EFFECTS OF ELECTRICAL MUSCLE STIMULATION (EMS) ON BODY COMPOSITION AMONG WORKING ADULTS

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Abstract. Electrical Muscle Stimulation (EMS) has emerged as an innovative and time-efficient training modality that enhances muscle activation and promotes metabolic adaptations. While its benefits for athletes are well established, its potential for improving body composition among working adults who often face sedentary lifestyles and limited time for exercise remains underexplored. This study examined the effects of EMS training on body composition parameters among working adults with sedentary lifestyles. Thirty participants aged 30–40 years were randomly assigned to either an EMS training group (n = 15) or a control group (n = 15). The intervention lasted eight weeks, with the EMS group completing two 20-minute sessions per week. Body composition variables, including body mass, body fat percentage (%BF), lean muscle mass (LMM), and body mass index (BMI), were measured before and after the intervention using bioelectrical impedance analysis (BIA). Results showed that the EMS group demonstrated significant reductions in body fat percentage (−3.4%, $p < 0.01$) and BMI (−1.1 kg/m², $p < 0.05$), along with a significant increase in lean muscle mass (+1.8%, $p < 0.05$), whereas no significant changes were observed in the control group. These findings suggest that EMS training is an effective and time-efficient approach for improving body composition among working adults, offering a practical alternative for individuals with limited time to engage in conventional exercise.
Keywords: *Electrical Muscle Stimulation (EMS), body composition, working adults, lean muscle mass, sedentary lifestyle*

Introduction

Modern working environments are increasingly characterized by prolonged sedentary behavior, extended sitting hours, and limited opportunities for structured physical activity. Such lifestyle patterns are strongly associated with increased risks of obesity, metabolic disorders, and cardiovascular disease among adults (WHO, 2023). Although regular physical activity and balanced nutrition are widely recognized as essential for maintaining health, many working adults report time constraints, occupational fatigue, and lack of motivation as major barriers to exercise participation (Thivel et al., 2018). Consequently, alternative exercise strategies that are both effective and time efficient are increasingly being explored. Electrical Muscle Stimulation (EMS)

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has emerged as an innovative training modality that induces involuntary muscle contractions through externally applied electrical impulses. These impulses activate both slow- and fast-twitch muscle fibers, resulting in enhanced neuromuscular activation and increased metabolic demand even during low-intensity movements (Kemmler et al., 2018). Previous research has demonstrated that EMS training can improve muscle strength, functional capacity, and body composition, particularly among athletic and rehabilitation populations (Rodrigues-Santana et al., 2023; Beato et al., 2021; Anderson and Durstine, 2019; Filipovic et al., 2019).

Physiologically, EMS has been associated with increased muscle fiber recruitment, elevated oxygen consumption, and enhanced energy expenditure, which may contribute to reductions in adipose tissue and improvements in lean muscle mass (Chen et al., 2022a). Despite its growing commercial popularity, empirical evidence examining EMS effectiveness among non-athletic working adults remains limited. Most existing studies have focused on elite athletes or clinical populations, creating a gap in understanding its applicability for sedentary working adults. Similar to other time-efficient training strategies that enhance neuromuscular activation under reduced mechanical load, EMS may induce favourable adaptations in muscle function and metabolic demand (Chen et al., 2022b; Kemmler et al., 2021). Electrical muscle stimulation (EMS) has been increasingly investigated for its potential influence on body mass index (BMI), body fat percentage, and lean muscle mass across various populations, including working adults. EMS applies electrical impulses to evoke involuntary muscle contractions, thereby simulating certain physiological responses typically achieved through voluntary exercise. Previous studies have reported potential improvements in body composition following EMS interventions; however, findings remain inconsistent, particularly among non-athletic and occupationally active populations. These mixed outcomes highlight the need for further investigation into the effectiveness of EMS in improving body composition among working adults. Therefore, this study aimed to examine the effects of a four-week EMS training program on body mass index (BMI), body fat percentage (%BF), and lean muscle mass (LMM) among working adults. It was hypothesized that EMS training would result in significant improvements in body composition compared to a control group.

Materials and Methods

Participants, experimental design and EMS intervention

Thirty working adults aged between 30 and 40 years voluntarily participated in this study. All participants were apparently healthy, free from cardiovascular, metabolic, or musculoskeletal disorders, and had not engaged in any structured exercise program for at least three months prior to the study. Participants were randomly assigned to an Electrical Muscle Stimulation (EMS) group (n = 15) or a control group (n = 15). All participants received verbal and written explanations of the study procedures, potential risks, and benefits, and provided written informed consent prior to participation. Ethical approval was obtained from the university research ethics committee. A randomized controlled pre–post experimental design was employed over a four-week intervention period. Participants in the EMS group completed two supervised whole-body EMS sessions per week, with each session lasting approximately 20 minutes. The intervention utilized Miha Bodytec® whole-body EMS equipment, which simultaneously stimulated major muscle groups including the quadriceps, hamstrings, gluteals, abdominals, and

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lower back. Electrical stimulation parameters were standardized across sessions (frequency: 85 Hz; pulse width: 350 μs; contraction–rest cycle: 4s on, 4s off). Training intensity was individually adjusted to approximately 70–80% of each participant's tolerance to ensure effective yet comfortable muscle contractions. During stimulation, participants performed low-impact dynamic movements such as squats, lunges, and leg lifts. All sessions were supervised by a certified EMS trainer. The control group did not receive any EMS intervention and was instructed to maintain usual daily activities. All participants were advised to maintain habitual dietary intake and refrain from additional structured exercise during the study period. *Table 1* illustrates the baseline demographic and body composition characteristics of participants in both the EMS and control groups. No significant differences were observed between groups, confirming homogeneity before the start of the training intervention.

***Table 1**. Subject characteristics of participants (Mean ± SD).*

Variable	EMS Group (n = 15)	Control Group (n = 15)	Total (N = 30)
Age (years)	36.2 ± 5.1	35.8 ± 4.8	36.0 ± 4.9
Height (cm)	162.4 ± 6.2	161.8 ± 5.9	162.1 ± 6.0
Weight (kg)	68.7 ± 8.4	69.1 ± 7.9	68.9 ± 8.1
BMI (kg/m²)	26.0 ± 2.9	26.2 ± 3.0	26.1 ± 2.9
Body Fat (%)	35.8 ± 5.7	36.1 ± 6.2	35.9 ± 5.9
Lean Muscle Mass (kg)	23.4 ± 3.2	23.1 ± 3.5	23.2 ± 3.3

Note: BMI=Body Mass Index.

Measurements and statistical analysis

Body composition measurements were obtained using a bioelectrical impedance analyzer (BIA), specifically the InBody 270 (Biospace, Korea) a validated instrument for non-invasive assessment of body composition in adult populations. The analyzer estimates several parameters, including Body Mass Index (BMI), Body Fat Percentage (%BF), and Lean Muscle Mass (LMM), by passing multiple frequencies of electrical currents through the body and measuring impedance across tissues. All measurements were conducted pre- and post-intervention under standardized conditions at The Body Lab, Kuala Lumpur. Participants were instructed to: (1) Avoid eating or drinking (except water) for at least 3 hours prior to testing, (2) Refrain from alcohol, caffeine, or vigorous exercise for 24 hours, and (3) Empty their bladder 30 minutes before measurement. During testing, participants wore lightweight clothing, removed shoes and accessories, and stood barefoot on the foot electrodes while holding the hand electrodes in an upright position. Each test was performed twice, and the mean value was recorded to ensure reliability.

The following parameters were evaluated: (1) Body Fat Percentage (%BF): proportion of total body mass composed of fat tissue. (2) Lean Muscle Mass (kg): total estimated skeletal muscle tissue across all body segments. (3) Body Mass Index (BMI): calculated automatically by the analyzer as weight (kg) divided by height squared (m²). To minimize measurement error, all assessments were performed by the same trained technician using identical equipment calibration procedures. Statistical analyses were performed using IBM SPSS Statistics (Version 29.0). Descriptive statistics were presented as mean ± standard deviation (SD). Data normality was assessed using the Shapiro–Wilk test prior to inferential analyses. Pre- and post-intervention differences within each group (intervention and control) were examined using paired-samples t-tests for all body composition variables. Effect sizes for within-group changes were

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calculated using Cohen's d to quantify the magnitude of the intervention effects. Statistical significance was set at $p < 0.05$.

Results and Discussion

Table 2 presents the pre- and post-test values for body composition and body mass index (BMI) between the EMS and control groups. The EMS group showed significant reductions in body fat percentage (Pre = 35.8 ± 5.7 %; Post = 32.4 ± 5.2 %; $p < 0.001$) and BMI (Pre = 26.0 ± 2.9 kg/m²; Post = 24.9 ± 2.8 kg/m²; $p = 0.021$), along with a significant increase in lean muscle mass (Pre = 23.4 ± 3.2 kg; Post = 23.8 ± 3.1 kg; $p = 0.032$).In contrast, the control group showed no significant changes in any of the variables measured ($p > 0.05$). As shown in *Figure 1*, the Electrical Muscle Stimulation (EMS) group demonstrated a reduction in body fat percentage from 35.8% (Pre) to 32.4% (Post), representing an average decrease of 3.4 percentage points (−9.5%). In contrast, the control group showed minimal change, with body fat percentage decreasing slightly from 36.1% to 36.0% (−0.3%), indicating no significant improvement. *Figure 2* illustrates the mean body mass index (BMI) values before and after the four-week intervention for both EMS and control groups. The EMS group demonstrated a significant reduction in BMI from 26.0 ± 2.9 kg/m² to 24.9 ± 2.8 kg/m² ($p = 0.021$), while the control group showed no significant change (26.2 ± 3.0 kg/m² to 26.1 ± 2.9 kg/m², $p = 0.656$). *Figure 3* illustrates the changes in lean muscle mass (LMM) before and after the four-week intervention for both groups. The EMS group demonstrated a significant increase in lean muscle mass, rising from 23.4 ± 3.2 kg (Pre) to 23.8 ± 3.1 kg (Post) ($p = 0.032$). In contrast, the control group showed no changes in lean muscle mass across the same period (23.1 ± 3.5 kg to 23.1 ± 3.4 kg; $p = 0.902$).s

Table 2. *Pre and post-test of body fat %, BMI (kg/m²) and Lean Muscle Mass (kg).*

Variable	Group	Pre	Post	*p*-value
Body Fat (%)	EMS	35.8 ± 5.7	32.4 ± 5.2	< 0.001
	Control	36.1 ± 6.2	36.0 ± 6.3	0.812
BMI (kg/m²)	EMS	26.0 ± 2.9	24.9 ± 2.8	*0.021
	Control	26.2 ± 3.0	26.1 ± 2.9	0.656
Lean Muscle Mass (kg)	EMS	23.4 ± 3.2	23.8 ± 3.1	*0.032
	Control	23.1 ± 3.5	23.1 ± 3.4	0.902

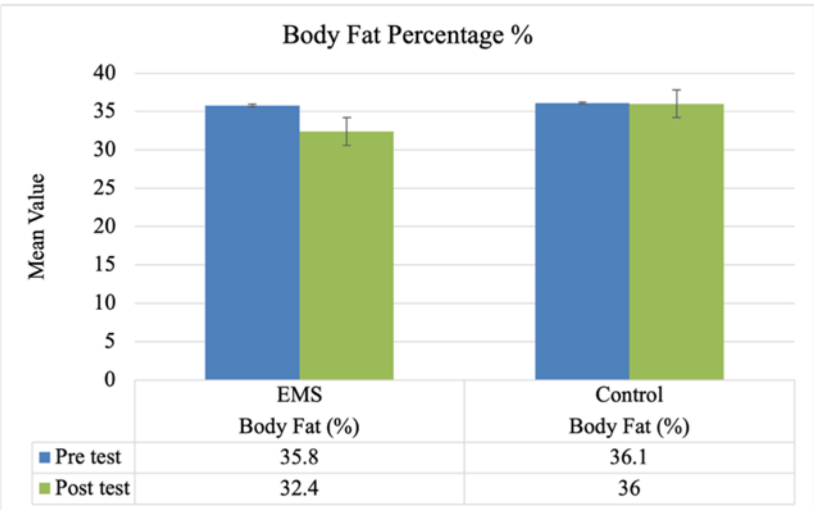

Figure 1. *Pre and post test body fat percentage (%).*

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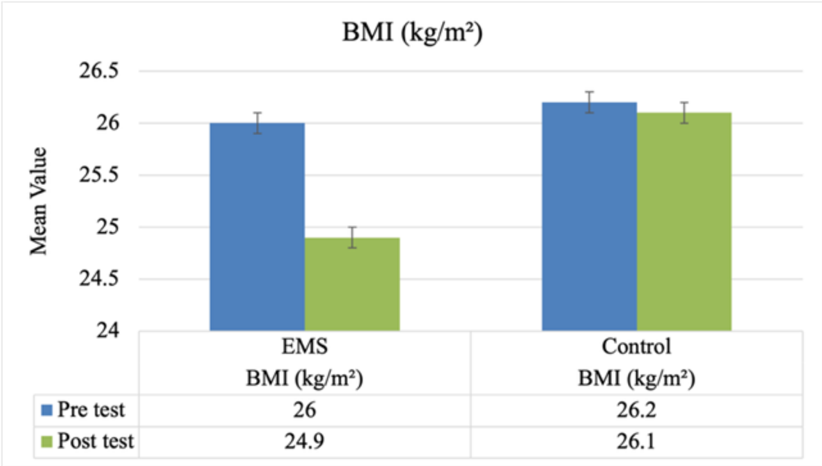

Figure 2. *Pre and post test body BMI kg/m².*

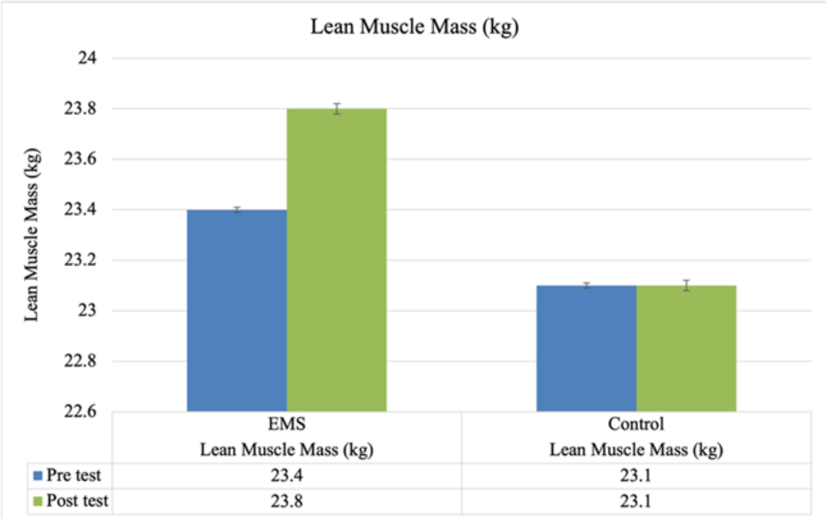

Figure 3. *The changes in lean muscle mass (LMM) before and after the four-week intervention for both groups.*

The finding showed four week Electrical Muscle Stimulation (EMS) training program resulted in significant improvements in body composition among working adults with sedentary lifestyles. Participants in the EMS group experienced reductions in body fat percentage (%BF) and body mass index (BMI), and significant increase in lean muscle mass (LMM). In contrast, there's no significant differences were observed in the control group. These findings are consistent with recent studies reporting that whole-body EMS can improve body composition and metabolic outcomes even over short intervention periods (Rodrigues et al., 2022; Kemmler et al., 2021). The present study extends current evidence by demonstrating that EMS is also effective for non-athletic working adults, a population that remains underrepresented in EMS research. The observed improvements in body composition may be explained by the physiological effects of EMS training. EMS induces involuntary muscle contractions that recruit a large number of muscle fibers simultaneously, including fast-twitch fibers that are usually less active during daily low-intensity activities (Filipovic et al., 2011). Fast-twitch fibers have a greater capacity for muscle growth and energy use, which may

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explain the increase in lean muscle mass observed in the EMS group. In addition, recent evidence suggests that EMS increases energy expenditure and metabolic activity, which may support fat oxidation and contribute to reductions in body fat percentage (Kemmler et al., 2021; Watanabe et al., 2019). The combined reduction in BMI and increase in LMM indicates that EMS promoted positive body recomposition rather than simple weight loss.

With respect to body composition and metabolic outcomes, recent research has provided stronger mechanistic and clinical support for EMS. Notably, a randomized controlled trial by Riyahi et al. (2025) demonstrated that WB-EMS training significantly improved body mass index, lipid profile, and hormonal markers in overweight adults. Specifically, the authors reported reductions in BMI and unfavourable lipid parameters alongside favorable alterations in anabolic and stress-related hormones, including increased growth hormone and reduced cortisol levels. Thes findings suggest that EMS may influence body composition not only through mechanical muscle activation but also via endocrine and metabolic pathways relevant to fat metabolism and energy regulation. From a practical perspective, EMS appears to be a suitable and time-efficient exercise option for working adults with limited time for physical activity. The short duration and low-impact nature of EMS sessions may improve exercise adherence compared with traditional training programs that require longer time commitments (WHO, 2023). However, several limitations should be acknowledged. The short intervention duration limits conclusions regarding long-term effects, dietary intake was not strictly controlled, and body composition was assessed using bioelectrical impedance analysis, which can be influenced by hydration status. Future studies should include longer intervention periods, dietary monitoring, and additional outcomes such as muscle strength, functional performance, and metabolic biomarkers to better understand the long-term effectiveness of EMS training in working adults.

Conclusion

In conclusion, this study demonstrated that a four-week Electrical Muscle Stimulation (EMS) training program led to significant reductions in body fat percentage and body mass index, together with a modest increase in lean muscle mass among working adults. These findings indicate that short-term EMS training can produce positive changes in body composition in individuals with sedentary lifestyles. From a practical perspective, EMS appears to be a time-efficient and feasible exercise option for working adults who face time and lifestyle constraints. The short duration and low-impact nature of EMS sessions may support better exercise participation compared to conventional training programs. However, future studies with longer intervention periods and additional outcome measures are recommended to further confirm the long-term effectiveness of EMS training.

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Conflict of interest

The authors confirm that there is no conflict of interest involving any party in this research study.

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