International Journal of Science Culture and Sport
December 2017 : 5(4)
ISSN : 2148-1148
Doi : 10.14486/IntJSCS676

Field *: Coaching*
Type *: Research Article*
Received: *29.08.2017* ***- Corrected:*** *17.10.2017* ***- Accepted:*** *20.10.2017*

Effects of Some Active and Passive Recovery Techniques on Strength Parameters[1]

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Abstract
Aim: The purpose of this study was to determine the acute effect of short term active and passive recovery methods on strength after high intensity interval training (HIIT). Method: Twelve trained male bodybuilders (18–30 years of age) voluntary participated in the study, on a voluntary basis. The criteria for the athletes were being healthy, not having any chronic or acute disorders, and not having restrictions on movement due to injuries.Subjects applied randomly active and passive recovery techniques (Electrostimulation, core training, control) after each HIIT on three different days. Performance tests were conducted on athletes before (Pre-T) and after HIIT (Post-T). The data collected were analysed with dependent two sample t test and independent samples t test. Results: Although there was an increase in the anaerobic strength, vertical jump, and back strength levels, no statistically significant difference was found in between groups ($p>0,01$). Similarly, a decrease was found in the levels of leg strength and right-left handgrip strength in three groups. Although the difference in the control group was not meaningful in terms of these values, there was a significant difference in the right-left hand grip strength levels in the core training and stimulation groups ($p<0,01$). Pre-T the values of right-left handgrip strength in the core training group decreased from 48,46±5,06 to 46,16±5,84, from 47,95±5,44, to 46,50±5,43 respectively compared to Post-T ($p<0,01$). In the electrostimulation group, on the other hand, Pre-T the right handgrip strength decreased from 47,36±4,48 to 45,72±5,31 while Pre-T the left handgrip strength decreased from 46,45±4,27 to 44,13±5,05, compared to Post-T ($p<0,01$). Additionally, the comparison between the groups Pre-T and Post-T showed no statistically significant difference ($p>0,01$).Conclusion: The active and passive recovery methots, did not have any effect on strength parameters in bodybuilders and does not provide any acute effect in the recovery period after high intensity training.

Keywords: Strength, recovery, electrostimulation, core training, HIIT

[*] *This study was presented in International Conference on Humanities and Educational Research, March 23-26, 2017, Houston, Texas, USA.*

Introduction

High intensity interval training is a frequently used exercise in training programs that aims to develop maximum oxygen consumption (MaxVO2) and the anaerobic capacity (Tabata et al., 1996:1327) (Gorostiaga et al., 1991:101). Performance and physiological adaptations related to these exercises vary depending on the intensity of the exercise, recovery methods and periods. Active or passive recovery methods are a few examples (Dupont., 2004:302). The effects of active and passive recovery methods on rapid recovery process has been an actively researched topic. It's shown that the active recovery method in interval exercises decreases the blood lactate level and shortens the tiredness period compared to the passive recovery methods (Ahmaidi et al,. 1996:450) (Billat, 2001:13). Electrostimulation which is also used as an active resting technique is a widely used technique for helping the muscle's voluntary contraction without activating the central nervous system. Electrostimulation has gained popularity in recent years among amateur and professional athletes and started to be used as a recovery technique along with strength training method. With this electrical stimulation method, it's thought that the local blood flow is increased and the skeleton muscle deformation which occurs during exercise is corrected rapidly (Miller et al, 2000: 53) (Cramp et al, 2002: 5) (Lattier et al, 2004:509). This is a clinical method used for increasing the technical muscle performance (Delitto and Snyder, 1990:158). There's literature on the fact that this method which affects the fiber length, shape and strength, may also lead to a decrease in muscle damage and tiredness levels over time (Rosemffet et al, 2004:246) (Delitto et al, 1998:187).

Another active resting technique used in the study is core exercises. Core exercise is an important element in preventing injuries by aiming to improve local strength and balance. Additionally, these exercises that increase the strength, balance, and the control of movement of upper and lower extremities, are the center of all kinetic chains in all fields of sports (Kibler et al, 2006): 189). Although core exercises are a frequently used training method in all fields of sports, it is of interest to find out how it affects strength after exercise and recovery as an active resting method.

The aim of this study was to determine the effects of electrostimulation and core training techniques on some strength parameters after intensity training, during recovery phase. The results of this study will help trainers and athletes to decide which resting method they should prefer during the recovery phase.

Method

Sample Group

The samples of this study consists of trained bodybuilding athletes between the ages of 18-30. High intensity interval training protocol was applied three times with different recovery techniques to 12 voluntary male athletes. The criteria for the athletes were being healthy, not having any chronic or acute disorders, and not having restrictions on movement due to injuries. This study was approved by the Clinical Research Ethics Committee in Ondokuz Mayıs University (Number: B.30,2.ODM.0.20.08/1533).

Research Design

The study was conducted in Sinop and the participants of the study were recruited in the city of Sinop. Performance tests conducted and recovery methods were applied to the participants

for 5 days without disrupting their daily and training routines. Athletes were asked to do high intensity exercises every other day and recovery methods were applied to them and the performance levels were checked. All athletes were subject to the same protocol three times. The athletes were asked to not do intensity training during the last 24 hours prior to the exercises for the performance tests and they were asked to eat as if preparing for competition before exercise. Also, athletes were warned against consumption of alcohol and stimulate substances, and advised to pay attention to their diet and resting. In the study, first the height and body mass measurements were taken and the BMI for athletes were determined. Then, the same protocol, training program and performance tests were conducted on the 1st, 3rd, and 5th days of the study.

The performance levels of athletes were measured and than high intensity interval training protocol was applied. Before the training (Pre-T), first the athletes were asked to warm up in order to get ready physically and mentally for the load and they were given 5 minutes. Afterwards, the moves consisting of 8 repetitions in 4 minutes were applied in 4 sets with the method of training for 20 seconds, resting for 10 seconds under the observation of the researcher. Two minute resting breaks were taken between the sets. Immediately after the training (Post-T), strength measurements were taken for performance levels again and the handgrip strength of athletes with a hand-dynamometer. The leg and back strengths were measured with a back/leg-dynamometer. And lastly, a jump test was conducted to determine the vertical jump level and the anaerobic strength.

The same training program and performance tests were conducted three times on the athletes but at the end of the tests, various recovery methods were applied for ten minutes. In the first day, no active recovery methods were applied during the recovery phase but only performance levels were measured. On the third day, an active resting method, core training was applied after the performance tests. The researchers showed the moves to the athletes before the training and tests. On the fifth day, athletes were connected to electrostimulation (muscle development and rehabilitation device) for active recovery after the training and performance tests, and the effects of the methods on strength parameters were identified and compared.

Handgrip Strength

The measurement was taken with a Takei brand hand dynamometer (Handgrip). The measurement was taken after the warm up while the participant is standing up without bending the arm that is being measured and with an angle of 450 without touching the body. This was repeated for right and left hands three times and the highest values were used (İbiş vd, 2004:285).

Leg Strength

The measurement was performed with a Takei brand back and leg dynamometer. After the warm up, the participants placed their feet on the dynamometer base while knees are bent and pulled up the dynamometer that they gripped with their hands while back is straight and body is slighlty bent forward, with their legs. This step was repeated three times and the best value for each participant was recorded (Saygın vd, 2005:205).

Squat Jump Test

The anaerobic strength and vertical jump of athletes in the study were identified with a jumping platform and a jumpmeter, that is connected to the platform in accordance with standards. After the identification of the anaerobic strength level, the calculation of the height

was done with the formula based on the jump test. Afterwards, the anaerobic strength was calculated. (Özkan vd, 2010:33).

Measurement of Heights and Body Weight; Calculation of Body Mass Index

The heights of the athletes were measured with a Charder brand height measurement device in centimeters. The bodyweights of athletes were measured with a Tanita BC418 segmental body analysis device in kilograms. The body mass indexes of the athletes were calculated by the division of the bodyweight value by the height's square in meters (kg/m2).

Recovery Programs

Passive Resting

High intensity and interval training method was applied to the athletes. After the training, athletes rested for 10 minutes without any cool down exercises or any method that would speed up the recovery. At the end of the 10 min rest, performance tests were conducted.

Core Training

All the movements were conducted with the athlete's own bodyweight and continued based on the order of the moves during the 10 minutes at the end of the high intensity interval training.

Electrostimulation

This study was conducted with a Norotrac brand, mobile muscle development and rehabilitation device. Surface electrodes were placed on skin and electrical current was applied through the electrodes to the locations where the working muscles were. When the electrodes are conntected, as the muscle group that is working continued contracting, the energy to be applied was adjusted automatically towards big and small muscle groups by the device. The recovery phase continued for 10 minutes after the high intensity interval training.

Statistical Analysis

The data obtained are presented as arithmetical mean and standard deviation. The parameters showing normal distribution were analysed with dependent paired-samples t test within the group and the comparison between groups were analysed with an independent t test. The statistical significance was accepted as $p<0.01$. SPSS v.22 packet program was used in the statistical analysis of the data obtained and in the comparison of results.

Results

Table 1. The means and standard deviations of the athletes' age, height, bodweight, and body mass index

CHARACTERISTICS OF ATHLETES					
	n	**Minimum**	**Maximum**	**Mean**	**Standard Deviation**
Age (years)	12	18,00	30,00	21,33	4,51
Athlete Age	12	6,00	15,00	9,33	3,23
Height (cm)	12	182,00	198,00	184,66	6,13
Bodyweight (kg)	12	66,00	82,00	72,66	5,78
Body-Mass Index (kg/m2)	12	19,90	23,50	21,26	1,17

The mean of age of athletes is 21,33±4,51 years, the mean of the years of being an athlete is 9,33±3,23 years, the average of height 184,66±6,13 cm, the mean bodyweight is 72,66±5,78 kg, and the mean BMI is 21,26±1,17 kg/m2 (Table 1).

Table 2. The changes in the performance levels before and after the load in the control group

PERFORMANCE VALUES OF THE CONTROL GROUP								
					%95 Confidence Interval			
Measurement Type	Phase	n	Mean	Std. Dev.	Lowest	Highest	t	p
Anaerobic Strength	Pre-T	12	336,50	52,51	-151,30	77,96835	-,822	,448
	Post-T	12	373,16	83,81				
Vertical Jump	Pre-T	12	44,00	5,01	-4,29718	3,63052	-,216	,837
	Post-T	12	44,33	4,58				
Back Strength	Pre-T	12	130,41	12,67	-21,9722	17,13896	-,318	,764
	Post-T	12	132,83	13,56				
Leg Strength	Pre-T	12	154,41	21,22	-13,5494	31,54944	1,026	,352
	Post-T	12	148,36	22,43				
Handgrip Strength (Right)	Pre-T	12	47,86	4,52	-3,60932	4,64265	,322	,761
	Post-T	12	47,35	5,60				
Handgrip Strength (Left)	Pre-T	12	46,21	3,10	,12272	4,14395	2,727	,051
	Post-T	12	45,08	4,61				

Table 2 shows the changes in the performance measurement levels in the control group Pre-T and Post-T. The results shows that anaerobic strength is 336,50±52,51 in Pre-T while 373,16±83,81 afterwards; Pre-T the vertical jump was 44,00±5,01 while it increased to 44,33±4,58 after HIIT; back strength increased from 130,41±12,67 to 132,83±13,56 in Post-

T. Pre-T the leg strength was 154,41±21,22 while it decreased to 148,36±22,43 after HIIT; Pre-T the right handgrip strength was 47,86±4,52 while it decreased to 47,35±5,60 after HIIT; Pre-T the left handgrip strength was 46,21±3,10 while it decreased to 45,08±4,61 after HIIT, however there was no statistically significant difference found in these results (p>0,01).

Table 3. The changes in performance levels before and after the load in the core training group

PERFORMANCE LEVELS OF CORE TRAINING GROUP								
					%95 Confidence Interval			
Measurement Type	**Phase**	**n**	**Mean**	**Std. Dev.**	**Lowest**	**Highest**	**t**	**p**
Anaerobic Strength	Pre-T	12	326,16	44,96	-84,3029	45,30297	-,774	,474
	Post-T	12	345,66	82,39				
Vertical Jump	Pre-T	12	43,33	4,45	-5,43810	3,10476	-,702	,514
	Post-T	12	44,50	7,03				
Back Strength	Pre-T	12	138,41	14,12	-13,5734	11,24007	-,242	,819
	Post-T	12	139,58	6,71				
Leg Strength	Pre-T	12	155,41	26,58	-8,88372	20,05039	,992	,367
	Post-T	12	149,83	27,46				
Handgrip Strength (Right)	Pre-T	12	48,46	5,06	1,38995	3,21005	6,497	,001★
	Post-T	12	46,16	5,84				
Handgrip Strength (Left)	Pre-T	12	47,95	5,44	,81425	2,08575	5,863	,002 ★
	Post-T	12	46,50	5,43				

p<0,01 ★

Table 3 shows the changes in the performance measurement levels before and after the high intensity interval training in the core training group. The data showed that Pre-T the anaerobic strength was 326,16±44,96 while it increased to 345,66±82,39 afterwards; Pre-T the vertical jump was 43,33±4,45 and increased to 44,50±7,03 after HIIT; and Pre-T the back strength was 138,41±14,12 while it increased to 139,58±6,71 afterwards. There was no statistically significant difference (p>0,01). Pre-T the leg strength was 155,41±26,58 while it decreased to 149,83±27,46 after HIIT but there was no statistically significant difference (p>0,01). Pre-T the right handgrip strength was 48,46±5,06 while it decreased to 46,16±5,84 after HIIT, Pre-T the left handgrip strength was 47,95±5,44 and it decreased to 46,50±5,43 afterwards (p<0,01).

Table 4. The changes in performance levels before and after the load in the electrostimulation group

PERFORMANCE LEVELS OF THE ELECTROSTIMULATION GROUP								
					%95 Confidence Interval			
Measurement Type	**Phase**	**n**	**Mean**	**Std. Dev.**	**Lowest**	**Highest**	**t**	**p**
Anaerobic Strength	Pre-T	12	332,16	46,31	-53,2803	19,83590	-,965	,348
	Post-T	12	348,88	77,15				
Vertical Jump	Pre-T	12	43,72	4,49	-2,02188	1,35521	-,416	,682
	Post-T	12	44,05	5,64				
Back Strength	Pre-T	12	135,33	12,41	-7,97093	4,35982	-,618	,545
	Post-T	12	137,13	9,76				
Leg Strength	Pre-T	12	160,25	16,94	-1,72038	8,88705	1,737	,143
	Post-T	12	156,66	19,34				
Handgrip Strength (Right)	Pre-T	12	47,36	4,48	,44721	2,83057	2,902	,010★
	Post-T	12	45,72	5,31				
Handgrip Strength (Left)	Pre-T	12	46,45	4,27	1,50873	3,11349	6,077	,000★
	Post-T	12	44,13	5,05				

p<0,01 ★

Table 4 shows the changes in performance measurement levels before and after the high intensity interval training in the electrostimulation group. According to the results, Pre-T the anaerobic strength was 332,16±46,31 while it increased to 348,88±77,15 after HIIT, Pre-T the vertical jump strength was 43,72±4,49 while it increased to 44,05±5,64 after HIIT, and Pre-T the back strength was 135,33±12,41 while it increased to 137,13±9,76 after HIIT. No statistically significant difference was found (p>0,01). Pre-T the leg strength was 160,25±16,94 while it decreased to 156,66±19,34 after HIIT, however no statistically significant difference was found (p>0,01). Pre-T the right handgrip strength was 47,36±4,48 while it decreased to 45,72±5,31, and Pre-T the left handgrip strength was 46,45±4,27 and it decreased to 44,13±5,05 after HIIT. (p<0,01).

Table 5. The comparison of performance levels of athletes before and after the load in between the groups

Measurement Type	**Phase**	**Control & Core Training**		**Control & Electrostimulation**		**Core Training & Electrostimulation**	
		t	p	t	p	t	p
Anaerobic Strength	Pre-T	,366	,722	,091	,930	-,281	,784
	Post-T	,573	,579	1,005	,338	,399	,698
Vertical Jump	Pre-T	,243	,813	,059	,954	-,186	,856
	Post-T	-,049	,962	,322	,754	,308	,765
Back Strength	Pre-T	,840	,326	-,987	,347	,171	,867
	Post-T	,107	,300	-,964	,358	,138	,893
Leg Strength	Pre-T	,983	,583	-1,151	,276	-,375	,715
	Post-T	,366	,433	-1,610	,138	-,478	,629
Handgrip Strength (Right)	Pre-T	-,217	,833	,836	,423	1,008	,337
	Post-T	,358	,728	1,235	,245	,818	,432
Handgrip Strength (Left)	Pre-T	-,677	,514	,481	,641	,981	,350
	Post-T	-,831	,426	,828	,427	1,578	,146

Table 5 shows the comparison of strength parameters before and after the load for the three groups. The results show no statistically significant difference between the groups (p>0,01).

Discussion and Conclusion

Training is loads that create functional and morphological change in the organism and are applied in certain intervals with the purpose of increasing exercise efficiency. Athletes can tolerate high intensity and low intensity loads only for short periods of time. These sorts of trainings are used in sports fields where anaerobic capacity is in the foreground to improve resistance and speed (Aslankeser, 2010). Athletes can use various applications to ease or speed up the recovery after a tiring training or tiredness after a high load. Using these recovery techniques are as important as completing an efficient training. Body builders use anaerobic system frequently as well. Strength and anaerobic strength are two of the most important elements of sportive performance. Therefore, changes in the strength performance level affect athletes directly.

Selkowitz (1985) determined that electrostimulation method increases the leg strength (Selkowitz, 1985:186). There are other studies that show that the electrostimulation method has positive effects on performance (Kale et al., 2014: 142). When the effects of core training on performance are examined; Dedecan et al. (2016:131) showed that core training has positive effects on some physical and physiological characteristics; Karacaoglu & Kayapinar (2015:221) showed that it has positive contribution on volleyball players' postures; Taskin (2016:115) showed that it improves the speed, acceleration, vertical jump and long jump; Dogan et al. (2016:1) showed that athletes had significant recovery on several performance parameters of athletes in addition to leg and back strength; Atici and Afyon (2016:542) found that it increases some physical and motor skills of swimmers.

Schilling et al. (2013:278) examined the effect of core training of 6 weeks on athletic performance by identifying the athletes' performances in the beginning and performing performance tests again on the 3rd and 6th weeks. As a result, athough regular core training has significantly positive effects on some performance levels such as squat strength, bench press strength, no significant difference was found in the vertical jump test. Weston et al. (2015:204) conducted a study on swimmers at the national team level where he examined some performance parameters of swimmers that had done core training for 12 weeks. When he compared the core training group with the control group, he found that the core training has positive effects on the 50 meter swim time, prone-bridge test, and straight-arm pull down test performance levels. Zanotti et al. (2003:292) conducted a study where they examined the effects of electrostimulation on muscle strength during a 30 min period a day for 4 weeks on patients who are confined to bed and found significant improvement on the muscle strength. Miller et al. (2000), Cramp et al. (2002), Delitto & Snyder-Mackler (1990) and Delitto et al. (1989) stated that electrostimulation method affects muscle strength.

In this study, an increase was found on performance parameters such as anaerobic strength, vertical jump, and back strength, but no significant difference was found. These parameters show similarities and differences with several studies. The other results show that there's a decrease in leg strength and right/left hand grip strength in all three groups and this decrease created a significant difference between core training and electrostimulation groups on right/left hand grip strength. These results can be evaluated as a situation emerging due to the tiredness after a high intensity interval training.

According to the results of the study, active recovery methods don't have any positive effect on strength and anaerobic strength levels after high intensity interval training. Although the study provides an important result in terms of strength which is one of the most important performance elements in athletes, more research on the subject matter might reveal different results.

Acknowledgement

This study was supported by Sinop University Scientific Research Projects. We would like to thank Sinop University Scientific Research Projects Coordinationatorship for the support they provided.

Conflicts of Interest

The authors have no conflicts of interest to acknowledge.

REFERENCES

Ahmadi S, Granier P, Taoutaou Z, Mercier J, Dubouchaud H, Prefaut C (1996). Effects of active recovery on plasma lactate and anaerobic power following repeated intensive exercise. Medicine and Science in Sports and Exercise, 28(4): 450-456.

Aslankeser Z (2010). The effects of anaerobic trainings on central-peripheral fatigue and recovery periods. PhD Thesis, Çukurova University Institute of Health Sciences, Adana.

Atıcı M, Afyon YA (2016). The Effects of Core Training on Swimming in Sedentary Women. Anthropologist, 23(3): 542-549.

Billat LV (2001). Interval training for performance: a scientific and empirical practice. Sports Medicine, 31(1): 13-31.

Cramp FL, Mccullough GR, Lowe AS, Walsh DM (2002). Transcutaneous electric nerve stimulation: the effect of intensity on local and distal cutaneous blood flow and skin temperature in healthy subjects. Archives of Physical Medicine and Rehabilitation, 83(1): 5-9.

Dedecan H, Çakmakçı E, Biçer M, Akcan F (2016). The Effects of Core Training on Some Physical and Physiologıcal Features of Male Adolescent Students. European Journal of Physical Education and Sport Science, 2(4): 131-144.

Delitto A, Brown M, Strube MJ, Rose SJ, Lehman RC (1989). Electrical stimulation of quadriceps femoris in an elite weight lifter: a single subject experiment. International Journal of Sports Medicine, 10(03): 187-191.

Delitto A, Snyder-Mackler L (1990). Two theories of muscle strength augmentation using percutaneous electrical stimulation. Phys Ther, 70(3):158-164.

Doğan G, Mendeş B, Akcan F, Tepe A (2016). The Effects of Eight-week Core Training on Some Physical and Physiological Parameters of Football Players. Niğde University Journal of Physical Education And Sport Sciences, 10(1): 1-12.

Dupont G, Moalla W, Guinhouya C, Ahmaidi S, Berthoin S (2004) Passive versus active recovery during high-intensity intermittent exercises. Medicine and Science in Sports and Exercise, 36(2): 302-308.

Gorostiaga EM, Walter CB, Foster C, Hickson RC (1991). Uniqueness of interval and continuous training at the same maintained exercise intensity. European Journal of Applied Physiology and Occupational Physiology, 63(2): 101-107.

Ibiş S, Gökdemir K, Iri R (2004). The analysis of some the physical and physiological parameters of the 12-14 years old male football players attending and not attending to football schools. Kastamonu Education Journal, 12(1): 285-292.

Kale M, Kaçoğlu C, Gürol B (2014). The Effects of Electromyostimulation Training on Neural Adaptation and Sports Performance. Hacettepe University Journal of Sport Sciences, 25 (3): 142–158.

Karacaoğlu S, Kayapınar FÇ (2015). The Effect of Core Training on Posture. Academic Journal of Interdisciplinary Studies, 4(1): 221-226.

Kibler WB, Press J, Sciascia A (2006). The role of core stability in athletic function. Sports Medicine, 36(3): 189-198.

Lattier G, Millet GY, Martin A, Martin V (2004). Fatigue and recovery after high-intensity exercise Part II: recovery interventions. International Journal of Sports Medicine, 25(07): 509-515.

Miller BF, Gruben KG, Morgan BJ (2000). Circulatory responses to voluntary and electrically induced muscle contractions in humans. Physical Therapy, 80(1): 53-60.

Ozkan A, Köklü Y, Ersöz G (2010) Anaerobik Performans ve Ölçüm Yöntemleri. Ankara, Türkiye: Gazi Kitabevi.

Rosemffet MG, Schneeberger EE, Citera G, Sgobba ME, Laiz C, Schmulevich H, Cocco JAM (2004). Effects of functional electrostimulation on pain, muscular strength, and functional capacity in patients with osteoarthritis of the knee. JCR: Journal of Clinical Rheumatology, 10(5): 246-249.

Saygın Ö, Polat Y, Karacabey K (2005). The effects of movement training, applied to children on their physical fitness parameters. Fırat University Medical Journal of Health Sciences, 19(3): 205-212.

Schilling JF, Murphy JC, Bonney JR, Thich JL (2013). Effect of core strength and endurance training on performance in college students: Randomized pilot study. Journal of Bodywork & Movement Therapies, 17: 278-290.

Selkowitz DM (1985). Improvement in Isometric Strength of the Quadriceps Femoris Muscle After Training with Electrical Stimulation. Phys Ther, 65: 186-196.

Tabata I, Nishimura K, Kouzaki M, Hirai Y, Ogita F, Miyachi M, Yamamoto K (1996). Effects of moderate-intensity endurance and high-intensity intermittent training on anaerobic capacity and VO2max. Medicine and Science in Sports and Exercise, 28(10): 1327-1330.

Taşkın C (2016). Effect of Core Training Program on Physical Functional Performance in Female Soccer Players. International Education Studies, 9(5): 115-123.

Westan M, Hibbs AE, Thompson KG, Spears IR (2015). Isolated core training improves sprint performance in national-level junior swimmers. International Journal of Sports Physiology and Performance,10(2): 204-210.

Zanotti E, Felicetti G, Maini M, Fracchia C (2003). Peripheral Muscle Strength Training in Bed-Bound Patients with COPD Receiving Mechanical Ventilation: Effect of Electrical Stimulation. Chest, 124(1): 292-296.