Influence of electromyostimulation training with voluntary muscle contractions on basal metabolic rate of sedentary women

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Abstract

Purpose of our study is to investigation of effect of electromyostimulation training with voluntary muscle contractions (EMS) on basal metabolic rate (BMR) in sedentary women. EMS training that was took 6 weeks (25 minutes/day, 3 day/week) was implemented on sedentary women volunteers (n = 10) via EMS training device (Miha Bodytec, Augsburg, Germany). The EMS electrodes placed to 16 region on whole body. 80 Hz stimulation frequency was used all training units. After general warm-up, it was applied in the EMS training that included weight lifting with 4 seconds stimulation/4 seconds non-stimulation in first 10 minutes, and step-aerobic exercises with constant stimulation in second 10 minutes, and active cooling exercises with 1 second stimulation/1 second non-stimulation in last 5 minutes. Bioelectrical impedance analyzer (Tanita BC418MA) was used for determination of BMR. Measurements were practiced at one day before and after of 6-week EMS training program. Paired samples t-test was used for analysis of pre- and post-tests. After EMS training program increment was found in BMR (pre-test: 1375.20 ± 228.33 kcal; post-test: 1392.20 ± 239.91 kcal), however there is no significance (p > 0.05). As a result, it could be said that as a technologic method in exercise science, the EMS training with voluntary muscle contractions may not be affect basal metabolic rate of sedentary women.

Key Words: Exercise, Voluntary contractions, Electromyostimulation, Basal metabolic rate

Introduction

The EMS is a time-saving, low-intensity exercise program in fitness industry. EMS for whole-body with voluntarily muscle contractions differs from classical EMS that is passive and without voluntarily muscle contraction. The EMS with voluntarily muscle contractions aims fitness field, while EMS without voluntarily contractions is used for therapeutical field (1). The Ems devices can stimulate all main muscle groups (i.e., up to an area of 2,800 cm²) with slight movements and are thus increasingly used within the health, beauty, and fitness fields (2).

The basal metabolic rate is the energy required by rested and post-absorptive body to maintain physiological processes, and it comprises 60-75% of daily energy expenditure (3, 4). The EMS was investigated on muscle strength (5), body composition (Kemmler et al., 2014), energy expenditure (Kemmler et al., 2012), or on resting metabolic rate in postmenopausal women (Kemmler et al., 2010a), elders (Kemmler et al., 2010b), but was not worked with sedentary healthy women (6, 7,
The aim of the present study was to examine the effects of electromyostimulation training with voluntarily muscle contractions on basal metabolic rate of sedentary women.

Materials and Methods

Experimental Design
The present study was including 8-weeks training program, and test-retest design in order to identify effect of the EMS. The all subjects have visited three times laboratory. During first visit, the subjects were familiarized basal metabolic rate measurement and the EMS training device. During second (pre-test) and third visit (post-test), basal metabolic rate test with bioelectrical impedance analyzer was applied on the subjects. Between second and third visit, 8-week EMS exercise protocol applied on all the subjects.

Subjects
Ten sedentary women (age = 30.50 ± 5.50 years, height = 164.70 ± 4.72 cm) participated in the study as subject. Nutrition advice were not given to the subjects. The pregnant, the persons who was in first two days of the menstruation period. EMS practice was not applied on the subjects during first two days of the menstruation period.

Exercise Protocol
The EMS exercise program was implemented during 8 weeks (3 days/week, 25 min/day) with Miha Bodytec EMS device (Augsburg, Germany) as following four steps; 1. 10 minutes general warm-up, 2. First 10 minutes of the EMS training, worked out with the dumbbell lifting in intensity of 4 seconds stimulation and 4 seconds rest, 3. Second 10 minutes of the EMS training, worked out with the step-aerobic moves in intensity of constant stimulation, 4. Last 5 minutes of the EMS training, applied active cooling moves, in intensity of 1 second stimulation and 1 second rest (6, 1). The EMS electrodes were placed on 16 regions of body. Electric current (current range 35-99 Hz) in 80 Hz frequency was used each training unit. According to intensity of the subjects can tolerate, current intensity was adjusted separately for the each region of the body. The conductive gel was used to improve electrical current transmission (7).

Data Collection Procedures
Height was measured in the anatomic position, and without shoes. Weight, body mass index (BMI), and basal metabolic rate (BMR) recorded with bioelectrical impedance analyzer (BC418MA, Tanita Corp., Tokyo, Japan). During the measurement, the subjects put their foot on the metal surface of the analyzer as barefoot, and they held the hand electrodes with their hands. At this position, they wait one minute, and after data were recorded (9). The measurement was taken two times as one day before and after 8-week exercise period.

Statistical Analyses:
All statistical calculations were performed using SPSS version 22.0. Data were presented as mean, and standard deviation. Shapiro-Wilk test was used for normality. Paired Samples T test was applied for analysis of difference between the pre- and post-test. Statistical results were evaluated on p ≤ 0.05 as significance level.

Results
The pre- and post-test results of the subjects were presented in Table 1. Significant decrease (p < 0.05) was observed in the weight, and BMI. There was no significant difference in the BMR of all the subjects between pre- and post-tests (p > 0.05). The weight was recorded 64.23 ± 7.65 kg, and 61.43 ± 7.41 kg; the BMI was observed 24.18 ± 2.56 kg/m², and 22.66 ± 2.74 kg/m²; and the BMR was determined as 1375.20 ± 228.33 kcal, and 1392.20 ± 239.91 kcal in the pre- and post-tests, respectively.

Table 1. Analysis of obtained data

<table>
<thead>
<tr>
<th>Variable</th>
<th>Test</th>
<th>Mean ± SD</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (kg)</td>
<td>Pre-test</td>
<td>64.23 ± 7.65</td>
<td>7.519</td>
<td>0.001*</td>
</tr>
<tr>
<td></td>
<td>Post-test</td>
<td>61.43 ± 7.41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>Pre-test</td>
<td>24.18 ± 2.56</td>
<td>4.001</td>
<td>0.003*</td>
</tr>
<tr>
<td></td>
<td>Post-test</td>
<td>22.66 ± 2.74</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BMR (kcal)</td>
<td>Pre-test</td>
<td>1375.20 ± 228.33</td>
<td>1.119</td>
<td>0.292</td>
</tr>
<tr>
<td></td>
<td>Post-test</td>
<td>1392.20 ± 239.91</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*significant difference between pre- and post-test. BMI = Body mass index, BMR = basal metabolic rate, SD = standard deviation
Discussion and Conclusion

The effects of the EMS with voluntarily muscle contractions on the BMR in sedentary women were examined in the present study. Significant decrements were not found in BMR, while weight and body mass index showed significant decrement in the present study. Previous studies showed that the EMS with voluntarily muscle contractions can affect weight and body mass index (10, 6, and 11). From this perspective, the findings of the present study showed similarly with previous researches. Researchers observed the effects of EMS on jumping (5, 12, 13), strength (Deley et al., 2011; Herrero et al., 2006; Maffiuletti et al., 2009), and skill development (Billot et al., 2010; Hettinga and Andrews, 2007) previously (14, 15, 16). But there were no study about of EMS and basal metabolic rate in sedentary women. Recent research showed that the EMS was not affect BMR in postmenopausal women (Kemmler et al., 2010a) and elders (Kemmler et al., 2010b). The BMR represents a key determinant of the magnitude of fat-free mass, and change in basal metabolic rate shows lean mass changes (17, 18). In the present study, the BMR showed a small amount of increment but there was no significant change. The above knowledge may be explained why there is no change in BMR.

In conclusion, in this group of sedentary women, the EMS training with voluntarily muscle contractions may not be affecting the BMR. There is a requirement for further studies for the EMS and the BMR in various age, gender, and trained groups.

Conflict of interest
The authors declare no conflict of interest

References

15. Billot M, Martin A, Paizis C, Cometti C, Babault...