

# Effect of acute detraining following two types of resistance training on strength performance and body composition in trained athletes

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## Abstract

The purpose of this study was to investigate the effects of short-term detraining after two different protocols of resistance training on maximal strength and body composition in trained men. Participants were 30 male student athletes who were divided into two experimental groups. Group (I) performed resistance training with a low intensity and high volume (LIHV) and group (II) low volume and high intensity (HILV) for six weeks and then experienced 2 weeks detraining. Subjects were evaluated three phases in pretest, posttest, and end of the detraining period. Results demonstrated that after six weeks of resistance training enhanced significantly maximal strength while Body Mass Index (BMI) and percent of body significantly decreased in both groups. However, after two weeks of detraining, maximal strength significantly decreased in all of movements but BMI and percent of body significantly increased in both groups. Nevertheless, maximal strength in all of movements remained significantly higher than pre-exercise levels in both groups. BMI had no meaningful differences with pre-exercise values in both groups, and percent of body fat remained significantly lower than pre-exercise values, only in group (I). However significant differences were not seen between two groups after training and detraining periods but based on data it could be suggested that detraining related strength losses develop less followed HILV protocol.

**Keywords:** Resistance training, modality of training, body composition, detraining.

## INTRODUCTION

The subject which should be considered by coaches and athletes is the principle of training reversibility or loss of training-induced adaptations in response to detraining. There are some elements of exercise involving power, velocity, rate, complexity, and range of motion by which could identify individual capabilities and physiological components such as strength, speed, endurance, flexibility and coordination (1). Reinforce these environmental features of locomotors for a successful performance among athletes is very important and creates the main tasks of coaches and athletes under different seasons. Therefore, stoppage or significant reduction of training leads to a partial or complete reversal of training-induced adaptations, thus compromising athletic performance (13). Research have been shown that a 6 to 7% reduction in  $VO_2\max$ , arterial-venous oxygen differences, hemoglobin concentration, enzymatic activities and blood volume only following one

week bed rest while a highly trained athlete may experience it after four to eight weeks training cessation (1).

Fatouros et al. (3) after 24 weeks with two intensity strength protocols [low intensity training (LIST 55%1RM), or high intensity training (HIST 82% 1RM)] followed by a 48 week detraining period demonstrated that all training induced gains in the LIST group had been canceled after four to eight months of detraining, whereas in the HIST group strength and mobility gains were maintained throughout detraining. However, anaerobic power had returned to baseline levels after four months of detraining in both groups. Therefore, they suggested that higher intensity training may sustain the gains for more prolonged periods after training ceases.

Lovell et al. (11) examined the effect of short-term strength and detraining types on maximal force and rate of force development in older men and found that high intensity strength training could increase maximal force and rate of force

development in older men. Nevertheless, they stated that during periods of inactivity neuromuscular gains are quickly lost (7,18).

According to the data reported in the exercise science literature, the effects of training cessation on adaptations resulted from endurance training appear to be clear more than strength training induced changes because the oxidative energy system declines much more rapidly (19). Therefore, due to the limited evidence available for the effect of detraining on strength training with different intensity and volume, the main aim of present study was to determine the influences of short term detraining after two kinds of resistance training on strength performance and body composition in trained athletes.

## MATERIAL AND METHODS

### Participants and Training phases

Thirty healthy men students recruited from Razi University of Kermanshah were divided into two experimental groups as follows: group (I) performing resistance training with low intensity and high volume (GRI: n=15), weight 73.7±10.3 kg, height 174.5±7.5 m and age 24.7±1.4 years old and group (II) performing low volume and high intensity (GRII: n=25), weight 63.2±6.2, height 175.8±5.5 and age 25.4±1 (years old). First, a written consent form was signed by all participants and then they attended physical education classes for six weeks/three times a week, with duration of 45-60 min each session. Each training session involved three phases in both groups and lasted 50–60 minutes: warm up, specific or related training and cool down. Warm up and cool down phases were similar in both groups included 7 min running with intensity sufficient to raise breath rate, 3 min stretching training. Difference in the specific training between two experimental groups was designed corresponding to characteristics of each group. Specific program were included bench press, squat, arm curls, triceps, biceps and shoulder press which

exerted as circuit training workouts with 60 to 90 seconds rest between each. Subjects performed 12–15 maximal repetitions/set (55–60% 1RM) in group I, low intensity and high volume (LIHV protocol), and 5 maximal repetitions/set (85–90% 1RM) in the group II, low volume and high intensity (HILV protocol) (Table1). 1RM was retested in the end of every week so that resistance could be adjusted properly.

### Detraining phase

After completion of the strength training program by the two groups, subjects in the both experimental groups were instructed to resume their normal lifestyle and prevent any type of systematic exercise for two weeks (training stoppage). During detraining, subjects were asked to continue their dietary and avoid using vitamins and supplementations and also not engaged in regular exercises.

### Statistical analysis

Means (SD) were calculated. Repeated measures multivariate analysis of variance was performed on each dependent variable to detect differences in each group for each time point. When F ratios were significant, we used t test to compare time effect. Significance was accepted at  $p < 0.05$ .

## RESULTS

There were no differences among the groups with respect to age, height, and weight level at baseline (Table 2). All subjects in both groups exhibited significant development in strength performance in all movements. Moreover, body mass index and body fat percent was also significantly decreased. Data revealed that following two weeks detraining, strength similarly decreased and body composition enhanced meaningfully in both groups. Indeed, within group differences were seen whereas between group differences were not found.

Table 1. Design of training program performed by two groups.

	Sets	Reps	Rest interval between circuits	Rest interval between sets	Intensity
LIHV	3	12-15	60-90 seconds	2-3 min.	55-60% 1-RM
HILV	5	5	60-90 seconds	2-3 min.	85-90% 1-RM

LIHV: resistance training with low intensity and high volume. HILV: resistance training with low volume and high intensity  
Reps: repetition. min.: minutes. 1-RM: one repetition maximum

Table 2. Changes in body mass index, body fat percent and strength performance in both groups in pre-post training and detraining.

Variable	Group	Pre test	Post test	Detraining	Post-test to pre-test	Detraining/ Post-test	Detraining/ Pre-test
Maximum bench press strength(kg)	HILV	88±19.07	100.2±18.27	91.2±17.92	0.001	0.001	0.007
	LIHV	86.67±14.1	96.6±15.26	88.67±14.69	0.002	0.001	0.046
Maximum lateral raises(kg)	HILV	61.53±10.04	72.8±10.5	64.93±9.08	0.001	0.001	0.030
	LIHV	55.13±9.94	65±10.58	56.87±10.35	0.001	0.001	0.063
Maximum one arm row(kg)	HILV	63±13.6	77.2±12.67	69.4±11.66	0.003	0.002	0.001
	LIHV	61.33±11.72	70.8±11.79	64.4±10.99	0.001	0.002	0.011
Maximum squat strength(kg)	HILV	101.33±21.07	120.07±87	108.8±19.36	0.001	0.001	0.001
	LIHV	101.67±20.24	114.60±20.45	105.93±19.73	0.002	0.001	0.004
Maximum biceps strength(kg)	HILV	55.68±9.98	66.93±10.86	58.2±9.23	0.001	0.002	0.036
	LIHV	51.27±12.08	61.07±10.82	54.07±10.89	0.001	0.001	0.030
Maximum triceps strength(kg)	HILV	64±10.39	76.8±13.47	68.8±15.16	0.003	0.001	0.008
	LIHV	59±12.85	68.2±12.95	60.4±13.52	0.001	0.001	0.354
BMI (kg.m <sup>-2</sup> )	HILV	23.3±2.91	22.56±2.69	23.08±3	0.001	0.016	0.066
	LIHV	22.45±2.45	21.3±2.79	22.23±2.35	0.002	0.008	0.105
Body fat%	HILV	11.91±3.81	10.59±3.72	11.47±3.78	0.001	0.001	0.055
	LIHV	12.15±3.7	9.73±3.12	11.27±3.37	0.001	0.001	0.001

## DISCUSSION

During periods of insufficient training stimulus, detraining happens that may cause partial or complete declines in athlete's capabilities and performances (14). Detraining induces strength losses which may be depending on many factors such as different training duration and cessation period, frequency, exercises selected, and training status of the subjects (17). The effects of detraining in athletes and non-athletes have not been clearly established and results have been reported contradictory in the literature (10). Recent evidence indicates that LIHV exercise can increase aerobic power, energy expenditure, enzymatic activity and fat loss (7) whereas HILV exercise results in muscle hypertrophy, strength improvement, decreased body fat percent, basal metabolism enhancement, and glycogenolysis (1) but the problem is the detraining effects upon each of these protocols due to limited data and inconsistent reports in this area. Therefore, we decided to investigate the effect of two resistance training with different intensities on strength performance and body composition in trained athletes following two weeks of detraining.

Published recommendations have been reported that 1-RM will improve after strength training. From the findings of the present study, strength performance after six weeks training was improved. The differences were not statistically significant between two groups but the main achievement was that HILV is more effective than LIHV which induced gains in strength performance more effectively than LIHV during detraining.

**Training responses:** All of strength performances were increased by LIHV and HILV in intensity dependent protocols ( $p < 0.01$ ). Furthermore, marked decrease was seen in BMI and body percent ( $p < 0.01$ ).

There are considerable evidences to suggest that high intensity strength training elicits large increases in maximal strength (5,12). Whereas, other studies have stated that low and very low strength training protocols can also enhance strength (16). Interestingly, one study in which subjects performed LIST and HIST program with equal amounts of total work, LIST induced strength gains considerably less than those induced by HIST (8).

In our study, gains in the LIHV group (55-60% 1RM) were smaller than those observed in a study that used a lower intensity (52% 1RM) (3) because our subjects were student athletes whereas their subjects were inactive elderly people. Although LIHV leads to mild strength gains than HILV, but based on some documents it could be more effective for inactive elderly people (8). Strength gains may be attributed to increased motor unit activation of the trained muscles and muscle hypertrophy (1). The other findings of our investigation were BMI and body percent which were decreased with strength training in both groups. These results suggest a major positive effect of strength training over body fat loss that may occur. This could be related to strength exercise which can contribute to increase on fat metabolism. However, further research is required to investigate these causes and identify other possible responsible mechanisms.

**Detraining responses:** Previous investigations reported that strength is maintained after 4–32 weeks of detraining periods in young subjects (9) and 5–27 weeks in the elderly (6,20) but little is known about the effects of strength training intensity on the results of strength loss during detraining due to marked differences in a number of factors, including the sample and the method of measurement used. Taken together, the magnitude of strength loss during detraining has been reported to range between 0.3% (15) to 0.8% (20) per week following isometric strength training. Such differences even suggest that trained resistance athlete may respond differently to short term detraining compared to who initially start strength training (21).

However, it sounds that with shorter detraining periods of between 2 to 6-7 weeks, performance could be maintained (2). Our results also are in agreement with previous reports, because improving 1-RM was maintained followed 2 weeks detraining in both groups. Moreover, according to our results it seems that exercising at a higher intensity will result in a lower magnitude of strength loss throughout detraining. In one study it has been reported that moderate to high ST intensities may probably maintain training induced gains in subjects during detraining (3) and detraining dependent strength losses could be attributed to decline of muscle size and motor unit recruitment efficiency because despite of muscle size, strength declines slowly (4,2).

Unfortunately, mentioned mechanisms of detraining period were not evaluated in our study which is one of the limitations of our study. However, according to the other studies it has been shown that detraining induced strength losses which have been attributed to a number of physiological causes lead to deterioration of fiber size, muscle strength reduction such as muscle mass and water content reduction, hormonal changes, decline of metabolic and molecule adaptations, reduction of neural propagation and motor unit recruitment efficiency (2,19).

Based on the results obtained from this study, the effect on performance was not different between the two exercise regimens, it can be concluded that HILV has no significance advantage over LIHV characteristics.

## ACKNOWLEDGMENT

We thank all the subjects for their participation and commitment to the study.

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