

The Effects of Unilateral and Bilateral Lifting Techniques on Unilateral and Bilateral Strength in Untrained Women

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ABSTRACT

Strength training techniques vary when it comes to gaining strength. When strength training bilaterally, there is a possibility of the stronger limb overcompensating for the weaker limb. If this occurs it inhibits the weaker limb from getting stronger. Ten untrained college aged women participated in this study to compare the benefits of unilateral vs. bilateral strength training. The 10 women were tested to obtain a maximum weight lifted. A predicted maximum chart was used to establish a one repetition maximum. The 10 women were split into two equal groups. One group lifted using unilateral strength training techniques which involves isolating and exercising one limb at a time. The other group strength trained using bilateral strength training techniques which involves exercising both limbs simultaneously. For 6 weeks each participant completed a specific workout regimen 2-3 times a week. The results of this study indicate that there is a statistically significant difference when training each bicep unilaterally, and the right tricep. (P-values equals .003 for unilateral right bicep and unilateral left bicep $<.001$) T-tests were used in the analysis of this data. The right tricep values were analyzed using a Mann-Whitney Rank Sum Test. (p-value was .040) Although all the other exercises showed a greater improvement for unilateral group, the results were not statistically significant.

Keywords: *Unilateral Strength Training, Bilateral Strength Training*

INTRODUCTION

There are many physiological benefits to strength training for women including increasing muscular strength, (Brown & Harrison, 1986) and lean body mass (Chilibeck, Calder, Sale & Webber, 1998) in young and middle aged women.

There are many different techniques that can be used when attempting to gain muscle strength through resistance and weight training. When training muscles bilaterally, such as exercises similar to bench press and leg press, there is a possibility of a bilateral strength deficit. Bilateral strength deficit (BLD) refers to a decrease in the strength of a muscle group when the contra-lateral limb is concurrently performing a maximal contraction, which involves the stronger limb overcompensating for the weaker limb.

Earlier studies of BLD found that movements using two joints during an exercise (leg press: hip and knee; bench press: shoulder and elbow) often demonstrate a BLD. Other exercises, such as the leg extension, typically do not. (Janzen, 2006) In Janzen's study the unilateral and bilateral groups increased in strength, but there was no significant difference between training groups due to high variability.

In J.J. Summers (2007) study of "Bilateral and unilateral movement training on upper limb function in chronic stroke patients" subjects were randomly assigned to either the unilateral training or bilateral training. The bilaterally trained subjects demonstrated a pre-test and post-test improvement on each section of the test (which involved upper arm function, hand movement, and advanced hand

activities.) There was no evidence of improvement in the unilaterally trained group. The result of this study proposes that bilateral actions may be effective in improving the recovery of upper limb motor function in chronic stroke patients.

The purpose of this study is to determine if unilateral or bilateral weight training is more effective in gaining strength in a 6 week period of time in untrained women.

MATERIALS AND METHODS

The materials used for this experiment were a measuring tape, weight scale, and McPherson College weight room equipment. A workout program for each group was constructed with a personal trainer. Ten women who were not already participating in a weight lifting regimen were randomly assigned to two equal groups. The unilateral group completed exercises in which each limb was isolated and exercised. The bilateral group completed exercises that incorporated both limbs simultaneously. The exercises in each group were related and similar to each other. Before the exercise program was introduced, the following measurements were taken: resting heart rate, weight, height, and girth of each extremity.

The maximum weight lifted unilaterally and bilaterally was measured for the following exercises:

bench press, squat, leg extension, leg curl, bicep curl, and overhead triceps extension. The heart rate of each participant was taken before testing began. Weight and height also was measured before testing

began. Dumbbells were used in the measurement of unilateral biceps, overhead triceps extension and bench press. A standard 45 pound bar was used for bilateral bench, squat, and also the unilateral squat. The unilateral squat was done by performing a static lunge and was done for each leg. The bilateral and unilateral test for leg extension and leg curl participants used a leg extension/leg curl machine and added weight as desired.

Before and after measurements of the maximum weight lifted were done in the same location with the same equipment. However, some participants were tested with others present and others were tested alone. Prior to obtaining the maximum weight lifted the participants were encouraged to stretch and given the opportunity to warm up with weight, if desired. To ensure proper technique each participant was given a demonstration of each exercise. The participants completed each exercise with as much weight as they could, as many times as they could, not exceeding twelve repetitions. A predicted maximum chart (NSCA) takes the amount of weight lifted and was divided by a decimal that is associated with the number of repetitions completed to determine the maximum weight lifted. Using a predicted maximum chart to establish a one repetition maximum was done to maintain the safety of the participants; none of the women were accustomed to lifting weights the possibility of injury is possibly greater. All the measurements were taken during the same session, and were done in the same order for each participant. Following the measurements, participants were then shown the proper techniques for each strengthening exercise according to each participant's specific workout regimen. Pictures and descriptions were provided for participants to refer to.

The participants each accomplished the specific work out 2-3 times a week for a six week period. They had sheets to fill in each time they went to work out; this was done in order to keep track of each individual's progress. Following the six week period the participants were tested again in the same manner as the measurements done prior to the workout regimen.

RESULTS

Analysis of this data was done on the computer program for Sigma Stat. TM At first glance the unilateral weight lifting group seems to show a greater improvement. Three exercises showed a statistically significant difference: the unilateral right bicep curls, unilateral left bicep curl and the unilateral left overhead tricep extension did demonstrate a statistically significant difference. (See Table 1) One of the participants from the bilateral group dropped out of the study therefore only 4 participants were measured. For the unilateral right bench press,

and the unilateral right triceps extension the Mann-Whitney Rank Sum Test showed that the difference. For the fifteen other exercises a t-test was administered to compare the change difference in each group. Each sampling group was small may have contributed to the variability.

The unilateral group showed a greater improvement in all exercises except the bilateral overhead triceps extension on a 95% confidence level. (See tables 2 and 3) The bilateral group showed an improvement in six of the eighteen exercises measured on a 95% confidence level. In addition the general trend of the unilateral group seemed to have a more consistent improvement.

Table 1. Compares the difference of the means or medians between the unilateral group vs. bilateral group.

	ΔUnilateral	Standard	ΔBilateral	Standard	
	Group	Deviation	Group	Deviation	P-Value
Bilateral Bench Press**	24.0	N/A	15.0	N/A	0.556
Unilateral Right B.P.**	10.0	N/A	3.5	N/A	0.111
Unilateral Left B.P.	6.4	4.8	4.0	4.5	0.469
Bilateral Squat	58.4	21.0	46.0	9.4	0.313
Unilateral Right Squat	49.8	16.6	33.3	23.6	0.255
Unilateral Left Squat	51.4	19.0	35.0	20.0	0.248
Bilateral Leg Extension	58.6	23.8	36.3	44.3	0.426
Unilateral Right L.E.	25.2	7.9	17.5	11.3	0.266
Unilateral Left L.E.	21.6	12.6	16.0	8.9	0.458
Bilateral Leg Curl	15.0	9.9	13.8	11.5	0.866
Unilateral Right L.C.	12.8	5.9	6.8	7.3	0.210
Unilateral Left L.C.	12.6	5.3	7.3	9.0	0.300
Bilateral Tricep Extension	7.0	8.6	7.0	10.2	0.926
Unilateral Right T.E.**	5.0	N/A	3.5	N/A	0.286
Unilateral Left T.E.	6.2	5.5	3.3	8.1	0.040*
Bilateral Bicep Curl	15.8	5.5	14.5	8.1	0.781
Unilateral Right B.C.	11.6	2.3	3.8	3.1	0.003*
Unilateral Left B.C.	13.0	3.2	3.0	1.8	<0.001*
**Median					
*S.D. is below <.05					

Table 2. Compares the difference in each exercise using a paired t-test of the bilateral lifting group.

	Bilateral Group	
	T-Value	P-Value
Bilateral		
Bench	-2.63	0.08
Squat	-9.80	0.00
Leg Extension	-1.77	0.18
Leg Curl	-2.38	0.10
Tricep	-1.37	0.26
Bicep	-3.58	0.04
Unilateral RIGHT		
Bench	-1.56	0.22
Squat	-2.82	0.06
Leg Extension	-3.10	0.05
Leg Curl	-1.84	0.16
Tricep	-12.12	0.00
Bicep	-2.42	0.09
Unilateral LEFT		
Bench	-1.76	0.18
Squat	-3.51	0.04
Leg Extension	-2.55	0.08
Leg Curl	-1.60	0.21
Tricep	-10.00	0.01
Bicep	-3.29	0.05

Table 3. Compares the difference of each exercise using a paired t-test on the unilateral lifting group.

	Unilateral Group	
	T-Value	P-Value
Bilateral		
Bench	-12.52	0.0002
Squat	-6.23	0.0033
Leg Extension	-5.51	0.0053
Leg Curl	-3.38	0.0270
Tricep	-1.99	0.1180
Bicep	-6.48	0.0020
Unilateral RIGHT		
Bench	-3.81	0.0188
Squat	-6.70	0.0026
Leg Extension	-7.14	0.0020
Leg Curl	-4.86	0.0082
Tricep	-5.66	0.0047
Bicep	-11.27	0.0004
Unilateral LEFT		
Bench	-2.99	0.0401
Squat	-6.06	0.0037
Leg Extension	-5.42	0.0056
Leg Curl	-5.30	0.0061
Tricep	-7.75	0.0014
Bicep	-8.97	0.0009

DISCUSSION

Table 1 indicates that the unilateral group showed a greater improvement in the maximum weight lifted. This possibly could be evidence that unilateral training may be more efficient in gaining strength than training bilaterally. In order for the data to have shown a significant difference the sample group must have consisted of approximately 60 members in each group. The measurements of the weight, resting heart rate and the girth of the extremities showed no variability.

Modifications to this study for future research would be to increase the number of participants in each group. The overhead triceps extension should be performed on a machine rather than using free weight, because it was difficult for the participants to accomplish the unilateral triceps extension. Unilateral and bilateral bench press could be measured using the Smith Machine because it may be easier to perform unilateral bench press versus using free weights. For attaining the squat measurements a leg press may be less demanding than the static lunges. Using the same leg extension machine with a hip belt may show better results. Another option would be to perhaps focus on fewer exercises; it is difficult to get participants to participate with such a demanding time commitment to complete the workouts. Also testing over a three day period (bilateral one day, wait two days for soreness to disappear then test unilaterally) in order to give muscles time to rest may be beneficial to the participant.

In conclusion, to increase strength in the biceps, perform exercises unilaterally which isolates and targets the specific muscle group. Unilateral training may be more effective when training for strength overall.

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