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## THE EFFECT OF AN IMAGERY TRAINING COURSE ON MUSCLE STRENGTH IN NON-ACTIVE YOUNG MEN

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### ABSTRACT

*The purpose of this study was to investigate the effect of motor imagery training on increasing strength. Twenty young men as participant, were divided into experimental group (N=10) and control group (N=10). Records were recorded for 3 movement (leg press, bench press and seated row) before and after 4 weeks and 8 weeks of imagery training. repeated measure were used to evaluate the effect of intra-group and three-times difference, and manova were used to check the difference between two groups. The findings demonstrated a significant difference between the amount of strength in the leg press, bench press and seated row between all three measuring times in the experimental group. There is a significant difference between the amount of strength between the control and MI group (MIs). This difference can be seen in all three movements after eight weeks, but after 4 weeks the difference between the groups was observed just in benchpress. ( $p \leq 0.01$ ).*

**Keywords:** Imagery, Strength, Non-active young men.

### INTRODUCTION

Today, sport science has made significant progress and is being studied in a variety of fields. Two key features required by athletes are physical fitness and individual skills. These, coupled with personal characteristics and psychological skills, will be enhanced and will lead to success. Physical fitness involves many factors, one of the most important of which is strength. It is now well established that skeletal muscle strength gains result from both morphological and neurological adaptations (Folland & Williams, 2007; Lebon et al., 2010). Although some morphological changes (i.e., muscle hypertrophy, myofibrillar growth, and proliferation) usually occur in the later stages of practice (Komi, 1986), neurological adaptations may rather be obtained during the early phase of training. These changes, for example, improved coordination, may enhance the recruitment and the activation of the involved muscles during a strength task (Kidgell, 2010). Moreover, there is accumulating evidence of a cross-over effect with training of one limb that slightly increases strength in the contralateral untrained limb. This latter finding supports the hypothesis of a central adaptation in response to training. As a consequence, voluntary strength may be improved before the muscles exhibit hypertrophy (Westcott, 2012). Greater agonist muscle surface electromyography activity accompanied the early strength enhancement, hence bringing further evidence of neural adaptation in the involved muscle (Westcott, 2012; Tod, 2015). Although physical exercises can greatly improve strength, there are no physical exercises due to some factors, such as lack of facilities or injury.

On the other hand Researchers have identified typical cognitive strategies which athletes use prior to performing strength-based tasks (e.g. imagery, self-talk, goal setting), and the reasons why they employ them, with typical motives including increasing arousal, confidence, and self-belief (Shelton & Mahoney, 1978). These reasons can be interpreted via the activation set hypothesis (Schmidt & Lee, 2005). According to the hypothesis, a specific internal state is associated with optimal task execution (e.g. level of activation, attentional focus, and confidence). Cognitive strategies may facilitate performance by enabling athletes to adjust their internal state to one that is desirable for the upcoming task (Mellalieu & Shearer, 2012). The activation set hypothesis implies that athletes use cognitive strategies to marshal their psychological and physical resources to bear on the strength task at hand. In the absence of cognitive strategies, there is the perception that task performance will suffer because athletes are not making use of their psychological and physical assets (c.f. with Steiner's (Higgins & Green, 2011) model of group productivity where actual performance equals possible performance minus coordination and motivational losses).

So, it is possible that mental exercises can improve strength either immediately before exercise or in a long term training period. One of the most important mental interventions that have been studied is motor imagery. Motor imagery is a physical activity without any obvious muscle movement (Monsma & Overby, 2004). In reports by Gould et al. (2003), in the last 20 years, psychologists and researchers have sought to explore mental imagery in sport and physical activity. Studies have shown that mental imagery is one aspect of mental fitness used by athletes. Subsequent studies have also confirmed that mental imagery can be done before, during and after exercise, which can have an impact on individual self-efficacy and individual motivation for physical activity. Athletes use mental imagery not only to improve performance, but also to enjoy their own sporting experiences (Chang & et al., 2012). In this regard, much research has been done on the impact of imagery on strength. Zijdwind et al. (2003) also provided evidence that MI may be useful in enhancing the voluntary force of the plantar-flexor muscles. They suggested that the effect may be related to the agonist/antagonist coordination, rather than to low-level muscle activation or nonspecific motivational training aspects. Sidaway and Trzaska (Sidaway & Trzaska, 2005) reported similar results for the ankle dorsiflexor muscles, whereas Ranganathan et al. (2004) found that MI improved both distal and proximal muscles voluntary strength of human upper extremities. They further suggested that the mental repetitions of maximal muscle activation made the brain generating stronger signals to muscles. Hence, a stronger central command was thought to recruit the motor units that would otherwise remain inactive under untrained condition, and/or drive the active motor units to higher intensity (higher discharge rate), leading to greater muscle force. Alternatively, training the central nervous system may lead to either remove more effectively or reduce inhibitory input to the motoneurons pool, resulting in increased strength output. These findings contrast, however, with many previous data showing that MI was ineffective at improving performance of strength-based tasks. Newsom et al. found that There was no significant change in wrist-flexion or -extension strength in the mental-imagery group (Newsom et al., 2003). Herbert et al. argued that the physical training group increased in strength significantly more than imagined training and control groups ( $P= 0.01$  for both comparisons), but the small difference between imagined training and control groups was not significant (Herbert et al., 2003). Given the contradictory results and the importance of MI as a



cognitive intervention on the strength of the present research, it is intended to examine whether a course of motor imagery training will increase strength.

## METHOD

### *Subjects*

The statistical population of the present study was male students of the universities of Takab in the academic year of 2017- 2018. The statistical population is available. The total number of students was 1,800. Out of these students, 20 healthy people were randomly selected without a history of sports in the field of fitness or weight lifting. Ten of them as control group with a mean weight of  $69 \pm 1.47$  kg and mean age of  $175 \pm 4/78$  cm and 10 as an MI group (Motor Imagery) with an average weight of  $68 \text{ kg} \pm 1.72$  kg and mean The rate of  $175 \pm 4$  69.4 was selected.

### *Procedures*

Initially, during one session, the correct implementation of the movements was taught to both groups. Then, at a separate session, recorders were made for three moves of leg press, bench press and seated row. So that a person can do 10 repetitions in fatigue. Among the movements, intervals were considered for complete recovery. The MI group (MI group) trained 3 sessions of mental imagery for 8 weeks and each week. MI training was designed in such a way that the person, imagining all the details of the movement, imagined himself performing a weight movement that eventually had the ability to perform 10 repetitions. After each week of mental training, the individual imagined moving with 5 to 10 percent increase in load. From all subjects in both experimental and control groups, after 3 and 4 weeks, three movements were re-recorded. SPSS 20 was used to analyze the data. To evaluate the effect of intra-group and three-times difference, repeated measurements were used to check the difference between two groups of manova.

## RESULTS

Regarding the results and repeated measurements of mental imagery training, the strength is significantly improved in all three movements. The results will be detailed in more detail As shown in Table 1, the mean of all three records in the MI group increased after 4 weeks and after 8 weeks, but in the control group, the mean of records in the three movements did not change significantly. In general, the amount of strength increase in various movements was between 12% to 37%.

A repeated measurement test was used to measure the difference between the frequencies. In the movement of legpresses, in both groups, in mauchly test of sphericity, the P-value was  $P < 0.05$ , so the amount of Greenhouse-Geisser was reported. However, in two benchpress and seated row moves, since the p-value was  $p > 0.05$ , the Huynh fledt value was reported.

According to Table 2, in the MI group (MI), in all three moves, the value of F is significant. In other words, mental imagery training have caused a difference between the number of readings, that is, motor imagery training improve strength of legpress, benchpress and seated row significantly. But in the control group there is no significant difference between the frequency of measurement. In the following, the difference between the 3 times of measurement in 3 movements will be reviewed.



According to Table 3, there is a significant difference between the three times of strength measurement in the movement of the legpress of the MI group.

According to Table 4, there is a significant difference in seatedrow movement strength between all three measuring times in the experimental group.

According to Table 5. There is a significant difference between the amount of strength in the bench press between all three measuring times in the experimental group. Manova test was used to check the difference between groups. In Table 6, the results of this test are presented.

According to Table 6, There is a significant difference between the amount of strength between the control and MI group (MIs). This difference can be seen in all three movements after eight weeks, but the difference between the groups at the end of the fourth week of motor imagery training is visible only in the movement of the benchpress.

## DISCUSSION

The purpose of this study was to investigate the effect of motor imagery training on increasing strength. Based on the results of this study, imagery in 12 and 24 sessions has shown a significant effect on the increase of strength in three movements of leg press, bench press and seatedrow. A lot of research has had the results consistent with the present research (Collaborative Research). But some studies have reported inconsistent results with the present study. For example, Herbert et al. (2003) in their research showed that imagery training did not have a significant effect on strength increase. However, motor imagery training increased strength in the intended muscle, but this increase was not significant. The possible reason for this difference is the type of imagery and the type of muscular contraction (isometric). In another study, Newsom et al. (2003) Reported that MI did not have a significant effect on increased strength. In this study, the motion of the wrist flexion was used, which could be explained by the contradiction between the results of this study and the results of this study. Because the motion of the wrist was a single-movement movement, and because of daily use of wrist movements, even physical exercises did not have a significant effect on strength increase.

As no significant imagery-related effect was observed in the upper limb muscles, which have nonetheless larger cerebral areas compared with lower limbs, this hypothesis stating that MI may elicit some cerebral reorganizations driving the motor units to a higher intensity and/or leading to the recruitment of motor units that remain otherwise inactive, remained to be questioned. Interestingly, previous researches dealing with the effects of MI on voluntary strength of both distal and proximal muscles have highlighted the neural origin of strength gain, occurring before muscle hypertrophy (Ranganathan et al. 2004; smith et al. 2003; Sidaway & Trzaska, 2004; Yue, & Cole, 1992). In these experimental studies, the efficacy of the MI intervention seemed to be proportionally dependent upon the corresponding cortical area surface of the muscle on the primary motor cortex. Hence, the strength gain after mental practice was expected to be greater in muscles having large assigned cortical areas in the primary motor cortex.

Apparently, primary mechanism underlying the strength increase is a mental training-induced enhancement in the central command to muscle. The data suggest that repetitive mental attempts of maximal muscle activation trained and enabled the brain to generate stronger signals to muscle.



Previous research (32, 33, 34) has shown a proportional relationship between magnitude of brain-to-muscle signal and voluntary muscle force by young human subjects, indicating that greater strength is a consequence of stronger brain activity. A stronger central command could recruit the motor units that were otherwise inactive in an untrained state and/or drive the active motor units to higher intensity (higher discharge rate), leading to greater muscle force. Alternatively, the trained CNS may be able to more effectively remove or reduce inhibitory input to the motoneuron pool of the muscles, resulting in an increase in motoneuron output. Training-induced neural adaptations may also include improvements in muscle coordination, such as reductions in the activity of the antagonist muscles when performing the agonist muscle MVC.

To explain this inconsistent and unexpected MI-related effect, an alternative plausible explanation may be provided. Indeed, MI has been shown to serve both cognitive and motivational functions operating on general and specific levels to enhance performance (Guillot & Collet, 2008). The cognitive components of such analytic MI framework tap into technical skill improvement and refer to the imagery of game strategies, whereas the motivational components refer to the use of goal-oriented responses and the management of arousal level. Especially, MI may contribute to improve performance by enhancing intrinsic motivation and individual self-confidence, and by regulating anxiety related to a competitive event (Murphy et al. 2008; Cumming & Hall, 2002). It may thus be hypothesized that MI impacted the individual ability to improve self-confidence and motivation to enhance strength in a greater extent than its effect on the technical key components of the movement per se. Increasing motivation is, among others, one of MI functions in the field of motor skill learning (Guillot & Collet, 2008). Self-reports of the participants confirmed that they were more confident to perform the movement successfully after MI. Furthermore, it is well established that imagery-based interventions can reduce anxiety (Jones & River, 2000). The participants reported that leg press training was here more physically painful and uncomfortable than bench press exercise (this being probably due to the difference in the weight the participants lifted in each of the 2 movements). The MI-related reduction of the apprehension regarding the maximal weight to be lifted may have been more effective for the lower limbs than for the upper body movement, mean weight being, respectively, 287.23 kg ( $\pm 66.86$ ) and 73.28 kg ( $\pm 9.13$ ) during the post-test. Such hypothesis is linked to the specific effects of MI on the focused attention during the preparation phase of the movement. During this period, athletes perform final adjustments to their attentional/activation set, which seem essential to perform their best attempt. As suggested by Feltz and Landers (1983) and Hall et al. (1990), MI may be a reliable technique to improve the quality of the preparation period by increasing the level of attention and thus to be more efficient in subsequent performance. From an applied perspective, strength gains would be here more directly related to the psychological effects of MI rather than to pure physiological adaptations resulting in greater motor units activation and cerebral cortex reorganization across time.



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**Table 1. the means of 3 movements in 2 group(MI and control)**

Control group		MI group			
sd	mean	sd	Mean		
3.58	51.25	3.62	50.25	Pre-test	Leg press (kg)
3.53	52.5	3.62	62.75	After 4 week	
4.21	53	4.75	68.75	After 8 week	
3.71	35.7	4.93	36.2	Pre-test	Bench press (kg)
4.59	35.3	5.12	40.4	After 4 week	
3.04	36.8	5.79	43.6	After 8 week	
6.68	31.5	5.77	30	Pre-test	Seated row (kg)
6.36	32.6	7.81	35	After 4 week	
6.49	33	5.92	36.60	After 8 week	

**Table 2. Test of within subject effect**

Seatedrow			Benchpress			Legpress			
Df	F	P-value	Df	F	P-value	Df	F	P-value	Df
2	23.46	0.00	2	91.147	0.00	2	94.043**	0.00	MI group
2	1.89	0.179	2	1.99	0.176	2	0.325	0.112	Control group

\*\*p&lt;0.01

**Table 3. Pairwise Comparisons (legpress)**

legpress	legpress	Mean Difference	Std. Error	Sig. <sup>a</sup>
Pre-test	After 4 week	-4.000*	.408	.000
	After 8 week	-7.750*	.786	.000
After 4 week	Pre-test	4.000*	.408	.000
	After 8 week	-3.750*	.417	.000
After 8 week	Pre-test	7.750*	.786	.000
	After 4 week	3.750*	.417	.000

\*\*p&lt;0.01

**Table 4. Pairwise Comparisons (Seatedrow)**

Seatedrow	Seatedrow	Mean Difference	Std. Error	Sig. <sup>a</sup>
Pre-test	After 4 week	-5.000*	1.054	.003
	After 8 week	-6.600*	.980	.000
After 4 week	Pre-test	5.000*	1.054	.003
	After 8 week	-1.600	.980	.411
After 8 week	Pre-test	6.600*	.980	.000
	After 4 week	1.600	.980	.411

\*\*p&lt;0.01

**Table 5. Pairwise Comparisons (benchpress)**

(I) benchpress	(J) benchpress	Mean Difference	Std. Error	Sig. <sup>a</sup>
Pre-test	After 4 week	-4.200*	.416	.000
	After 8 week	-7.400*	.653	.000
After 4 week	Pre-test	4.200*	.416	.000



	After 8 week	-3.200*	.554	.001
After 8 week	Pre-test	7.400*	.653	.000
	After 4 week	3.200*	.554	.001

\*\*p≤0.01

**Table 6. Univariate Tests**

Dependent Variable		df	F	Sig.	Partial Eta Squared
leg1	Contrast	1	.385	.543	.021
	Error	18			
leg2	Contrast	1	2.561	.127	.125
	Error	18			
leg3	Contrast	1	9.391	.007	.343
	Error	18			
benchpress1	Contrast	1	.065	.801	.004
	Error	18			
benchpress2	Contrast	1	5.489	.031	.234
	Error	18			
benchpress3	Contrast	1	10.781	.004	.375
	Error	18			
seatedrow1	Contrast	1	.288	.598	.016
	Error	18			
seatedrow2	Contrast	1	.567	.461	.031
	Error	18			
seatedrow3	Contrast	1	4.532	.047	.201
	Error	18			

\*\*p≤0.01

