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The Effects of Whole-Body Electromyostimulation Training on Body Composition in Sedentary Adults

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Abstract

It is necessary to determine the effects of whole-body electromyostimulation (WB-EMS) training, which is an innovative training method that is based on voluntary muscle activation by providing muscle contraction with electrical currents applied externally through the skin to muscle tissues and motor points and saves time by being applied in a short time, on body composition, which is one of the basic requirements of healthy life in inactive adults. The study aimed to explore the impact of WB-EMS training on body composition in sedentary adults. Fifty-five healthy adults (27 male, 28 female) aged 30-39 who did not engage in regular exercise voluntarily participated in the study. Participants were divided into two groups: the training group (TG, n=27) and the control group (CG, n=28). The training group performed WB-EMS training twice weekly for eight weeks, while the control group continued their usual routines without any training intervention. Body composition measurements were taken before and after the training program using the Tanita BC 418 model device. A 2*2 Repeated Measures ANOVA was employed to compare pre-test and post-test measures, and the data were analyzed using SPSS 25.0 (SPSS Inc., Chicago, IL, USA). The significance level was set at $p<0.05$. The results showed significant changes in body weight, body fat percentage, and body mass index due to time and group-time interactions ($p<0.05$). However, no significant interaction was related to lean body mass ($p>0.05$). The eight-week WB-EMS training program decreased body weight, body fat percentage, and body mass index among sedentary adults, while lean body mass remained unchanged. Therefore, WB-EMS training creates significant changes, especially in the body's fat tissue. WB-EMS training, which enables high muscle activation and time efficiency within a short duration, may be recommended as an intervention to reduce body fat mass in healthy adults who do not exercise regularly.

Keywords: Electromyostimulation (EMS), body composition, body mass index

Özet

Sedanter Yetişkinlerde Tüm Vücut Elektromyostimülasyon Antrenmanının Vücut Kompozisyonu Üzerine Etkileri

Kas dokularına ve motor noktalara deri yoluyla dışarıdan uygulanan elektrik akımları ile kas kasılmasını sağlayarak istemli kas aktivasyonuna dayanan, kısa sürede uygulanarak zaman kazandıran yenilikçi bir antrenman yöntemi olan tüm vücut elektromiyostimülasyon (WB-EMS) antrenmanının sedanter yetişkinlerde sağlıklı yaşamın temel gereksinimlerinden biri olan vücut kompozisyonu üzerindeki etkilerinin belirlenmesi gerekmektedir. Bu nedenle çalışmada, WB-EMS antrenmanının aktif olmayan yetişkinlerde vücut kompozisyonu üzerindeki etkilerinin incelenmesi amaçlanmıştır. Çalışmaya günlük yaşamlarında egzersiz yapmayan 30-39 yaş arası elli beş (27 erkek, 28 kadın) sağlıklı yetişkin gönüllü olarak katılmıştır. Katılımcılar iki gruba ayrılmıştır: antrenman grubu (AG, n=27) ve kontrol grubu (KG, n=28). Antrenman grubu sekiz hafta boyunca haftada iki kez WB-EMS antrenmanı yaparken, kontrol grubu herhangi bir antrenman programı olmaksızın rutin yaşamlarına devam etmiştir. Vücut kompozisyonu ölçümleri Tanita BC 418 model cihaz kullanılarak antrenman programı öncesinde ve sonrasında gerçekleştirilmiştir. Ön ve son test ölçümleri 2*2 Tekrarlı Ölçümler ANOVA kullanılarak karşılaştırılmıştır. Veriler SPSS 25.0 (SPSS Inc., Chicago, IL, ABD) programında analiz edilmiştir ve anlamlılık düzeyi $p<0.05$ olarak belirlenmiştir. Zaman ve grup-zaman etkileşimlerinde vücut ağırlığı, vücut yağ yüzdesi ve vücut kitle indeksi sonuçları anlamlı bulunmuştur ($p<0.05$). Ancak, yağsız vücut kütlesi için herhangi bir etkileşim bulunmamıştır ($p>0.05$). Aktif olmayan yetişkinlerde sekiz haftalık WB-EMS antrenman programı vücut ağırlığını, vücut yağ yüzdesini ve vücut kitle indeksini azaltırken, yağsız vücut kitlesini değiştirmemiştir. Dolayısıyla, WB-EMS antrenmanı özellikle vücudun yağ dokusunda önemli değişiklikler meydana getirmektedir. Kısa sürede yüksek kas aktivasyonu ve zaman tasarrufu sağlayan WB-EMS sistemi antrenmanının, düzenli egzersiz yapmayan sağlıklı yetişkinlerde vücut yağ kütlesini azaltmak amacıyla uygulanması önerilebilir.

Anahtar Kelimeler: Elektromiyostimülasyon (EMS), vücut kompozisyonu, vücut kütle indeksi

INTRODUCTION

Electromyostimulation (EMS) is an innovative training method that enables the activation of fast motor units, which are challenging to engage voluntarily. This is achieved by applying electrical currents externally through the skin to the muscle tissues and motor points, thereby enhancing performance (11). Since the introduction of EMS and its subsequent advancements, its applications in sports have expanded significantly over time. The adjustable current parameters and the isokinetic contractions facilitated by EMS allow for a variety of training methods tailored to individual needs. Research has demonstrated that EMS serves as a comprehensive option for strength training (7).

EMS (Electromyostimulation) is used in various fields, particularly for rehabilitating muscle-related injuries and addressing postural disorders. Modern whole-body EMS (WB-EMS) devices stimulate all major muscle groups simultaneously while allowing for gentle movements. These devices are gaining popularity in the health and fitness sector. WB-EMS is often praised for its time-saving benefits and positive effects on body composition (21). The use of EMS devices is on the rise, and they are recognized as a modern approach to sports and rehabilitation. They are user-friendly and can easily be operated at home or outdoors. The advantages of using EMS include reducing treatment time and costs while enhancing the overall effectiveness of workouts. Research indicates that after just a few training sessions with EMS, muscle resistance improves, and muscle hypertrophy occurs, benefiting both athletes and non-athletes. EMS specifically targets weakened muscle tissues and helps mobilize hard-to-reach muscles by inducing contractions through electrical stimulation. Furthermore, it can enhance athletic performance and facilitate quicker recovery from muscle injuries (2,8,18).

EMS is a widely used method for muscle strengthening across sports, medical rehabilitation, and functional recovery. Numerous studies have explored the impact of electrical stimulation on the strengthening of skeletal muscles, the improvement of muscle function following knee surgery, and the prevention of atrophy during periods of immobilization (1,13,23,27). In recent years, EMS has been adopted as a transcutaneous method for inducing muscle contractions and strengthening exercises in athletes. A key distinction of EMS research compared to other studies in this area is its ability to activate specific muscle fibers that are difficult to engage voluntarily, thus enabling targeted contraction and strengthening of these muscles. Electrical stimulation is applied superficially to the muscle's center using electrodes, resulting in a rapid and powerful contraction. Today, many professional athletes utilize EMS training to enhance their performance and accelerate muscle recovery (19).

Body composition refers to the different components that make up the body, including bone, adipose (fat) tissue, muscle tissue, other organic matter, and extracellular fluids. It can be broadly categorized into two groups: fat mass and lean mass (25). Lean mass encompasses bones, muscles, nerves, water, blood vessels, and other organic matter, while fat mass can be further classified into three types: storage fat, subcutaneous fat, and essential fat. Body composition measurement provides important insights into various physical parameters, such as a person's movement efficiency, speed, coordination, and overall fitness. The first step in measuring body composition is to determine body density, which can then be used to calculate body fat percentage (6).

Training with the EMS system is an innovative technology that initially focused on rehabilitation and treatment. However, it has gained popularity among coaches, athletes, and sports scientists as an effective training method. EMS involves applying electrical currents to muscle tissue or motor points. Modern EMS devices can stimulate all major muscle groups simultaneously at a designated intensity during slow movements. As a result, their use in the health and fitness sectors is on the rise. One of the significant advantages of EMS is its time-saving nature and its positive impact on body composition. Its practicality and ease of use, particularly due to its ergonomic design, make it appealing. In recent years, whole-body EMS (WB-EMS) devices have become more popular than localized EMS options. The fitness industry frequently promotes exercise programs that are low in intensity but save time while still benefiting fitness and body composition. Recent studies have shown positive effects of EMS on body composition and fitness parameters. There is growing interest in the potential benefits of a method like WB-EMS, which offers a high level of muscle activation in a shorter duration compared to traditional training methods. This is particularly relevant for individuals who do not engage in regular exercise or struggle to find time for workouts. However, only a limited number of studies have explored the effects of WB-EMS training on physical, physiological, and motor characteristics, particularly body composition. More research is needed to investigate the impact of WB-EMS training on body composition, an essential aspect of a healthy lifestyle for inactive individuals. Therefore, our study aimed to examine the effects of whole-body EMS training on body composition in sedentary adults.

METHOD

Research Design and Participants

The study was conducted using a pre-posttest model, one of the experimental research designs. A power analysis was performed to determine the appropriate number of subjects using G*Power 3.1. In total, 55 healthy adults (27 male, 28 female) who did not engage in regular physical exercise and had no health issues participated voluntarily. The participants were divided into two groups: training group (TG, n=27) and control group (CG, n=28). The mean age of the training group was 33.52 ± 2.87 years, while the mean age of the control group was 34.75 ± 3.01 years. The average height of the training group was 169.30 ± 8.55 cm, compared to 170.75 ± 7.98 cm for the control group. The content and risks associated with the study were explained in detail to all participants, who were then asked to sign a consent form confirming their voluntary participation. Prior to the start of the study, approval was obtained from the Selçuk University Clinical Research Ethics Committee for all phases of the research (Protocol number: 105/04.09.2024).

Research Procedure

Before the pre-test measurements, participants underwent a two-week adaptation period to adapt to the device and electrical currents. The training group participated in whole-body EMS training twice a week for eight weeks, ensuring at least 72 hours between training sessions. Meanwhile, the control group continued their daily activities without participating in any training program. Body composition measurements were taken both before and after the training program.

Training Protocol

Adaptation practices were implemented so participants could adapt to the device and the incoming electrical currents. These practices included 20 minutes of walking, jogging, and static stretching exercises, conducted twice a week for two weeks before the training program and the pre-test measurements. The Miha Bodytec (GmbH, Gersthofen, Germany) wearable EMS device was utilized for the whole-body EMS (WB-EMS) training. WB-EMS was applied during eccentric contractions, with the participants returning to the starting position during the rest intervals. The WB-EMS involved the application of a bipolar electric current with the following parameters: frequency of 85 Hz, pulse width of 350 μs, a current pulse duration of 6 seconds, and a rest interval of 4 seconds (9). In the WB-EMS protocol, electrodes were positioned over the primary muscle groups, including the pectoral region (pectoralis major and minor), abdominal area (rectus abdominis), upper and lower back (latissimus dorsi, erector spinae, iliopsoas), upper extremities (deltoids, biceps, triceps), gluteal region (gluteus maximus), and lower limbs (quadriceps and hamstrings). The training equipment was moistened to ensure optimal delivery of electrical impulses to the muscles. Current intensity was individualized and modified as needed throughout each session. To improve participant adaptation and reduce the risk of experimental harm, a 2–3-minute familiarization phase with electrical stimulation was conducted prior to every training session (24). Participants underwent 20 minutes of WB-EMS training twice a week for 8 weeks. The first 10 minutes of each session consisted of non-specific exercises, including squats, chest presses, shoulder presses, and lat pull-downs. The following 10 minutes incorporated biceps curls, triceps extensions, glute bridges, and plank exercises. In the initial four weeks of the training program, exercises were performed using body weight only. Additional weights were introduced in the subsequent four weeks, tailored to everyone's capacity. Standard warm-up and cool-down exercises were carried out before each workout.

Numerous studies employ a controlled maximum pulse intensity determined by the individual's pain tolerance, commonly referred to as the maximum tolerated current. This approach can lead to high muscle tension and restrict the dynamic range of motion (4,18). The maximum tolerable electrical intensity was self-assessed by participants before the session, with stimulation applied at 80–100% of this value. The intensity was fine-tuned based on performance during dynamic movement tasks. Careful and sensitive management of the current intensity is crucial for achieving positive results. Additionally, various factors, such as skin, fat, and muscle thickness, can affect the impedance differences in the stimulated areas. To tailor the exercise intensity to everyone, participants maintained a rate of perceived exertion (RPE) ranging from "difficult (heavy)" to "very difficult" (Borg CR-10 scale, 6 to 10) during the training sessions (3).

Body Composition

The measurements were conducted using the Tanita BC 418 model (Tanita Body Composition Analyzer, Type BC-418MA, Japan) with the Bio-Electrical Impedance method at the beginning and end of the 8-week training program. Anthropometric data, including body weight, body fat percentage, lean body mass, and body mass index (BMI), were systematically collected and subjected to analysis.

Statistical Analysis

Normality of the data was evaluated both statistically—via the Shapiro-Wilk test, skewness, and kurtosis—and graphically using histograms and Q-Q plots. Means and standard deviations were used in the data presentation. A 2*2 Repeated Measures ANOVA was performed to examine the differences in pre- and post-test values between the groups. The percentage changes for each group were calculated from the pre-test to the post-test. Additionally, Group, Time, and Group*Time interaction effects, along with effect size estimates, were calculated. Statistical analyses were performed using SPSS version 25.0 (SPSS Inc., Chicago, IL, USA), with the level of significance set at $p<0.05$.

FINDINGS

Table 1. Body composition pre/post-test values by groups

Variables	Group	N	Pre-Test	Post-Test	% Change
			$\bar{x}$ ± SD	$\bar{x}$ ± SD	
Body Weight (kg)	TG	27	78,837 ± 13,47	75,807 ± 13,83	**% 3,84**
	CG	28	74,836 ± 13,36	75,096 ± 13,13	% -0,35
Lean Body Mass (kg)	TG	27	56,411 ± 12,24	56,304 ± 12,35	% 0,19
	CG	28	55,961 ± 11,50	55,129 ± 10,98	% 1,49
Body Fat Percentage (%)	TG	27	28,648 ± 8,01	25,796 ± 7,86	**% 9,96**
	CG	28	25,279 ± 6,33	26,725 ± 5,81	% -5,72
Body Mass Index (kg/m^2)	TG	27	27,544 ± 3,60	26,333 ± 3,71	**% 4,40**
	CG	28	25,579 ± 3,06	25,604 ± 3,07	% -0,10

TG: Training Group; CG: Control Group; $\bar{x}$: Mean, SD: Standard deviation

Table 1 presents the pre-test and post-test body composition values and the percentage changes for the participants categorized by study groups. In the training group (TG), body weight, body fat percentage, and body mass index decreased by 3.84%, 9.96%, and 4.40%, respectively. However, there was no significant change in lean body mass, which showed a slight increase of only 0.19%. In contrast, the control group (CG) exhibited no significant differences in the measured variables.

Table 2. ANOVA results of repeated measures for body composition

Variables	Interaction	F	p	Effect Size
Body Weight (kg)	**G**	0,424	0,518	0,008
	T	31,591	**0,000***	**0,373**
	G*T	44,610	**0,000***	**0,457**
Lean Body Mass (kg)	**G**	0,066	0,798	0,001
	T	2,998	0,089	0,054
	G*T	1,784	0,187	0,033
Body Fat Percentage (%)	**G**	0,420	0,520	0,008
	T	6,501	**0,014***	**0,109**
	G*T	60,804	**0,000***	**0,534**
Body Mass Index (kg/m²)	**G**	2,229	0,141	0,040
	T	35,125	**0,000***	**0,399**
	G*T	38,148	**0,000***	**0,419**

G: Group comparison; T: Time comparison; G*T: Group-Time interaction; *p<0,05.

The results of the repeated measures ANOVA for the participants' body composition are presented in Table 2. Statistically significant findings were observed for body weight, body fat percentage, and body mass index (BMI) in terms of time and group-time interactions ($p < 0.05$). However, no significant interaction was found for lean body mass values.

DISCUSSION AND CONCLUSION

Our study investigated the effects of WB-EMS training on body composition parameters in sedentary adults, including body weight, body fat percentage, body mass index (BMI), and lean body mass. The primary finding of our research was that an eight-week WB-EMS training program resulted in significant reductions in body weight, body fat percentage, and BMI, while having no effect on lean body mass.

Due to its portability and time efficiency, the WB-EMS system is increasingly favored as an alternative training method. It is particularly popular among adults who struggle to find time for daily exercise, lead sedentary lifestyles, and aim to lose weight. As the usage of this training method grows, research on its physical and physiological effects is becoming more common. A key indicator of physical characteristics is body weight. In an eight-week study involving sedentary women, Özdal and Bostancı (2016) reported a significant decrease in body weight with EMS training. Similarly, Çetin et al. (2017) observed notable reductions in body weight in sedentary women over eight weeks of EMS training. Kirişçioğlu et al. (2019) found that participating in EMS training twice weekly for eight weeks significantly lowered body weight in sedentary women. Our study also demonstrated that an eight-week WB-EMS training program significantly decreased adult body weight. These findings align with previous studies regarding the body weight variable. Overall, the literature and our results indicate that body weight significantly decreases with WB-EMS training.

The WB-EMS can enhance various body composition indices, including BMI and body fat mass. This improvement leads to a healthier body shape and a reduced risk of metabolic diseases. BMI and body fat mass are widely used measures that indicate the amount of fat stored in the body and its distribution. By improving these metrics, WB-EMS can help mitigate the risk of health issues associated with obesity and enhance overall well-being (13). Research studies support the effectiveness of WB-EMS training. For instance, Kirişçioğlu et al. (2019) found that EMS training conducted twice a week for eight weeks significantly reduced BMI, body fat percentage, and body fat mass in sedentary women. Similarly, Kim and Jee (2020) determined that eight weeks of EMS exercises significantly reduced body fat mass and fat percentage among healthy women. Kılıç et al. (2018) reported that a six-week WB-EMS training program significantly decreased fat mass, fat percentage, and BMI in sedentary adults. Kemmler et al. (2010) noted that 14 weeks of WB-EMS training significantly reduced subcutaneous body fat mass in adult women. Willert et al. (2019) found that 16 weeks of WB-EMS training significantly decreased body fat mass in overweight adult women. Furthermore, Jose Amaro-Gahete et al. (2018) indicated that a six-week WB-EMS training program significantly reduced body fat mass and BMI in recreational runners. Park et al. (2021) reported that an eight-week EMS exercise program significantly decreased body fat percentage and fat mass in adult women. A review by Rodrigues-Santana et al. (2023) concluded that the WB-EMS training program significantly reduces body fat mass. These findings align with our study's duration, methodology, and results. The literature and our research indicate that body fat mass and percentage decrease significantly with WB-EMS training. One primary reason for this effect may be the intense muscle activation and increased calorie burning associated with the WB-EMS method. By sending electrical impulses directly to the muscles, WB-EMS causes them to contract and stimulates up to 90% of muscle fibers, compared to just 30-40% stimulated during conventional exercise. This heightened muscle activation can accelerate metabolism and lead to a greater calorie burn. Another factor contributing to this effect is the increased metabolic rate and fat oxidation with WB-EMS training. The training elevates the basal metabolic rate by causing the muscles to work more intensely, enabling the body to burn more calories even at rest. The accelerated metabolism during WB-EMS training also prompts the body to utilize fat as an energy source (23).

Research indicates that the WB-EMS training method effectively increases lean body mass and muscle mass while reducing adipose tissue components such as body fat mass, fat percentage, and BMI. For example, Kemmler et al. (2016) found that 16 weeks of WB-EMS training significantly enhanced lean body mass in healthy adult men. Similarly, Zink-Rückel et al. (2021) reported that a 16-week WB-EMS program positively impacted lean body mass in amateur golfers. Furthermore, Kemmler et al. (2017) demonstrated that 16 weeks of WB-EMS training significantly increased muscle mass in obese adult men. Kim and Jee (2020) also showed that eight weeks of EMS exercises led to a notable increase in skeletal muscle mass in healthy women. Additionally, Willert et al. (2019) confirmed that 16 weeks of WB-EMS training significantly boosted lean body mass in overweight adult women. In their review, Rodrigues-Santana et al. (2023) concluded that the WB-EMS training program significantly positively impacts muscle mass. However, unlike the studies mentioned, our study found that WB-EMS training did not significantly change lean body mass. This discrepancy may be due to the longer duration of the WB-EMS training program in previous studies compared to ours. Furthermore, the limited effects of WB-EMS on lean body mass could be attributed to variations in training parameters, such as the number of beats per second, contraction time, rest time, training content, and intensity.

In conclusion, an eight-week WB-EMS training program for sedentary adults significantly reduced body weight, body fat percentage, and body mass index, while lean body mass remained unchanged. This indicates that WB-EMS training effectively decreases body fat, particularly in adipose tissue. The WB-EMS system, which achieves high muscle activation quickly, can be recommended as an effective method for reducing body fat mass, even in adults who do not exercise regularly.

The study has several limitations. Essential variables, such as daily nutritional status and caloric intake, were not controlled, which is crucial for accurately assessing changes in body composition components like body weight and fat mass. Additionally, muscle mass was not explicitly measured in the assessment of lean body mass. Addressing these limitations in future research will enhance methodological quality, leading to a more effective evaluation of the effects of WB-EMS on body composition.

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