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Effects of whole-body electromyostimulation with two different frequencies and combined training on lipid profile and body composition in overweight women

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Abstract

Introduction. The study aimed to investigate the effects of whole-body electromyostimulation (WB-EMS) and combined training on lipid profile and body composition in overweight women.
Methods. Overall, 45 overweight (body mass index [BMI]: 27.73 ± 1.59 kg/m2) women (aged 32.89 ± 4.59 years) voluntarily participated in this study. They were randomly assigned to 3 groups: a WB-EMS group, who received WB-EMS (2 sessions/week, 20 min/session; first session each week: 85 Hz, 350 µs, 4 s pulse, 4 s rest; second session: 7–15 Hz, 350 µs, continuous pulse); a combined training group, who underwent aerobic and bodyweight resistance training (2 sessions/week, 20 min/session); and a control group. In all 3 groups, lipid profile and body composition were assessed before and after 8 weeks of intervention.
Results. In the WB-EMS group, within-group comparison revealed significant differences in triglyceride, cholesterol, high-density lipoprotein, low-density lipoprotein, body weight, BMI, waist-hip ratio, waist circumference, body fat percentage, body fat mass, and lean body mass values ($p \leq 0.05$); there was no significant difference only in fasting blood sugar. In the combined training group, a significant difference was only observed in BMI ($p \leq 0.05$). In the post-intervention between-group comparison, there were significant differences only in high-density lipoprotein and body fat percentage ($p \leq 0.05$).
Conclusions. Since WB-EMS has positive effects on lipid profile and body composition, it may be a proper method for people who have limited time for exercise or are unable or unmotivated to practise conventional exercises.
Key words: electromyostimulation, aerobic training, bodyweight resistance training

Introduction

Today, obesity and overweight are important problems which have a negative impact on life quality and community health [1]. The World Health Organization has reported the prevalence of overweight in Iranians to be generally 60.5% (58.0% in men and 63.1% in women) [2]. Also, studies in Iran have shown a higher prevalence of obesity and overweight among women than men [3]. People who are overweight are at higher risk of a variety of disabling and life threatening chronic conditions, such as high blood pressure, cardiovascular diseases, diabetes, gallbladder diseases, digestive diseases, cancer, menstrual abnormalities, arthritis, gout, respiratory dysfunction, psychosocial dysfunction, etc. [4]. Exercise has positive impacts on many of the risk factors, diseases, and disabling conditions in the middle-aged and older. However, the majority of middle-aged and older people do not implement the recommended exercise doses that have positive effects on cardiorespiratory, musculoskeletal, and neurophysiologic systems and fitness or disabling conditions. Whole-body electromyostimulation (WB-EMS) may be a promising intervention for individuals unable or unmotivated to practise conventional exercise [5].

In the WB-EMS technology, electrical stimuli are directly transferred into the skin near the dermis tissue through electrodes embedded in vests and special straps. These impulses make muscles expand and contract exactly the way they do during common exercise. Modern WB-EMS devices stimulate all main muscle groups (up to an area of 2800 cm^2) simultaneously with selectable intensity for each region while performing slight movements [6]. Exercising with WB-EMS equipment is safe and easy and accelerates the convalescence of patients with musculoskeletal diseases. It also improves body composition, alleviates cardiovascular risk factors, and enhances muscle performance [7–12].

Owing to its higher safety, the suggested WB-EMS protocol (20 minutes each session, bipolar pulse type, 85 Hz pulse frequency, 350 µs pulse width, 4–6 seconds pulse duration, 4 seconds rest, 0.1 pulse ramp) has been used by researchers recently [13]. Kemmler et al. [8] evaluated the effects of WB-EMS on resting metabolic rate, body composition (waist circumference [WC], sums of skinfolds), and maximum strength in 30 postmenopausal women and reported maintenance of resting metabolic rate levels and improvement of body composition and strength. This was one of the few studies that used a combination of 2 protocols in one training session (20 minutes) (10 minutes with 85 Hz and 10 minutes with 7 Hz frequency) [8]. Furthermore, D'Ottavio et al. [14] compared the effects of 2 WB-EMS protocols (85 Hz and 7 Hz frequencies) on strength and power variables. They found that both protocols improved the variables but no significant differences were observed between the groups [14]. Also, Kemmler et al. [10] evaluated the impact of WB-EMS and high-intensity resistance training on body composition in 46 healthy untrained men aged 30–50 years. They reported an improvement of body composition and strength in both groups, with no significant differences between the groups. This was one of the few studies that investigated the effects of WB-EMS in early adulthood. The research by Wittmann et al. [11] also showed that WB-EMS exerted a favourable influence on components of metabolic syndrome in elderly women with sarcopenic obesity. Moreover, Kemmler et al. [12]

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revealed positive effects of WB-EMS training on cardio-metabolic risk factors in elderly men with sarcopenic obesity.

Past research concerning WB-EMS in the field of body composition and lipid profile disorders, which are components of metabolic syndrome and cardio-metabolic risk factors, was often performed in elderly people with sarcopenic obesity and osteopenia, and WB-EMS effect on healthy women in early adulthood (under 40 years of age) who are only overweight has not been investigated. Also, stimulation frequency of 85 Hz was often used in the studies of WB-EMS, while a frequency below 50 Hz increases blood flow through aerobic pathway. What is more, many studies have emphasized that WB-EMS is a promising technology for people unable or unmotivated to practise regular exercise or have limited time. Therefore, it is important to evaluate the effect of WB-EMS compared with common exercise at gyms of the same duration. Thus, the aim of this study was to investigate the impact of exercise by WB-EMS with 2 different frequencies and combined training on lipid profile and body composition in overweight women.

Subjects and methods

Design and participants

The present study involved a pre-test and post-test design. The statistical population consisted of women in early adulthood who were overweight and had a training experience at gyms. Overall, 45 overweight (body mass index [BMI]: 27.73 ± 1.59 kg/m^2) women (age: 32.89 ± 4.59 years) that were normal in terms of general health voluntarily participated in this study. After being informed about the possible benefits and risks of the tests and training protocols, the subjects completed forms of written consent, test guide, health questionnaire, and medical history, confirmed their readiness to cooperate with the researcher, and were selected as participants. Then, they were randomly divided into 3 groups of 15:

– a group receiving WB-EMS with 2 different frequencies;
– a combined training group;
– a control group.

The primary criteria of selection consisted of female sex; age of 25–40 years (before menopause); BMI in the overweight range (25–29.9); absence of illnesses such as cardiovascular diseases, neurological diseases (myasthenia gravis, Parkinson's disease, epilepsy, and seizures), psychological diseases, cancer, blood and viral diseases, skin diseases, thyroid disorders, orthopaedic problems, high blood pressure; absence of pregnancy; no consumption of medications or supplements; no weight loss diets; and avoiding exercises outside of this research. Table 1 lists the baseline characteristics of the participants. No relevant differences between the groups were observed for these parameters.

After selecting the samples, 1 week before the start of the main protocol, pre-intervention assessments of lipid profile and body composition variables, including height, weight, limb perimeter, subcutaneous fat thickness, and blood samples, were conducted in all 3 groups. Then, the subjects performed the respective training protocols during 8 weeks. After the completion of the 8-week training, all the assessments that were applied before were repeated.

The study outcomes involved:

– triglycerides (TG), total cholesterol (TC), high-density lipoprotein (HDL), low-density lipoprotein (LDL), fasting blood sugar (FBS);

– BMI, waist-hip ratio (WHR), WC, body fat percentage (BF%), body fat mass (BFM), lean body mass (LBM).

Study procedure

Whole-body electromyostimulation with 2 different frequencies

The WB-EMS group carried out their training with WB-EMS equipment (miha bodytec, Gersthofen, Germany). The system used in this research was of the wired system type. The device enables simultaneous activation of 14–18 regions or 8–12 muscle groups (both upper legs, both upper arms, bottom, abdomen, chest, lower back, upper back, latissimus dorsi, and 4 free options; up to 2800 cm^2 stimulated area) with different selectable intensity for each region [15]. Such contraction requires the production of a strong magnetic field; in this device, the magnetic field is created in the system panel and then the required energy is transmitted to the electrodes embedded on the vest, belt, arm, and leg cuffs through wires in order to facilitate the contraction of all the muscles groups.

The exercise was performed individually with a certified instructor. During the sessions of WB-EMS, the subjects used special (cotton) clothes. In order to warm up the body before exercise, each participant did about 5–10 minutes of simple stretch and flex exercises. Before the individuals wore the electromyostimulation vest, first, all the electrodes embedded on the surface of the electromyostimulation vest, belt, arm, and leg cuffs were wetted with serum or water. Also, before exercise, the subjects consumed isotonic drinks. While performing the 20-minute WB-EMS, it was necessary to do simple exercises (low loading, low amplitude movement) to create autonomic contractions and angles in the major joints and prevent any injury to the muscle spindle. The various

Table 1. Baseline characteristics of the groups (mean ± standard deviation)

Variable	WB-EMS (*n* = 15)	CT (*n* = 15)	CG (*n* = 15)	*p*
Age (years)	32.00 ± 4.94	34.27 ± 4.81	32.40 ± 3.96	0.362
Height (cm)	164.07 ± 4.33	163.73 ± 6.90	162.20 ± 3.02	0.559
Weight (kg)	74.80 ± 6.07	73.89 ± 7.76	73.48 ± 4.18	0.810
BMI (kg/m^2)	27.81 ± 1.68	27.45 ± 1.85	27.94 ± 1.24	0.691
Body fat (%)	32.44 ± 2.82	33.61 ± 1.99	32.08 ± 1.67	0.155
Received energy (calories/day)	1972.8 ± 72.5	1943.1 ± 123.5	1950.8 ± 54.9	0.638

Significance level was considered at $p < 0.05$.
WB-EMS – whole-body electromyostimulation, CT – combined training, CG – control group, BMI – body mass index

Table 2. Whole-body electromyostimulation protocol in the current research

Components	First program (first session) in a week (muscle building)	Second program (second session) in a week (cardio)
Pulse frequency (Hz)	85	7–15
Pulse duration (s)	4	Continuous
Rest duration (s)	4	–
Pulse width (µs)	350	350
Pulse type	Bipolar	Bipolar
Perceived pulse intensity (RPE scale)	Hard and very hard (Borg scale 6–20) 14–16 RPE	Hard and very hard (Borg scale 6–20) 14–16 RPE
Training session duration (min)	20	20

RPE – rating of perceived exertion

exercises that were performed during the 20-minute electromyostimulation with the help of the instructor included isometric exercises (static press, squat, deadlift, crunch, lunge, plank, leg raise, glute bridge, etc.) and simple dynamic exercise without adding loads or weights. These exercises were designed to be simple and in accordance with the inducted pulse and rest duration. Autonomic contractions (such as squats etc.) were done during pulse induction; during rest, the body was in a non-contraction and relaxed state.

The subjects carried out their exercises for 8 weeks, 2 sessions per week, each session lasting for 20 minutes. The setup program selected in this schedule in accordance with the recommended WB-EMS protocol [13] is listed in Table 2. The WB-EMS exercises involved 2 different frequencies. The schedule of the first session of the week was as follows: 20 minutes, 85 Hz, 350 µs, 4 s pulse duration, 4 seconds rest, Borg scale 14–16 (rating of perceived exertion [RPE]) [16]; and the schedule of the second session of the week was as follows: 20 minutes, 7–15 Hz, 350 µs, continuous pulse duration, and RPE of 14–16. This sequence was performed for 8 weeks. The current intensity used in each muscle area was increased gradually every 3–5 minutes in each session, with a cooperation between the subject and the instructor until the RPE scale was maintained in the 'somewhat hard and hard' range. The RPE scale values reported by the participants at the end of each session were recorded every week. Also, at the end of each session, the instructor wrote down and recorded the selected setup program on individual cards for quick and accurate adjustments in the subsequent sessions.

Combined training

The subjects carried out combined training including aerobic exercises (running and treadmill) and bodyweight resistance exercises (push-ups, burpee, squat, lunge, plank, mountain climber, etc.) for 8 weeks, 2 sessions per week, 20 minutes for each session.

A heart rate monitor (Polar, Finland) and Borg scale were used for measuring the intensity of the aerobic exercises and RPE. The formula of 220 – age was applied to calculate maximum heart rate. The training intensity started at 50–60% of maximum heart rate and was increased to 70–80% of maximum heart rate in the final weeks. In the bodyweight resistance exercises, the combination of exercises started with 5 types and was increased to 10. Exercise repetition count was 12–20, rest duration was 30–60 seconds, and training intensity equalled 65–80% of maximum heart rate.

Control group

This group implemented no regular or planned physical activity for 8 weeks.

Measurements

Blood samples were collected 1 week before the training schedule and 72 hours after the final training session while the subjects had been fasting for 12 hours, in the morning (9:00–10:00), in a sitting position, from an antecubital vein. They were taken by a laboratory technician of the Razi Pathobiology Laboratory of Rasht, Iran. It must be mentioned that following ISO 9001:2008 standard management requirements, specialized laboratory standards such as ISO 15189:2007, and the requirements described by health reference laboratory is of special importance to this laboratory. The investigated blood parameters (TG, TC, HDL, LDL, and FBS) were measured with Olympus laboratory equipment and Pars Azmoon and Bionik laboratory kits.

The weight and height of the subjects with least amount of clothing were determined by using Beurer scales and stadiometer (manufactured in Germany), with measuring accuracies of 0.1 kg and 0.1 cm, respectively. BMI was calculated as weight (kg) divided by height squared (m^2). Limb perimeter was established with a measuring tape and the recommended instructions of the International Society for the Advancement of Kinathropometry were followed. WC and WHR were calculated as per instructions. BF% of was evaluated with the subcutaneous fat thickness method. The Jackson and Pollock 7-site method (the following equation) was suggested for calculating BFM [17, 18]:

$$\text{Body density} = 1.097 - 0.00046971 \times (\sum 7) + \\ + 0.00000056 \times (\sum 7)^2 - 0.00012828 \times x^2$$

$\sum 7$ = total subcutaneous fat thickness (mm),
x^2 = age (years)

$$\text{Siri BF\%} = [(4.95 / \text{body density}) - 4.5] \times 100$$

The subcutaneous fat thickness was assessed with a calliper (Lafayette, USA). In this method, the calliper is placed on the subject for 2–4 seconds. This short period prevents the skinfold from being compressed between the calliper tips. The measurements were taken with the participant standing, from the right side of the body. Each of the 7 marked sites (Jackson and Pollock method) was measured 2 or 3 times. BFM was obtained by multiplying BF% by total body fat. LBM was calculated by subtracting BFM from total body weight (TBW) (LBM = TBW – BFM; BFM = TBW × BF%).

A medical history questionnaire and the Physical Activity Readiness Questionnaire were used to evaluate the subjects' demographic status (age, health and disease, lifestyle, daily activity level, etc.). Also, to calculate individual calorie intake in the daily diet, a protocol of a 4-day food record questionnaire was filled in by each participant before and after intervention. The calorie intake in this study was assessed on the basis of the calculation of several diet days. Thus, the subjects wrote down the contents of their daily diet in accordance with the guidelines on the food leaflets over several days. The researcher then added the calories of the products, obtained the calorie intake of each individual, and recorded the mean for each person. The subjects were also asked not to alter their normal calorie intake during the intervention; this was monitored via their reports on the food leaflets.

Statistical analysis

The Shapiro-Wilk test was used to verify the normality of data distribution. The mixed-design analysis of variance (ANOVA) test (2 × 4) and Bonferroni post-hoc test were applied to test the research hypotheses. Data analysis was performed with the SPSS software, version 23.

Ethical approval

The research related to human use has complied with all the relevant national regulations and institutional policies, has followed the tenets of the Declaration of Helsinki, and has been approved by the Research Ethics Committee of the Institute of Physical Education and Sports Sciences, Teheran (ID No.: IR.SSRC.REC.1399.001).

Informed consent

Informed consent has been obtained from all individuals included in this study.

Results

Individual information on the subjects, including age, height, weight, BMI, and calorie intake, which were used to verify group homogeneity, are provided in Table 1. As can be seen, no significant differences were observed for age, height, weight, BMI, or calorie intake of the participants, which indicates the normal distribution of groups.

The subjects' attendance rate in the training sessions was complete. It should be noted that in the WB-EMS group, exercises were not performed by the participants during their menstruation; instead, they were compensated for in alternative sessions during the intervention period. No incidents of medical importance or relevant negative side effects related to the study interventions were reported by the participants during the study period. Furthermore, changes in parameters (such as lifestyle, energy intake, diseases, medication, etc.) that may have affected our study outcomes did not vary between the groups.

Exercise volume did not vary between the WB-EMS and combined training groups and equalled 20 ± 0 minutes per session for both groups. Mean exercise intensity in the WB-EMS group that was reported by the subjects (Borg RPE scale: 6–20) was 14.8 ± 0.77. Moreover, mean exercise intensities in the combined training group that were reported by the subjects were 12.53 ± 0.51 in the first 2 weeks, 13.4 ± 0.63 in the second 2 weeks, 14.93 ± 0.70 in the third 2 weeks, and 15.8 ± 0.67 in the final 2 weeks.

Significant differences were observed for the lipid profile (TG, TC, HDL, and LDL) in the WB-EMS group ($p \leq 0.05$): TG, TC, and LDL were significantly decreased and HDL was significantly increased, while there was no significant difference in FBS. No significant differences were found in the lipid profile variables (TG, TC, HDL, and LDL) or FBS in the combined training group. However, in the between-group comparison, significant differences were only revealed in HDL between the WB-EMS and combined training group ($p = 0.001$) and the WB-EMS and control group ($p = 0.001$); there were no significant between-group differences in other variables.

In the body composition variables, significant reductions were observed in body weight, BMI, WHR, WC, BF%, BFM, and LBM in the WB-EMS group ($p \leq 0.05$). In the combined training group, a significant reduction was only seen in BMI ($p = 0.04$). However, in the between-group comparison, a significant difference was only noted in BF% between the WB-EMS group and the combined training group ($p = 0.035$); there were no significant differences in other variables.

The lipid profile and body composition variables before and after the study intervention in all 3 groups are listed in Table 3.

Discussion

The research results revealed that 8 weeks of exercise with WB-EMS with 2 different frequencies could reduce components of body composition (weight, BMI, WHR, WC, BF%, BFM, and LBM), TG, TC, and LDL, as well as increase HDL, while FBS presented no significant changes. In turn, 8 weeks of combined training only reduced BMI, although the decrease in BMI in the WB-EMS group was higher than that in the combined training group, and no significant changes were observed in the other variables. Significant between-group differences were only observed in HDL and BF%.

The findings of this study in the combined training group are consistent with those obtained by Zarei et al. [19], who did not demonstrate any significant differences in TC, LDL, HDL, body weight, WHR, LBM, or BF% after 12 weeks of combined training. However, they observed a significant decrease in TG and no significant changes in BMI, which is not consistent with the present study. Arazi et al. [20] showed that 8 weeks of combined training resulted in a significant decrease in TG, TC, LDL, and blood glucose, as well as a significant increase in HDL, which is not in line with the present study. Hosseini Kakhk et al. [21] revealed a significant decrease in BMI and insignificant changes in LBM and WHR after 8 weeks of combined training, which is consistent with the current study. Nevertheless, they found a significant decrease in body weight, WC, hip circumference, BF%, TG, TC, LDL, and TC/HDL ratio, which does not corroborate the present study. Jahanshiri and Bijeh [22] showed that 8 weeks of combined training resulted in a significant decrease in BMI, which is consistent with the present study, but they also found a significant decrease in WHR and BF%, as well as an improvement of lipid profile, not in line with the current study. Among the reasons for these inconsistencies with the above-mentioned studies could be the general characteristics of the subjects, type of exercise (weight training or bodyweight resistance training), number of training sessions, exercise duration in each session, the length of the training period, the intensity of the activity, and others.

Studies of lipid profile and FBS are limited for comparison and discussion. However, the results in lipid profile and FBS obtained in the WB-EMS group are consistent with those provided by Kemmler et al. [12], who demonstrated that

Table 3. Study outcomes in the 3 groups (mean ± standard deviation) before and after the intervention

Parameter		WB-EMS (n = 15)	CT (n = 15)	CG (n = 15)	Between-group comparison p
Triglycerides (mg/dl)	Before	89.93 ± 29.55	100.53 ± 33.65	92.40 ± 16.74	0.219
	After	83.20 ± 29.31	105.00 ± 32.61	92.6 ± 15.62	
Within-group comparison p		0.001*	0.620	0.625	–
Total cholesterol (mg/dl)	Before	161.40 ± 23.26	147.60 ± 19.66	151.80 ± 22.33	0.523
	After	149.80 ± 23.36	145.93 ± 19.59	151.53 ± 21.18	
Within-group comparison p		0.001*	0.656	0.750	–
HDL (mg/dl)	Before	52.13 ± 7.98	39.46 ± 5.16	41.80 ± 5.00	0.001*
	After	59.73 ± 8095	40.40 ± 6.37	41.93 ± 4.38	
Within-group comparison p		0.001*	0.427	0.750	–
LDL (mg/dl)	Before	89.00 ± 22.25	83.80 ± 15.40	80.66 ± 16.05	0.912
	After	77.86 ± 21.84	80.53 ± 18.63	80.45 ± 15.59	
Within-group comparison p		0.001*	0.166	0.683	–
FBS (mg/dl)	Before	85.53 ± 1.88	82.26 ± 5.62	84.20 ± 6.67	0.174
	After	83.20 ± 6.25	79.60 ± 7.85	83.73 ± 5.52	
Within-group comparison p		0.149	0.089	0.509	–
Body weight (kg)	Before	74.80 ± 6.07	73.59 ± 7.76	73.48 ± 4.18	0.975
	After	72.84 ± 5.47	73.09 ± 7.71	73.46 ± 4.19	
Within-group comparison p		0.001*	0.072	0.424	–
BMI (kg/m²)	Before	27.81 ± 1.68	27.45 ± 1.85	27.94 ± 1.24	0.559
	After	27.05 ± 1.59	27.22 ± 1.89	27.91 ± 1.27	
Within-group comparison p		0.001*	0.040*	0.366	–
WHR	Before	0.79 ± 0.04	0.80 ± 0.03	0.79 ± 0.03	0.438
	After	078 ± 0.03	0.80 ± 0.03	0.78 ± 0.02	
Within-group comparison p		0.017*	0.903	0.565	–
WC (cm)	Before	93.70 ± 8.95	97.46 ± 7.42	90.26 ± 8.03	0.061
	After	89.96 ± 8.76	96.53 ± 6.80	90.10 ± 8.11	
Within-group comparison p		0.001*	0.160	0.173	–
Body fat (%)	Before	32.44 ± 2.82	33.61 ± 1.99	32.08 ± 1.67	0.085
	After	31.56 ± 2.51	33.57 ± 1.99	32.08 ± 1.67	
Within-group comparison p		0.001*	0.334	0.334	–
BFM (kg)	Before	24.38 ± 3.72	24.84 ± 3.83	23.62 ± 2.38	0.609
	After	23.10 ± 3.18	24.57 ± 3.74	23.61 ± 2.39	
Within-group comparison p		0.001*	0.070	0.267	–
LBM (kg)	Before	50.41 ± 2.91	48.74 ± 4.16	49.85 ± 2.13	0.375
	After	49.89 ± 2.50	48.51 ± 4.17	49.84 ± 2.14	
Within-group comparison p		0.039*	0.151	0.582	–

* significant values ($p < 0.05$)
WB-EMS – whole-body electromyostimulation, CT – combined training, CG – control group, HDL – high-density lipoprotein, LDL – low-density lipoprotein, FBS – fasting blood sugar, BMI – body mass index, WHR – waist-hip ratio, WC – waist circumference, BFM – body fat mass, LBM– lean body mass

exercise by WB-EMS caused similar TC reduction and the TC/HDL ratio improvement; also, no significant changes were observed in FBS. However, the aforementioned study showed no significant increases in HDL levels and TG, which is not consistent with our research. Possible causes for this inconsistency could include the age of the subjects, the length of the training period, as well as nutrition and supplementation. Also, Kemmler et al. [23] revealed that 16 weeks of exercise by WB-EMS led to no changes in the ratio of TC/HDL, TG, or glucose, which is not in line with this study. Possible causes for this inconsistency could be the length of the training period, schedule type, and frequency. Furthermore, the results of this study do not support the research by Wittmann et al. [11], who observed no significant changes in FBS, TG, or HDL during 6 months of exercise by WB-EMS. Possible causes for this inconsistency could be the age of the subjects, number of training sessions, schedule type, and frequency. The subjects of this study were in their early adulthood (25–40 years) and it seems that the physiological responses in this population are different than in the elderly. Also, the training status in the said study was a lying position on a chair with slight movements, while in our study, active training status was used. Furthermore, the applied protocol involved 1 session per week, whereas in the current study, 2 sessions per week were applied and 2 frequencies (85 Hz for resistance training and 7–15 Hz for aerobic exercise) were combined over a 2-month period. The different schedules of aerobic (low frequency and continuous pulse) and resistance (muscle building) training (high frequency and short pulse duration with short breaks) were implemented in 2 different sessions every week with WB-EMS equipment.

The results of this study concerning body composition in the WB-EMS group indicate positive effects of the intervention; this is consistent with the findings by Kemmler et al. [8], who showed that WB-EMS caused similar changes in body weight reduction, skinfolds, and WC. Moreover, Kemmler and von Stengel [9] revealed that exercise by WB-EMS similarly reduced WC; Kemmler et al. [15] demonstrated that WB-EMS similarly reduced WC and slightly decreased BFM; Kemmler et al. [10] implied that WB-EMS similarly reduced BF%; Wittmann et al. [11] reported significant effects of WB-EMS on the reduction of WC; Kemmler et al. [23] described significant effects of WB-EMS on the reduction of WC; and Kemmler et al. [12] indicated that WB-EMS caused similar changes in WC and BF%. Not in line with our study, however, Kemmler et al. [15] and Kemmler et al. [10] observed a significant increase in LBM. Possible causes for this inconsistency could be the exercise duration and the applied stimulation frequency: in the current study, 85 Hz (resistance training) and 7–15 Hz (aerobic exercise) were implemented during 8 weeks of training. Also, WB-EMS led to weight loss and, as a result, BFM and LBM reduction. The amount of reduction and effect size (0.719) for BFM were more than 3 times higher than the respective values for LBM (effect size: 0.270). The subjects' nutrition could be another possible cause of this inconsistency. Proper nutrition and calorie restriction are factors that can affect LBM changes [24]. Furthermore, the participants' gender could have influenced LBM reduction as all the participants in the current study were female, while in the aforementioned studies, all participants were male.

Conclusions

After 8 weeks of exercise by WB-EMS, positive effects were observed in lipid profile and body composition, while after 8 weeks of combined training (aerobic and resistance) of the same duration, no significant changes were seen in lipid profile or body composition. However, the changes that resulted from WB-EMS application were not significantly different when compared with conventional exercises such as combined training. Finally, it can be concluded that exercise by WB-EMS is uneconomical for people in their early adulthood who are able to do conventional exercise. Nevertheless, this modern technology can be an interesting and time-efficient exercising method for individuals unable or unmotivated to exercise conventionally. For a more precise conclusion, more research in this field seems necessary, especially with regard to different training protocols and their comparison with different types of exercise.

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Disclosure statement

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Conflict of interest

The authors state no conflict of interest.

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