THE EFFECT OF ELECTRO-MYO-STIMULATION ON ANTHROPOMETRIC PARAMETERS IN ADULT WOMEN

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ABSTRACT

The goal of the study was to evaluate and compare the short-term adaptations in body composition in two different fitness programmes a) with and b) without the electro-stimulation (EMS) in adult women. Twenty inactive healthy women were recruited by advertisements in a fitness-studio and were selected into two groups. Group E1 (n=10, age 33.4±8.2 years, height 167.7±4.6 cm, weight 64.8±4.8 kg, BMI 23.03±1.1 kg.m^{-2}) participated in a fitness program with the application of electro-stimulation. The group E2 (n=10, age 36.4±4.5 years, height 167.2±3.9 cm, weight 65.9±5.0 kg, BMI 23.6±1.2 kg.m^{-2}) was involved in the same exercise program, but without the application of electro-stimulation. Both groups were involved in the training for 5 weeks, 2 times per week, and with the duration of 15 minutes per session. The anthropometric data was analyzed before and after the training period. Results of all parameters are expressed as the mean ± standard deviation (SD). Variables in the two different groups were compared by an independent Student's *t*-test. The significance level was set to $p \leq 0.05$. The results show that training with the EMS has led to a decrease in all anthropometric parameters, with the exception of BMI, as follows: Body Weight $p \leq 0.05$, Waist Circumference $p \leq 0.01$, Hip Circumference $p \leq 0.05$, Waist /Hip Ratio $p \leq 0.05$, and % Body Fat $p \leq 0.05$. We conclude that the regular training program with the application of EMS contributes to the reduction of central obesity with weight loss, even if it is only performed 2 times per week and with the duration of 15 minutes per session. Such training could be an effective way of body forming for people with busy daily timetable.

Key words: electro-stimulation training, body weight reduction, percentage of body fat, hip waist- ratio

INTRODUCTION

Electro-myo-stimulation or electrical muscle stimulation (EMS) has been a mainstay of physical therapy practice for many years as a method to rehabilitate muscles after an injury or surgery (DEVAHL, 1999; BOECKH-BEHRENS, 2002). In the early 1960s it was often used in an attempt to prevent the atrophy that occurs when skeletal muscle is enervated. As more sophisticated stimulation devices were developed, it became a popular treatment technique for patients that had sustained central nervous system impairment secondary to a stroke or spinal cord injury (KEMMLER et al., 2009).

Over the past 20 years, manufacturers have developed units with an improved ability to modulate a variety of electrical wave forms resulting in an electrical current that can be comfortably used to stimulate innervated muscles (VAN SWEARINGEN, 1999; VATTER, 2003; PORCARI et al., 2010) or to help in therapy of various diseases KLEIINER - GREENWOOD-ROBINSON, 2010). Because of these developments, EMS has been more commonly used to promote strength gains in the lower extremity of patients who have had orthopaedic surgery, particularly anterior cruciate ligament reconstructive surgery. The improved ability of EMS units to stimulate innervated muscle has ignited interest in its use as a training technique for healthy individuals without neuromuscular pathology. The early work of Kots (1977) suggested that EMS was more effective than exercise alone in strengthening skeletal muscle in elite athletes.

The proposed advantage of using EMS is that the recruitment order is reversed relative to volitional exercise: during volitional activity, the central nervous system first activates the smallest alpha motoneurons and with increasing levels of required force, progressively larger motoneurons are activated. This recruitment order has been termed the ''size principle'' of motor unit recruitment. The size of alpha motoneurons is related to the type of muscle fibber innervated by the motoneuron. Slow oxidative (SO) muscle fibber types are typically recruited first, whereas fast glycolitic (FG) are the most difficult to recruit during volitional activation. The order of muscle fibber recruitment is reversed when the muscle is activated via electrical stimulation, with the largest-diameter muscle fibbers (FG) being recruited first and the smaller-diameter (SO) muscle fibers being recruited later (BAKER at al., 1993).

Miha Bodytec ® is an innovative advance in the electrical muscular stimulation principle already used by leading competitive athletes, physiotherapists, and personal trainers as well as by elite fitness, wellness and beauty facilities (http://www.miha-bodytec.com/miha/index.php/home-international.html). For EMS exercise we use current producing low-frequency stimulation (Šajter, et. al., 2006).

The goal of the study was to evaluate and compare the short-term adaptations in body composition in two different fitness programmes a) with and b) without the electrical muscular stimulation in adult women.

METHODS

Subjects and design of the study

Twenty inactive healthy women were recruited by advertisements in a fitness-studio and were randomly assigned to either a control or EMS group.

The group E1 (n =10, age 33.4 ± 8.2 years, height 167.7 ± 4.6 cm, weight 64.8 ± 4.8 kg, BMI 23.03 ± 1.1 kg.m^{-2}) participated in a fitness program **with the application of electro-stimulation** *(Figure 1)*. All subjects in group E1 (with the application of EMS) attended an orientation session before initiation of the electrical stimulation training program. The proper location and application of the electrodes was demonstrated and subjects also received written instructions on how to apply the stimulation electrodes and operate the stimulator.

The group E2 (n = 10, age 36.4 ± 4.5 years, height 167.2 ± 3.9 cm, weight 65.9 ± 5.0 kg, BMI 23.6 ± 1.2 kg.m^{-2}) was involved in the same exercise program, but **without the application of electro-stimulation**.

Both groups of subjects underwent an identical training program for 5 weeks with the frequency of 2 training sessions per week, and with the duration of 15 minutes per session; in total they completed 10 sessions.

In the group **E1** we implement two Miha Bodytec ® training units called "advanced" and "cellulitis" (http://www.miha-bodytec.com/miha/index.php/home-international.html), alternatively during the week.

The specification of "advanced" is as follows:

- Duration - 15 minutes
- Time Pulse - 4 seconds
- Time Pause - 4 seconds
- Frequency - 85 Hz
- Type of pulse - bipolar

Figure 1 Application of electro-stimulation

The specification of “cellulitis” is as follows:

- Duration - 10 minutes
- Time Pulse - 10 minutes
- Time Pause - no pause
- Frequency - 70 Hz
- Type of pulse - bipolar

The identical exercises with identical number of repetitions, including the rest intervals were applied in both groups (squats, plié, lunges, trunk side flexion, peck deck, biceps curl) over the 5-week course.

Testing

Both groups of subjects underwent an identical battery of tests before and after the 8-week training programmes. The pre- and post-tests included measurement of body weight, body height, waist circumference, hip circumference, and skin folds.

Body Weight. Body weight was measured using a standard Health-O-Meter laboratory scale.

Body Height. Body height was measured using a standard Health-O-Meter laboratory tape.

Girth measurements. Waist and hip circumferences were made using a spring-loaded steel tape measure accordingly.

Skin folds. All skin folds were measured at the following 4 sites on the body using Lange callipers; biceps, triceps, sub-scapular, suprailiac. Percentage of body fat was estimated from the sum of all four skin folds (NEMČEK, 2008).

Statistical analyses

The anthropometric data was analyzed before and after the training period. Results of all parameters are expressed as the mean ± standard deviation (SD). Variables in the two different groups were compared by an independent Student’s *t*-test. The significance level was set to $p \leq 0.05$.

RESULTS

The physical characteristics of the 10 women in the EMS group (E1) and 10 subjects in the control group (E2) who completed the study are presented in Table 1. The groups were not different in terms of age, height, weight, or percentage of body fat at the beginning of the study.

Changes in body composition over the course of the study are summarized in Table 1. The results show that training with the EMS has led to a decrease in all anthropometric parameters, with the exception of BMI, as follows: Body Weight $p \leq 0.05$, Waist Circumference $p \leq 0.01$, Hip Circumference $p \leq 0.05$, Waist /Hip Ratio $p \leq 0.05$, and % Body Fat $p \leq 0.05$.

Table 1 Comparison of the E1 and E2 groups anthropometric variables with respect to pre-test and post-test. Data are means ± SD.

Variable	E1 (n=10)		E2 (n=10)	
	Pre-test	Post-test	Pre-test	Post-test
Body Weight [kg]	64.8±4.8	63.9±4.3*	65.9±5.0	65.5±4.9
BMI [$kg.m^{-2}$]	23.03±1.1	22.7±1.0	23.6±1.2	23.4±1.2
Waist Circumference [cm]	72.7± 2.2	71.3± 2.2**	73.6±3.9	73.2±3.8
Hip Circumference [cm]	101.2±2.7	99.0±2.2*	100.1±2.4	99,9±2.2
Waist /Hip Ratio	0.73±0.06	0.72±0.06*	0.74±0.06	0.73±0.07
% Body Fat	26.4±2.8	25.6±2.5*	26,9±2.5	26.6±2.3

Note: **Significantly different from the pre-test values (p ≤ 0.01), * significantly different from the pre-test values (p ≤ 0.05)

CONCLUSION

Electrical muscle stimulation devices have been advertised to increase muscle strength, to decrease body weight and body fat, and to improve muscle firmness and tone in healthy individuals. This study sought to test some of those claims. Twenty volunteers were assigned to either an EMS or control group. The EMS group underwent stimulation 2 times per week following the manufacturer’s recommendations, whereas the control group underwent concurrent identical sessions with no EMS.

We conclude that the regular training program with the application of EMS contributes to the reduction of central obesity with weight loss, even if it is only performed 2 times per week and with the duration of 15 minutes per session. Such training could be an effective way of body forming for people with busy daily timetable.

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