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Effects of Whole-Body Electromyostimulation and Resistance Training on Body Composition and Maximal Strength in Trained Women

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Abstract

Purpose: to investigate the effect of WB-EMS training and resistance training on body composition and maximal strength in trained women.
Material and methods: 30 trained women (with a mean age of 25.70 ± 2.27 years, height of 1.63 ± 0.032 m, and weight of 60.46 ± 5.50 kg) were randomly divided into three groups of ten (WB-EMS training, strength training (ST), and control group (CG)). The training program was performed for 6 weeks and two sessions per week (WB-EMS: 20 minutes, 85 Hz, 350 µs, 6 s pulse duration, 4 s rest; and ST: 1-RM 60-80%, 3 sets, 8-12 repeats, 50-90 s rest between each set). In all three groups, BF%, LBM and Maximal Strength were measured before and after the training period.
Results: Intragroup comparison in WB-EMS group showed a significant difference in BF% and LBM ($P \le 0.05$); while in the intergroup comparison, no significant difference was observed between the WB-EMS group and CG. Also in ST group, BF% and LBM values did not show any significant changes. There was also a significant difference in Maximal Strength in the intragroup comparison between both WB-EMS and ST groups and a significant difference between the WB-EMS group and CG and between ST group and CG in the intragroup comparison after the test ($P \le 0.05$); while there was no significant difference between WB-EMS and ST groups.
Conclusions: According to the findings, it can be concluded that both types of exercise can improve maximal strength, although each of these exercises has its own benefits.
Keywords: Electrical Stimulation, physical activity, fitness, weight control

Анотація

Садегіпур С., Мірзай Б., Коробейников Г.В., Тропін Ю. Вплив електростимуляції всього тіла і тренувань з обтяженнями на склад тіла і максимальну силу у тренованих жінок

Мета: вивчити вплив тренування з електростимуляцією всього тіла (WB-EMS) і силових тренувань на композицію тіла і максимальну силу у тренованих жінок.

Матеріал і методи: 30 тренованих жінок (середній вік 25,70 ± 2,27 років, зростання 1,63 ± 0,032 м і вага 60,46 ± 5,50 кг) були випадковим чином розділені на три групи по десять чоловік (тренування WB-EMS , силові тренування (СТ), і контрольна група (КГ)). Програма тренувань проводилася протягом 6 тижнів і двох занять на тиждень (WB-EMS: 20 хвилин, 85 Гц, 350 мкс, тривалість імпульсу 6 с, відпочинок 4 с; і ST: 1-RM 60-80%, 3 підходи, 8 -12 повторень, відпочинок 50-90 с між підходами). У всіх трьох групах BF%, LBM і максимальна сила вимірювалися до і після періоду тренування.

Результати. Внутрішньогрупове порівняння в групі WB-EMS показало значну різницю в BF% і LBM (P ≤ 0,05); в той час як при міжгруповому порівнянні не спостерігалося значної різниці між групою WB-EMS і CG. Також в групі ST значення BF% і LBM не показали значних змін. Також спостерігалася значна різниця в максимальній силі при внутрішньогруповому порівнянні між групами WB-EMS і ST і значна різниця між групою WB-EMS і CG, а також між групою ST і CG у внутрішньогрупповому порівнянні після тесту (P ≤ 0,05); в той час як не було значної різниці між групами WB-EMS і ST.

Висновки. Згідно з отриманими даними, можна зробити висновок, що обидва типи вправ можуть поліпшити максимальну силу, хоча кожне з цих вправ має свої переваги.

Ключові слова: електростимуляція, фізична активність, фітнес, контроль ваги.

Аннотация

Садегипур С., Мирзаи Б., Коробейников А.В., Тропин Ю. Влияние электромиостимуляции всего тела и тренировок с отягощениями на состав тела и максимальную силу у тренированных женщин

Цель: изучить влияние тренировки с электростимуляцией всего тела (WB-EMS) и силовых тренировок на композицию тела и максимальную силу у тренированных женщин.

Материал и методы: 30 тренированных женщин (средний возраст 25,70 ± 2,27 года, рост 1,63 ± 0,032 м и вес 60,46 ± 5,50 кг) были случайным образом разделены на три группы по десять человек (тренировки WB-EMS, силовые тренировки (СТ), и контрольная группа (КГ)). Программа тренировок проводилась в течение 6 недель и двух занятий в неделю (WB-EMS: 20 минут, 85 Гц, 350 мкс, длительность импульса 6 с, отдых 4 с; и ST: 1-RM 60-80%, 3 подхода, 8-12 повторений, отдых 50-90 с между подходами). Во всех трех группах BF%, LBM и максимальная сила измерялись до и после периода тренировки.

Результаты. Внутригрупповое сравнение в группе WB-EMS показало значительную разницу в BF% и LBM (P ≤ 0,05); в то время как при межгрупповом сравнении не наблюдалось значительной разницы между группой WB-EMS и CG. Также в группе ST значения BF% и LBM не показали значительных изменений. Также наблюдалась значительная разница в максимальной силе при внутригрупповом сравнении между группами WB-EMS и ST и значительная разница между группой WB-EMS и CG, а также между группой ST и CG во внутригрупповом сравнении после теста (P ≤ 0,05); в то время как не было значительной разницы между группами WB-EMS и ST.

Выводы. Согласно полученным данным, можно сделать вывод, что оба типа упражнений могут улучшить максимальную силу, хотя каждое из этих упражнений имеет свои преимущества.

Ключевые слова: электростимуляция, физическая активность, фитнес, контроль веса.

Introduction

Today's lifestyle in the digital age has minimized the opportunity to move. Sedentary lifestyle will have consequences such as reduced efficiency, increased health costs, and therefore a sick community. Having an active lifestyle by engaging in physical activity and having high physical fitness and proper weight control, helps to reduce a variety of deaths, heart disease, high blood pressure, hyperlipidemia, some types of cancers, type 2 diabetes, osteoporosis, hip fractures, menstrual disorders, and mental health [1].

Researches on physical activity and exercise programs have shown that resistance training can improve physical function and health indicators in women [2]. Most of these studies have reported increased cross-sectional area, volume, strength, and muscle function after resistance training [3]. Resistance training can also rebuild lost muscle tissue, prevent muscle mass loss, and even reverse the process [4]. Moreover, recent studies have shown that electrical whole-body electromyostimulation (WB-EMS) also plays an important role in increasing muscle strength, reducing fat percentage and increasing lean body mass. This exercise method (WB-EMS) has been proposed as a new training and therapeutic method to strengthen muscles in cases where there is immobility or when there is a limit to voluntary exercise such as time constraint or disability and physical or motivational limitation to exercise normally [5].

WB-EMS technology is a method that stimulates muscles with an electric current and causes muscle contraction. Electrical pulses from the electrodes embedded in the WB-EMS special clothing are sent directly from the skin surface to the muscles and travel to the deepest layers of them. This device is able to activate 14-18 areas or 8-12 muscle groups simultaneously (upper legs, arms, buttocks, abdomen, waist, back, latissimus dorsi, and four free options; over 2800 cm^2 of stimulated area) [6].

As reported in the studies, using this technique can clearly achieve improvements in body composition, cardiovascular risk factors, and muscle strength, rehabilitation, etc. [7-11]. In a study, Kemmler et al (2010) examined the effects of WB-EMS on body composition and maximal strength in 30 postmenopausal women and reported significant improvements in body composition and strength [7]. Kemmler et al. [8] also compared the effects of WB-EMS and HIT (high-intensity resistance training) on body composition and strength in 46 healthy middle-aged men. They reported improved body composition and strength in both groups, but there was no significant difference between the groups [8]. In addition, Micke et al. (2018) evaluated the effects of 8 weeks of WB-EMS on leg muscle strength and power in 18 young trained men and reported that strength and power improved significantly in the WB-EMS group. But in general, WB-EMS did not show more benefits than traditional resistance training in healthy young adults [9]. D'Ottavio et al. [10] studied the effects of two WB-EMS protocols (frequency of 85 Hz and 50 Hz) on strength and power in 22 physical education students with a moderate to high fitness level. They reported that in all three groups, i.e., two experimental groups (two WB-EMS protocols) and a control group (circuit training with overloads), the variables improved, but no significant difference was observed between the groups [10]. Dormann et al. (2019) studied the effects of WB-EMS and short-term resistance training on fitness factors in 22 young trained women and reported comparable findings on fitness factors in both groups. However, they concluded that WB-EMS had no greater effect on physical fitness factors in active women than traditional resistance training [11].

In previous studies there were many differences in WB-EMS exercise protocols such as duration of the training period, Voluntary exercises while using WB-EMS, exercises that were compared with this method, programs, variable evaluation method, etc. However, based on the results of a small number of studies done on young people, most studies did not report the superior effect of WB-EMS training over other exercises in healthy young people. Nevertheless, in the community, the majority of users of this exercise method are young adults, and especially because of the positive effects that WB-EMS studies reported on body composition and strength, we see the promotion of this method of exercise among healthy young women. In addition, time constraints are often reported as a major barrier to continuing exercise, which, given that WB-EMS is a time-saving exercise protocol, it has been welcomed by more and more users. Therefore, more research is needed to find more scientific and reliable methods to evaluate the effects of WB-EMS training compared to traditional exercises in the same training duration and load in young adults. Therefore, the aim of this study was to investigate the effects of WB-EMS training and resistance training on body composition and maximum strength in trained women.

Material and Methods

The present study was an applied study with pre-test and post-test design. The statistical population of this study consisted of active women between 20 and 30 years old who had at least 2 years of regular physical activity in one of the sports. After reviewing their medical history and ensuring of their health (no cardiovascular diseases, neurological diseases, mental illnesses, cancer, blood and viral diseases, skin diseases, thyroid, orthopedic problems, hypertension and pregnancy), 30 active women with a mean age of 25.70 ± 2.27 years, height of 1.63 ± 0.032 m, weight of 60.46 ± 5.50 kg and BMI of 22.54 ± 1.59 kg/m^2 were randomly selected as samples and were divided into three groups of ten: whole-body electromyostimulation (WB-EMS), strength training (ST), and control group (CG) (they did not have any regular and planned physical activity and performed their normal daily activities). It should be noted that the participants, after being aware of the possible benefits and risks of the tests and reading the test guide and completing the consent form, undertook not to have any training program outside the training protocol, they also guaranteed to continue their daily diet and not take any medication or supplements during this period. This research project was approved by the research ethics committee of the Research Institute of Physical Education and Sports Sciences with the ethics ID IR.SSRC.REC.1400.008.

Then, initial measurements including height, weight, limb circumference, and subcutaneous fat thickness and one-repetition maximum test in order to measure the maximum strength (comprehensive explanation in the measurement section) were done for all 3 groups, one week before beginning the main protocol. After completing the pre-test, the subjects performed their training protocol for 6 weeks. At the end of the training protocol, all subjects participated in the post-test 48 hours after the last training session (same as the pre-test) on different days of the week and the same tests were taken again at the same time.

Training Procedure

Whole-Body Electromyostimulation

The subjects performed their exercises with the WB-EMS device under the brand name of MihaBodytec, manufactured in Germany. This device is able to contract the body muscles, thus 14-18 areas or 8-12 muscle groups (upper legs, arms, buttocks, abdomen, chest, waist, back, latissimus dorsi, and four free options; an area of more than 2.800 cm^2) are simultaneously stimulated [6]. The exercise was performed individually with an expert instructor. First, the subjects performed stretch and flex exercises for 5-10 minutes in order to warm up the body. Subjects performed their exercises for 6 weeks and 2 sessions per week for 20 minutes per session. The electrical stimulation program in this study was selected based on the recommended WB-EMS protocol [12]. So that 12 training sessions with frequency of 85 Hz, pulse amplitude of 350µs, pulse duration of 6 seconds, rest time of 4 seconds, and the Borg Rating of Perceived Exertion (RPE) [13] of "somewhat hard and hard" RPE 14-16 were performed. Every 3-5 minutes, the instructor increased the intensity of the current used in each muscle area (leg, abdomen, etc.) separately and slowly, until the perceived exertion was maintained in the "somewhat hard and hard" range. The perceived amount of exertion reported by the subjects at the end of each session was recorded by the instructor on individual cards for quick adjustment in subsequent sessions.

It is noteworthy that the subjects wore special clothes (cotton) in the WB-EMS sessions. Also, before wearing the electrical stimulation vest, first all the electrodes embedded in the surface of the vest, belt, arm and leg cuffs were soaked in serum or water. In addition, in order to prevent any injury during the 20-minute WB-EMS exercise, simple exercises were performed to create voluntary contractions and angles in the main joints. The various exercises without overload that were performed during 20 minutes of WB-EMS under the guidance of an instructor included: squat (6 s down) and vertical chest press / squat (6 s up) and vertical rowing; squat (6 s down) and lat pulldown / squat (6 s up) and military press; deadlift (6 s down) with arm curls (ext.) / deadlift (6 s up) with arm-curls (flex.); squat (6 s down), crunch with butterfly / squat (6 s up) and reverse fly; squat (6 s down) and trunk flexion (crunches) / return to upright position; these exercises were suggested by Kemmler et al. (2016) [8]. It should be noted that there is a relationship between these movements and electrical stimulation, so that during the pulse or stimulation, voluntary contractions (such as squats, etc.) are performed and when at rest, the body is in a state of rest with no voluntary contraction. Continuous monitoring of breathing is another important recommendation during WB-EMS training. Meaning the inhalation process is done at rest and the exhalation process is done during the pulse and stimulation. Breathing should also be short and fast, deep breathing in the abdomen causes the person to be unable to hold the muscles of their body properly, therefore deep breathing causes the body to relax. The correct breathing technique during WB-EMS exercises is

reminded by the instructor and performed by the subject.

Strength Training

All subjects in this study participated in a demonstration training program for one week before beginning the study in order to get acquainted with the training equipment and to learn the correct movement techniques. Subjects in this group performed each movement for 3 sets with 80-60% of one repetition maximum (1-RM) and eight to twelve repetitions in 6 weeks and 2 sessions per week. The rest interval between each turn was 60 to 90 seconds.

The training movements consisted of:

1. Leg press machine, 2. Chest fly machine, 3. Leg extensions machine, 4. Seated cable rows, 5. Hamstring machine.

Measurements

A digital scale with a measurement accuracy of 0.1 kg and a wall-mounted stadiometer were used to measure weight and height. BMI was calculated as weight divided by height squared. Subcutaneous fat thickness measurement method was used to measure body fat percentage. Subcutaneous fat thickness was measured by Caliper Lafayette instrument (manufactured in USA) and was calculated according to Jackson-Pollock equation (equation bellow) [14]. Measurements were performed 2 or 3 times on the right side of the body and in 7 areas in a way that the subject was in a standing position. After calculating the body fat percentage (BF %), lean body mass was calculated by subtracting the body weight from the fat mass weight.

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 (year)

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

LBM= TBW – BFM

The maximal strength of the subjects was measured by leg press exercise using the formula of one-repetition maximum (equation below) according to Brzezinski method [15].

One-repetition maximum = weight (kg) / $(1.0278 - 0.0278 \times \text{repetition})$

First the participants performed the general warm-up exercises and then, with 40-60% of their estimated maximum weight, performed 8-12 repetitions of the mentioned exercises for the specific warm-up. After two minutes of rest, the weights were increased so that the heaviest weight that the subject was unable to perform for more than six repetitions was recorded and the obtained load and repetition were put into the equation and the calculation results were recorded as the subjects' maximal strength.

To assess Confounding Factors (such as: health and disease status, medication, lifestyle, daily activity level, etc.), a medical history questionnaire and a physical activity readiness questionnaire (PARQ) were used.

Statistical analysis

Standard mean and standard deviation were used to describe the individual characteristics of the subjects and the research variables. Shapiro-Wilk test was used to evaluate the data distribution type and Leven test was used to examine the homogeneity of variance. To compare the mean of the research variables, mixed-design analysis of variance (2 × 3) and Bonferroni post hoc tests were used. All hypotheses were tested using SPSS software version 23 at a significance level equal to or less than 0.05.

Results

Subjects' individual information such as age, height, weight and body mass index are presented separately in Table 1. The results of Shapiro-Wilk test showed that the research variables in three groups were naturally distributed ($p < 0.05$), therefore, all calculations were performed using parametric statistical methods.

The results of mixed analysis of variance (2×3) test for the mean of BF% variable showed time effect ($F = 36.087$, $P_= 0.001$, $\eta^2 = 0.735$), time interaction effect × type of exercise ($F = 37.524$, $P_= 0.001$, $\eta^2 = 0.572$) is statistically significant but the intergroup effect of exercise type ($F = 0.312$, $P_= 0.734$, $\eta^2 = 0.023$) is not statistically significant. The results of Bonferroni post hoc test for intragroup comparison of mean of BF% variable show a significant difference between the mean value of BF% variable in pre-test and pot-test ($P = 0.001$) in the intragroup comparison in WB-EMS group, but in ST and Control groups, no significant difference was observed between the mean value of BF% in pre-test and post-test.

Table 1

Mean and standard deviation of subjects' individual characteristics

Variable	**WB-EMS**	**ST**	**CG**
	Standard Deviation ± Mean	Standard Deviation ± Mean	Standard Deviation ± Mean
Age (year)	26.5 ± 2.17	24.90 ± 2.07	25.70 ± 2.49
Weight (kg)	58.60 ± 3.56	62.23 ± 6.28	60.56 ± 6.16
Height (m)	1.64 ± 0.03	1.63 ± 0.02	1.64 ± 0.03
BMI (kg/m²)	21.79 ± 1.109	23.34 ± 1.63	22.49 ± 1.71

The results of mixed analysis of variance (2×3) test for the mean of LBM variable showed that the effect of time (F= 23.885, P=0.001, η^2= 0.469), the interactive effect of time × type of exercise (F= 15.945, P=0.001, η^2= 0.542), and the intergroup effect of type of exercise (F= 3.475, P=0.045, η^2= 0.205) were statistically significant. The results of Bonferroni post hoc test for intragroup comparison of mean of LBM variable show a significant difference between the mean value of LBM variable in pre-test and pot-test (P= 0.001) in the intragroup comparison in WB-EMS group, but in ST and Control groups, there was no significant difference between the mean value of LBM variable in pre-test and post-test. The results of Bonferroni post hoc test for intergroup comparison of mean of LBM variable show that in intergroup comparison in post-test, a significant difference was observed between the mean value of LBM variable between WB-EMS and ST groups (P = 0.028) but no significant difference was observed between WB-EMS and ST groups with CG, also in the pre-test there was no significant difference between the mean value of LBM variable between WB-EMS, ST and CG (Table 2).

Table 2

Changes of study outcomes in the three study groups

Variable		WB-EMS (n=10)	ST (n=10)	CG (n=10)	Between-group comparison
		Mean ± SD	Mean ± SD	Mean ± SD	P
Body fat (%)	Pre-test	25.88 ±1.53	24.38 ±3.79	24.74 ±3.32	0.734
	Post-test	25.01 ±1.46	24.40 ±3.81	24.73 ±3.33	
Within-group comparison	P	0.001*	0.415	0.418	-
lean body mass	Pre-test	44.29 ±1.01	46.85 ±2.49	45.42 ±2.97	0.045*
	Post-test	43.96 ±0.90	46.82 ±2.48	45.40 ±2.94	
Within-group comparison	P	0.001*	0.388	0.699	-
Maximal Strength	Pre-test	63.66 ±4.70	66.21 ±6.81	65.40 ±67	0.001*
	Post-test	80.64 ±3.86	83.35 ±5.77	65.32 ±6 86	
Within-group comparison	P	0.001*	0.001*	0.734	-

The results of mixed analysis of variance (2×3) for the mean of the Maximal strength (leg press) variable showed that the effect of time (F= 2043.382, P=0.001, η^2= 0.987), interactive effect of time × type of exercise (F= 518.567, P=0.001, η^2= 0.975), and the intergroup effect of exercise type (F= 6.894, P=0.001, η^2= 0.338) are statistically significant. The results of Bonferroni post hoc test for

intragroup comparison of the mean of the maximal strength variable show that in the intragroup comparison in WB-EMS and ST groups, a significant difference was observed between the mean value of the maximal strength variable in the pre-test and post-test (P= 0.001) but in the CG, no significant difference was observed between the mean value of the maximal strength variable in pre-test and post-test. The results of Bonferroni post hoc test for intergroup comparison of mean of maximal strength variable show that in intergroup comparison in post-test a significant difference was observed between the mean value of maximal strength variable between WB-EMS and CG (P = 0.001) and between ST and CG (P = 0.001) But no significant difference was observed between WB-EMS and ST groups, also in the pre-test there was no significant difference between the mean value of the maximal strength variable between WB-EMS, ST and CG.

Changes in the variables in all 3 groups before and after the study are shown in Table 2.

Discussion

The results of this study showed that 6 weeks of WB-EMS training did not have a significant effect on BF%, because although a significant decrease in BF% was observed in the WB-EMS group, but this decrease was not significant in the post-test compared to the CG. Also, no significant effect was observed on BF% in ST group. In addition, the findings showed that WB-EMS training did not have a significant effect on LBM, because although a significant decrease in LBM was observed in the WB-EMS group, but this decrease was not significant in the post-test compared to the CG. Also, no significant effect was observed in LBM in ST group. However, both WB-EMS and ST exercises showed a significant increase in maximal strength (leg press) and no significant difference was observed between WB-EMS and ST groups for maximal strength.

The results of some studies on body fat percentage changes are consistent with the findings of the present study; For example, in a study, Filipovic et al. (2019) reported no change in BF% after 7 weeks of WB-EMS training, the results of which are consistent with the results of the present study [16]; It is also consistent with the results of Kemmler et al. (2014) that showed a significant reduction in BF% after WB-EMS training [17]. However, Kemmler et al. (2010 and 2016) reported a significant reduction in BF% after WB-EMS training, which is not consistent with the present study [7, 8]. It is likely that a significant reduction in BF% in the study of Kemmler et al. (2010) and (2016) was due to the duration of the training period. In the present study, the subjects were intervened for only 6 weeks; while the training period of the mentioned studies was more than twice the present study. Moreover, in the mentioned studies, the experimental groups were not compared with the non-training control group, while in the present study; WB-EMS group was compared with control group and it was observed that although there was a significant intragroup change in the WB-EMS group, there was no significant difference in these changes in the intergroup comparison with the CG. Based on this intergroup comparison, we concluded that WB-EMS had no significant effect on BF%. Also, as in the BF% changes in the present study, a significant decrease in intragroup changes was observed in the WB-EMS group on LBM, while non-significant intergroup changes in LBM were observed in the comparison between WB-EMS and CG which indicates ineffectiveness of WB-EMS on LBM; These results contradict the study of Kemmler et al. (2014) as well as Kemmler et al. (2016) who reported a significant increase in LBM [17, 8]. Reasons for this discrepancy may include fluctuations in body weight and nutrition. In the present study, there was a significant reduction in body weight in the WB-EMS group. As a result of this weight loss, both BF% and LBM showed a significant reduction in intra-group changes in the WB-EMS group. Nutrition is also one of the reasons that can affect LBM changes. Studies have reported that energy constraints as well as weight loss reduce LBM [18]. In addition, in the present study, no significant effect was observed on BF% and LBM in the ST group, which is consistent with the study of Monikh et al. (2015) who did not observe any significant changes on BF% and LBM after 6 weeks of strength training [19]. However, it is not consistent with the study of Gholami et al. (2018) who observed a significant difference in BF% and LBM after 8 weeks of resistance training [20]. Possible reasons for this discrepancy can be different training protocol and training duration.

The findings of this study in the field of maximal strength, which shows the positive effect of WB-EMS and ST exercises on maximal strength of the lower extremity muscles, are consistent with the results of many studies. For example, it is consistent with the results of D'Ottavio et al. (2019) who reported a significant increase in lower extremity muscle strength after 6 weeks of WB-EMS and Dynamic Strength training, while no significant differences were observed between the groups [10]; and with the results of Dormann et al. (2019) who showed that WB-EMS and ST training had a significant effect on maximal lower extremity muscle

strength, while they did not observe any significant differences between the groups [11]; Micke et al. (2018) who, after 8 weeks of WB-EMS and ST training, showed an improvement in maximal leg muscle strength and did not observe significant differences between the two groups of WB-EMS training and traditional strength training [9]; Filipovic et al. (2019) who showed a significant increase in maximal lower extremity strength after 7 weeks of WB-EMS training [16]; Wirtz et al. (2016) who showed significant improvement after 6 weeks of WB-EMS and ST training on maximal strength and did not observe any significant differences between the two groups of WB-EMS training and traditional strength training [21]; Filipovic et al. (2012) who, in a systematic review, showed that after 3 to 6 weeks of electromyostimulation, a significant increase occurs in maximal strength [22]; Kemmler et al. (2010), (2013) and (2014) who reported a significant increase in maximal lower extremity strength after WB-EMS training [7, 23 and 17]; Kemmler et al. (2016) who showed that both WB-EMS and HIT exercises significantly increase maximal strength, but did not report any significant differences between the two groups [8]. The results of the studies showed a clear consistency with the results of the present study on maximal strength. Also, no study was found to report the ineffectiveness of this type of exercise on maximal strength. According to the findings of the present study, both WB-EMS and ST exercises have a positive effect on maximal strength and since there was no significant difference in maximal strength between WB-EMS and ST groups, it can be concluded that both exercises improve maximal strength.

Conclusion

In summary, no significant effects were observed on body composition after 6 weeks of WB-EMS and ST training, while positive effects on maximal strength were observed in both types of training. Given that there is no difference between these two types of exercise to increase maximal strength, traditional exercise can be recommended to healthy and young people who have enough time to exercise traditionally and also because it is cost-effective. However, according to the existing results, WB-EMS training can be recommended as a time-effective workout as well as an effective exercise method for people who are not motivated enough to do traditional exercises.

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Conflicts of interest

The authors certify that there was no conflict of interest with any financial organization regarding the material discussed in this study.

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