on scientific study and expertise. These devices and tools target the muscles actively involved in performing the motor tasks of sporting events. This aligns with AragonVargas et al., (2008), who stated that the use of training methods and techniques similar to actual performance directly affects the development of physical fitness components. This is evident when the training is highly specialized and closely matches the required skill performance. The use of the muscles involved in the required motor performance has a real impact on the speed of motor learning and, consequently, on developing the level of skill and technical performance in the specific sport practiced (Abade et al., 2019; AragonVargas et al., 2008).

Since the bench press relies on maximum force to lift the weight, it requires muscular balance on both sides of the body, especially the muscles involved in the exercise (García-Ramos et al., 2021; Nobari et al., 2021). This balance is crucial for creating muscular equilibrium during both extension and flexion. Any imbalance in lifting or lowering the weight can lead to poor performance, potentially causing failure and loss for the athlete. Therefore, this study is essential to enable athletes to achieve higher levels of performance. It necessitates finding equipment, tools, and training methods that enhance the physical and technical aspects of the exercise and subjecting them to experimentation and study to determine the impact of experimental variables on the research sample (Suniga et al., 2025).

This highlights the need for equipment that helps athletes reduce muscular imbalances between the right and left sides, particularly in the arms. Because bench press training typically uses single-weight equipment like barbells or dumbbells, this does not provide true balance between the sides, potentially leading to one side dominating the other (Bompa & Buzzichelli, 2015). Therefore, it's necessary to experiment with dual-weight equipment such as cable machines and chest and shoulder machines that utilize equal strength from both sides (right and left). Most players suffer from a weakness in maximum strength in one of the limbs, which causes a decrease in the player's level and achievement in lifting heavy

weights. Therefore, the two researchers consider that there is a problem that must be addressed by developing a study that determines the best use of single and double weight machines and their positive impact on achievement (Abdullah & Abdullah, 2025). Hence, the importance of the study lies in developing appropriate solutions for coaches in their training programs in the future to raise the levels of their players.

Research objective is to identify the significant differences between the three groups in the pre-test and post-test, as well as the post-test, in the variables of maximum strength and bench press performance among advanced powerlifters.

B. METHOD

Participant

The researchers defined their research population as the players of the Diwaniyah Governorate's physical strength team, totaling (24) players from different weight categories and aged (23-30) years. The research sample was selected using stratified random sampling, given the population's diverse weight categories, and divided into three groups: a control group, a first experimental group, and a second experimental group. Each group consisted of (8) players. The mean weight and its deviations were (67.45 ± 4.8), while the mean age and its deviations were (26.5 ± 3.72), and the mean training age and its deviations were (5.15 ± 2.3). Equivalence was established for the three control groups and the first and second experimental groups in terms of the study variables, as shown in Table (1). The p-value (sig) was greater than (0.05), indicating that the groups were equivalent in the research variables.

Table 1. Equivalence of The Three Groups

Variables		Sum of Squares	df	Mean Square	F	Sig.
Beach Press	Between Groups	14.083	2	7.042	.313	.735
	Within Groups	472.875	21	22.518		
	Total	486.958	23			
Triceps	Between Groups	20.333	2	10.167	.393	.680
	Within Groups	543.000	21	25.857		
	Total	563.333	23			
Biceps	Between Groups	27.083	2	13.542	.460	.638
	Within Groups	618.750	21	29.464		
	Total	645.833	23			
Chest	Between Groups	6.250	2	3.125	.049	.952
	Within Groups	1341.750	21	63.893		
	Total	1348.000	23			
Shoulders	Between Groups	12.583	2	6.292	.368	.696
	Within Groups	358.750	21	17.083		
	Total	371.333	23			

Table 1. Statistical Description of the Main Research Sample in the Homogeneity Variables

Variable	Unit of Measurement	Mean	Median	Standard Deviation	Skewness Coefficient
Chronological age	Year	20.43	20.00	1.52	0.28
Training age	Year	4.67	4.50	1.21	0.14
Height	cm	178.53	178.00	5.68	0.31
Weight	kg	86.27	85.50	7.43	0.32
Digital performance	m	52.18	52.00	4.87	0.12

Research Design

The researchers used the experimental method with a pre-test and post-testing approach using equivalent groups. On June 4-5, 2025, at 4:00 PM, the researchers conducted a pre-test on the studied research variables in the 360 Gym, a facility specializing in bodybuilding and strength training. The three groups were trained using single-weight machines and equipment. The first experimental group received training using double-weight machines and equipment, while the second experimental group received training using double-weight machines. The control group continued with the trainer's program. The training program ran from June 8, 2025, to July 31, 2025, for eight weeks, consisting of three training sessions on Sundays, Tuesdays, and Thursdays. The training targeted core strength in bench press exercises with an intensity ranging from 80-100% of 1RM, with repetitions of 1-6 and sets of 3-4, with sufficient rest periods to allow the athletes to perform the exercise effectively. After the training period, a post-test, similar to the pre-test and under comparable conditions, was conducted on August 3-4, 2025.

Tests Used in the Research

The following are exercises used based on previous research studies.

1. Shoulder Press Maximum Strength Test. To measure the maximum strength of the shoulder muscles (Ali Emad, 2025).
2. Chest Press Maximum Strength Test (Ali Emad, 2025). To measure the maximum strength of the chest muscles (Ali Emad, 2025).
3. Biceps Press Maximum Strength Test (Nautilus). To measure the maximum strength of the biceps muscle (Ali Emad, 2025).
4. Triceps Press Maximum Strength Test. To measure the maximum strength of the triceps muscle (Ali Emad, 2025).

5. Bench Press Performance Test To measure the athlete's maximum performance in the bench press (Alawi & Radwan, 1994).

Data Analysis

To determine the impact of the training on the three groups and identify the most advantageous group among them, statistical analyses using one-way ANOVA were employed'.

C. RESULTS AND DISCUSSION

Results

As seen from Table 2, there were no significant differences between pre-test and post-test results of bench press strength, biceps strength, and chest strength ($p > 0.05$). While the variables of triceps strength and shoulder demonstrated significance ($p = 0.040$ and 0.026), only minimal strength development was seen from the control group that trained using the traditional program.

According to Table 3, there was a significant difference between the pre-test and post-test scores of bench press strength and shoulder strength ($p = 0.033$ and 0.004). All other variables displayed improvements; however, they were not significant ($p > 0.05$).

Table 2. Differences In Study Variables In Pre-Test And Post-Test For Control Group.

Variables	Paired Differences					T	Df	Sig.
	Mean	Std.d	Standard Error	95% Confidence Interval of the Difference				
				Lower	Upper			
BeachPress - BeachPresst	-5.62500-	7.28869	2.57694	-	.46850	-2.183	7	.065
Triceps - Tricepst	-3.87500-	4.35685	1.54038	-7.51742	-.23258	-2.516	7	.040
Biceps - Bicepst	-.62500-	1.76777	.62500	-2.10289	.85289	-1.000	7	.351
Chest - Chestt	-4.12500-	6.01041	2.12500	-	.89983	-	7	.093
Shoulders - Shoulderst	-3.50000-	3.50510	1.23924	-	-.56966-	-	7	.026
				6.43034-		2.824-		

Table 3. Differences In Study Variables In Pre-Test And Post-Test For First Experimental Group.

Variables	Paired Differences					T	df	Sig.
	Mean	Std. Deviation	Standard Error	95% Confidence Interval of the Difference				
				Lower	Upper			

BeachPress - BeachPresst	-5.00000	5.34522	1.88982	-9.46872-	-.53128-	-2.646-	7	.033
Triceps - Tricepst	-5.00000	7.07107	2.50000	-10.91156-	.91156	-2.000-	7	.086
Biceps - Bicepst	-2.50000	5.34522	1.88982	-6.96872-	1.96872	-1.323-	7	.227
Chest - Chestt	-7.87500	10.64274	3.76278	-16.77255-	1.02255	-2.093-	7	.075
Shoulders - Shoulderst	-6.12500	4.08613	1.44466	-9.54109-	-2.70891	-4.240-	7	.004

Table 4 illustrates that there was a significant difference between the pre-test and post-test scores of bench press strength and shoulder strength ($p = 0.033$ and 0.004). All other variables improved; however, they were not significant ($p > 0.05$).

Table 4. Differences In Study Variables In Pre- And Post-Tests For Second Experimental Group.

Variables	Paired Differences				T	df	Sig.	
	Mean	Std. Deviation	Standard Error	95% Confidence Interval of the Difference				
				Lower				Upper
BeachPress - BeachPresst	-5.00000-	5.34522	1.88982	-9.46872-	-.53128-	-2.646-	7	.033
Triceps - Tricepst	-5.00000-	7.07107	2.50000	-10.91156-	.91156	-2.000-	7	.086
Biceps - Bicepst	-2.50000-	5.34522	1.88982	-6.96872-	1.96872	-1.323-	7	.227
Chest - Chestt	-7.87500-	10.64274	3.76278	-16.77255-	1.02255	-2.093-	7	.075
Shoulders - Shoulderst	-6.12500-	4.08613	1.44466	-9.54109-	-2.70891	-4.240-	7	.004

Table 5. Post-Test Shows Three Groups

Variables		Sum of Squares	Df	Mean Square	F	Sig.
Beach Press	Between Groups	108.333	2	54.167	3.033	.070
	Within Groups	375.000	21	17.857		
	Total	483.333	23			
Triceps	Between Groups	156.583	2	78.292	1.941	.169
	Within Groups	847.250	21	40.345		
	Total	1003.833	23			
Biceps	Between Groups	264.583	2	132.292	3.198	.061
	Within Groups	868.750	21	41.369		
	Total	1133.333	23			
Chest	Between Groups	352.083	2	176.042	1.784	.192

	Within Groups	2071.875	21	98.661		
	Total	2423.958	23			
Shoulders	Between Groups	105.333	2	52.667	2.276	.127
	Within Groups	486.000	21	23.143		
	Total	591.333	23			

Table 5 displays the results of a one-way ANOVA comparing the difference in strength between all three groups after the training program. There were no statistically significant differences between any of the groups

When observing Table 6, there is a statistically significant difference between Group 1 and Group 3. This implies that Group 2 had better results than group 1 in terms of bench press strength and biceps strength ($p < 0.05$). There were no other statistically significant differences.

Table 6. Differences Between Three Groups In Post-Test

Dependent Variable	(I) Groups	(J) Groups	LSD				95% Confidence Interval	
			Mean Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound	
Beach Press	1.00	2.00	-1.25000-	2.11289	.560	-5.6440-	3.1440	
		3.00	-5.00000-*	2.11289	.028	-	-6.060-	
	2.00	1.00	1.25000	2.11289	.560	9.3940-	5.6440	
		3.00	-3.75000-	2.11289	.090	3.1440-	.6440	
		3.00	1.00	5.00000*	2.11289	.028	8.1440-	9.3940
			2.00	3.75000	2.11289	.090	-.6440-	8.1440
Triceps	1.00	2.00	-3.37500-	3.17590	.300	-9.9796-	3.2296	
		3.00	-6.25000-	3.17590	.062	12.8546	.3546	
	2.00	1.00	3.37500	3.17590	.300	-	9.9796	
		3.00	-2.87500-	3.17590	.376	3.2296-	3.7296	
		3.00	1.00	6.25000	3.17590	.062	9.4796-	12.8546
			2.00	2.87500	3.17590	.376	-.3546-	9.4796
Biceps	1.00	2.00	-4.37500-	3.21594	.188	3.7296-	2.3129	
		3.00	-8.12500-*	3.21594	.020	11.0629-	-	
	2.00	1.00	4.37500	3.21594	.188	14.8129	1.4371-	
		3.00	-3.75000-	3.21594	.257	-	11.0629	
		3.00	1.00	8.12500*	3.21594	.020	2.3129-	2.9379
			2.00	3.75000	3.21594	.257	10.4379	-
					1.4371	14.8129		
					-	10.4379		
					2.9379-			

Chest	1.00	2.00	-5.00000-	4.96640	.326	15.3282-	5.3282
		3.00	-9.37500-	4.96640	.073	19.7032	.9532
	2.00	1.00	5.00000	4.96640	.326	-	15.3282
		3.00	-4.37500-	4.96640	.388	5.3282-	14.7032
	3.00	1.00	9.37500	4.96640	.073	-	19.7032
		2.00	4.37500	4.96640	.388	-	14.7032
Shoulders	1.00	2.00	-1.50000-	2.40535	.540	5.9532-	3.5022
		3.00	-5.00000-	2.40535	.050	-6.5022-	10.0022
	2.00	1.00	1.50000	2.40535	.540	-	3.5022-
		3.00	-3.50000-	2.40535	.160	-	6.5022
	3.00	1.00	5.00000	2.40535	.050	8.5022-	1.5022
		2.00	3.50000	2.40535	.160	-	10.0022
					-	8.5022	
					1.5022-		

*. The mean difference is significant at the 0.05 level.

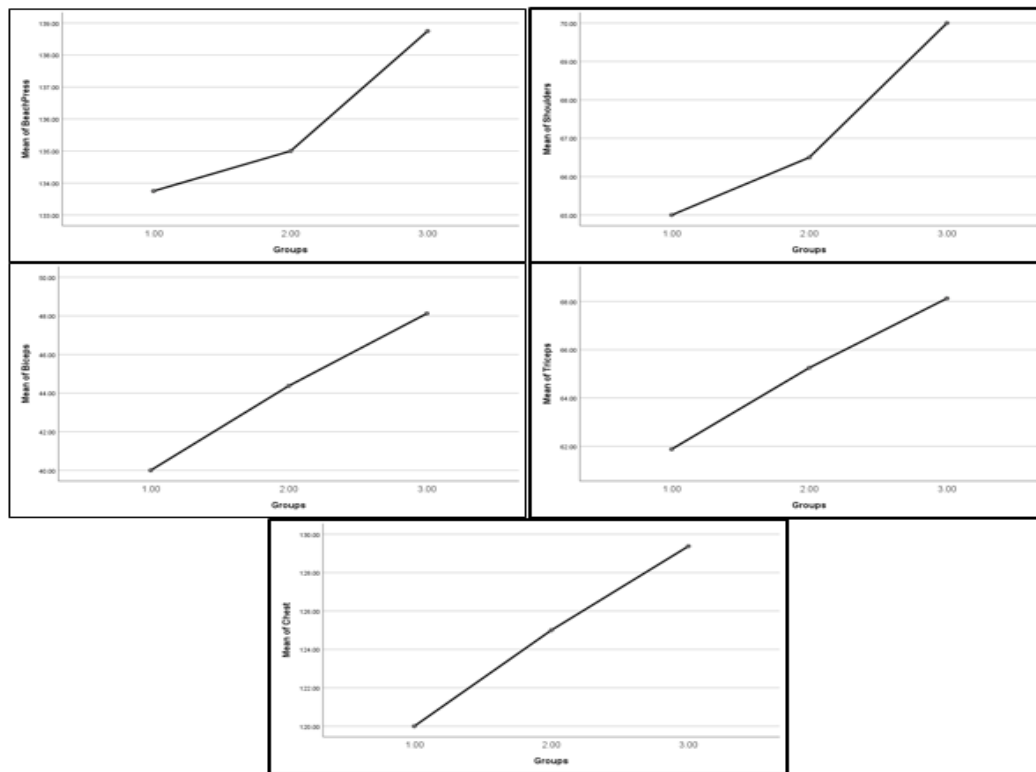


Figure 1. Research Results Graph

Figures (1) show the graph of the studied dependent variables and the extent of development achieved in the post-test for the three groups (control (1), first experimental (2), and second experimental (3)). Statistical analysis of the data extracted from the three

groups reveals the superiority of the second experimental group compared to the first experimental group and the control group. While no significant differences were found in most of the studied variables, this is due to the development observed in all three groups, albeit at different rates. This is illustrated by the five graphs, which demonstrate the superiority of the second experimental group over the other two.

Discussion

The researchers attribute this to the nature and quality of the training provided, the use of appropriate training loads tailored to the skill level of the research sample, and consideration of individual differences among the athletes. This was achieved by determining the strength requirements for each athlete and providing suitable rest periods between exercises. Furthermore, the use of dual-weight equipment ensures equal strength during performance, unlike single-weight performance. In other words, the more training aligns with the nature and form of performance, the greater its impact on achievement.

This aligns with the findings of Pratiwi et al., (2018), who stated that using training exercises that are consistent in their execution with the general form of specialized skills leads to better results in strength acquisition. This also reflects the development Not only did the second experimental group, as well as the first, show improvement in maximum strength and bench press performance, but the superiority of the two-weight group had the greatest impact. This was due to the type of exercises that matched the movement of the lift, thus stimulating a greater number of muscle fibers (Wang et al., 2024; Wiesinger et al., 2021). This was achieved through the equipment used by the athlete during the exercises, which increased neural stimulation and positively impacted the maximum strength of the main muscles involved in the bench press (de Paulo et al., 2019; García-Ramos et al., 2021; Haugen et al., 2023).

As the researchers state, exercises involving changes in resistance intensity contribute to raising the level of neural stimulation and increase the efficiency of the muscular system in producing force (Suniga et al., 2025). The researchers believe that this improvement is due to the effectiveness of the two-weight training, which focused on developing the maximum strength of the upper limb muscles actively involved in the performance (Amara et al., 2021; Schwarz et al., 2019). This helped the athlete generate equal maximum force in both arms because increasing the muscular strength of the muscles involved in the

movement leads to increased motor control and precision in high-intensity exercises (Sinulingga et al., 2024; Suryadi et al., 2024).

Furthermore, focusing on key muscles such as the chest, shoulders, biceps, and triceps was crucial in the extension and flexion of the weight during the lift. The researchers concluded that coordination the relationship between training style and skill performance style is one of the most prominent factors influencing the development of athletes' functional strength (Muratori et al., 2013). The development of these muscles has positively impacted the improvement of bench press performance significantly, which is the main objective of the study and its overall effectiveness (Saniah et al., 2024).

Performance improves better if training is specific to the type of activity performed, includes the most important working and opposing muscles in that activity, and develops them in the same way they are used in competition (Lundeberg et al., 2018; Ouergui et al., 2020). The main goal of this research, and most research in physical education and sports science, is to achieve performance. This is the goal we strive for as researchers, as well as for stakeholders, since the aim of the training process is to reach the best methods that improve the athlete's performance level, considering that performance is the focus of the training process (Ian Taylor & David Vear, 1998).

Study Limitations

There are few limitations to point out in this study. First, as aforementioned, our sample was relatively small and included only advanced powerlifters training at the same training center. This sample may not be representative of other training backgrounds, competitive levels, or training facilities. Second, we only observed improvements in performance over eight weeks of training. Longer-term interventions are needed to better understand the chronic effects of different frequencies on maximal strength and neuromuscular responses to training. Third, we tried our best to keep training variables constant between groups; however, we did not control recovery, nutrition, or training history which could have been confounding variables. Fourth, this study was primarily designed to assess maximal strength outcomes and we did not collect biomechanical, neuromuscular, or physiological data that could have explained some of the performance improvements that were seen. Lastly, we only

used one post-hoc test to determine differences between groups and did not report effect sizes.

D. CONCLUSION

The results from this study have shown that single and double weight machines help to improve maximal strength levels and bench press performance in advanced powerlifters. When looking at each training variable, double weight machines had greater strength improvements than single weight machines and traditional training methods. Training that focuses on key muscles involved in the bench press as well as follows proper lifting technique will allow for greater performance. Additionally, when manipulating variables with double weight machines you should vary and include both sides to stimulate muscle fibers in the right and left. The study adds to the current body of research by giving an example of experimentation of single vs. double weight machine use among elite powerlifters. Also, this study can add on to current research by showing one type of resistance training that can be done using machines. The take away from a theoretical standpoint is that bilateral loading can produce greater strength adaptations among advanced athletes. The take away from this study for the practical application is that strength and conditioning coaches can implement this information into their training programs when looking to help athletes improve their maximal strength on the bench press. By using double weight machines as well as manipulating different variables coaches can not only help their athletes get stronger, but can help decrease strength imbalances. This information can be used in elite training facilities to assist in advanced powerlifters' performance.

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F. AUTHOR CONTRIBUTION STATEMENT

Wissam Yasseen Burhan & Majid Abdul Hameed Rasheed played a role in finalizing the script

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