BALNEO RESEARCH Balneo and PRM Research Journal English Edition
e ISSN 2734 - 8458 p ISSN 2734 - 844X ROMANIAN ASSOCIATION OF BALNEOLOGY

Research article

Effects of Acupuncture Electro Muscle Stimulation on Body Composition in Overweight Women: A Randomized Controlled Trial

Nining Widyah Kusnanik [1], Rini Ismalasari [1], Priya Yoga Pradana [1], Tutur Jatmiko [1], Fifit Yeti Wulandari [1], Mochammad Yunus [2], Rizky Sota Dyaksa [3], Andreas J.F. Lumba [4], Stephen P Bird [5], Alvin Afandi [1], Novadri Ayubi[1,*]

Citation: Kusnanik N.W., Ismalasari R., Pradana P.Y., Jatmiko T., Wulandari F.Y., Yunus M., Dyaksa R.S., Lumba A.J.F., Bird S.P., Afandi A., Ayubi N. – Effects of Acupuncture Electro Muscle Stimulation on Body Composition in Overweight Women: A Randomized Controlled Trial
Balneo and PRM Research Journal ***2025****, 16(4): 898*

Academic Editor(s):
Constantin Munteanu

Reviewer Officer:
Viorela Bembea

Production Officer:
Camil Filimon

Received: 28.09.2025
Published: 30.12.2025

Reviewers:
Mariana Rotariu
Alexandra Ecaterina Ciota

Publisher's Note: Balneo and PRM Research Journal stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

1. Universitas Negeri Surabaya, Surabaya, Indonesia;
2. Universitas Negeri Malang, Malang, Indonesia;
3. Universitas Nahdatul Ulama, Blitar, Indonesia;
4. Kristen Artha Wacana, Kupang, Indonesia;
5. University of Southern Queensland, Toowoomba, Australia

* Correspondence: novadriayubi@unesa.ac.id

Abstract: This study aimed to evaluate the effect of acupuncture electro muscle stimulation on body composition in overweight women. A study experimental with pre- and post-test assessments was conducted on 30 overweight women aged 18–25 years with a body mass index (BMI) of 25–30 kg/m². Participants were allocated into two groups: group 1, which received acupuncture electro muscle stimulation targeting the biceps, triceps, abdominals, hamstrings, quadriceps, and gastrocnemius, and group 2, which performed the same physical exercise without acupuncture electro muscle stimulation. The intervention was administered three times per week for 15 minutes per session over 8 weeks. Intensity training consisted of weight training performed at a moderate intensity of 60-70% of maximum capacity, performed in 4 sets, with approximately 1 minute of recovery between sets. The exercises used were exercises to train the biceps, triceps, chest, abdominals, and quadriceps muscles. Body fat percentage was assessed using bioelectrical impedance analysis (BIA), while free fatty acid levels were measured by enzyme-linked immunosorbent assay (ELISA). Data were analyzed using paired t-tests. Test for differences in body fat in group 1 (p=0.022), group 2 (p=0.248). Test for differences in BMI in group 1 (p=0.001), group 2 (p=0.137). Test for differences in free fatty acids in group 1 (p=0.014), group 2 (p=0.126). Acupuncture electro muscle stimulation during exercise significantly reduced body fat and BMI, and increased free fatty acid levels compared with controls ($p < 0.05$). Acupuncture electro muscle stimulation combined with physical exercise may serve as an effective alternative approach to improve body composition in overweight women. However, diet, physical activity outside the intervention, and sleep patterns can influence body composition and should be controlled for or recognized as major limitations.

Keywords: Acupuncture, electro muscle stimulation, body fat, free fatty acids, body mass index, physiology exercise

1. Introduction

Electrical muscle stimulation (EMS) is a method of artificially activating muscles through various forms of electrical current, delivered through electrodes to the target muscle [1]. EMS is a feasible and effective rehabilitation approach for individuals with impaired physical performance and low physical activity [1]. Electro-acupuncture stimulation uses conductive panels that are attached to certain parts of the body with electricity to stimulate the muscles [2]. Physical activity using electro muscle stimulation can improve cardiopulmonary function, balance, muscle strength, muscle mass and reduce body circumference [3].

Body composition is the percentage of body mass consisting of tissue, both fat and non-fat [4]. Body composition measurements can evaluate a person's health [5]. The

composition of the human body consists of several components, including free tissue, body water and bone mineral [6]. Components of body composition that are more frequently measured include fat-free tissue and body fat tissue [7]. Body fat is more often called lipids that are the sole energy provider in the body. Each gram of fat contains two and a half times the energy produced by carbohydrates. Therefore, the energy stored in the human body is 150 times greater that the energy produced by carbohydrates [8].

In the last few decades, overweight has become a problem that is often encountered in a country, even in the world of health it has often become a main topic [9]. One of the main causes, according to WHO, is that overweight occurs due to an increase in consumption, especially of those containing more fat, apart from that, physical activity has decreased significantly both in the world of work, transportation, and an increase in the urban population [10]. The WHO classification of overweight people if the BMI calculation results are between 25kg/m2 – 30kg/m2 [11]. BMI is one way to find out the category of someone who can be said to be overweight if they exceed the threshold limit of the calculation provisions. BMI is calculated using the ratio of height in squares and body weight in kilograms [12].

Being overweight can be a trigger for various complex problems in a person's body [13]. There are various problems that arise due to being overweight, including hypertension, coronary heart disease and type 2 diabetes mellitus, apart from previous research it was also stated that being overweight can cause problems with the cardiovascular system [14]. Apart from disorders of the body system, people who are overweight can also cause bullying from the people around them [15]. It is stated that teenagers and adults who are overweight or obese so that they appear to have different body sizes physically can trigger bullying [16]. Furthermore, being overweight can cause psychological disorders and can reduce the level of self-confidence [16].

This study aimed to analyze the effects of acupuncture electro muscle stimulation on body composition in overweight women.

2. Materials and methods

2.1.1. Study Design

This type of research is quasi-experimental with a pre-test and post-test control group design. This study used a double-blind randomized controlled trial design. This design was chosen to test the effects of acupuncture electromuscular stimulation on body composition in overweight women.

2.1.2. Subjects

The study population consisted of overweight women with a body mass index (BMI) of 25–30 kg/m² and an age range of 18–25 years. A total of 30 participants were selected using purposive sampling and subsequently assigned to two groups: Group 1 (n=15) and Group 2 (n=15). The inclusion criteria for this study were overweight women who were not trained to exercise. The exclusion criteria were subjects under 18 years of age. Subjects received instructions on the study procedures and signed written consent to participate.

2.1.3. Prosedur Blinding

To minimize bias, this study employed a double-blind system. Participants were unaware of whether they were receiving acupuncture electromuscle stimulation or not. The researchers administering the treatments were also unaware of which group received the Acupuncture electromuscle stimulation intervention. Group coding was performed by a research administrator who was not involved in the treatment administration or data collection.

2.1.4. Research Procedures

Participants in Group 1 received electroacupuncture muscle stimulation during physical exercise, applied to the biceps, triceps, abdominals, hamstrings, quadriceps, and gastrocnemius muscles. Group 2 performed the same exercise protocol without electroacupuncture muscle stimulation. The intervention was carried out for 8 weeks, with three sessions per week. Intensity training consisted of weight training performed at a moderate intensity of 60-70% of maximum capacity, performed in 4 sets, with approximately 1 minute of recovery between sets. The exercises used were exercises to train the biceps, triceps, chest, abdominals, and quadriceps muscles.

Data collection included body mass index (BMI), body fat percentage, and free fatty acids. BMI was calculated from height and weight measurements, while body fat percentage was assessed using bioelectrical impedance analysis (BIA). Free fatty acids were determined using the ELISA method in a certified laboratory. Blood samples were collected by medical personnel at baseline (24 hours prior to the intervention) and after the final exercise session (24 hours following the last intervention in week 8).

2.1.5. Statistical analysis

Statistical analysis in this study used the IBM SPSS version 26 application, descriptive tests were carried out to obtain the mean, standard deviation, and standard error. Furthermore, the normality test was carried out using the Shapiro-Wilk method, if the data were normally distributed, the difference test was performed using a paired t-test. but if the data were not normally distributed, the difference was performed using the Wilcoxon signed-rank test.

3. Results

The results of data analysis for normality data of Group 1 and Group 2 using Shapiro-Wilk are presented in Table 1.

Table 1. Normality test results of body composition variables in Group 1 (Exercise with acupuncture electro muscle stimulation) and Group 2 (Exercise without acupuncture electro muscle stimulation)

Data	Group 1	Group 2
Pre-test body fat	0.289	0.127
Post-test body fat	0.343	0.176
Pre-test free fatty acids	0.752	0.684
Post-test free fatty acids	0.257	0.193
Pre-test body mass index	0.226	0.319

Values represent p-values from the normality test. As shown in Table 2, all variables were normally distributed ($p > 0.05$).

The results of the study showed that Group 1 was given physical exercise using acupuncture electro muscle stimulation and Group 2 that was given physical exercise without acupuncture electro muscle stimulation on body composition as presented in Table 2.

Table 2. Body composition before and after intervention in Group 1 and Group 2 (Mean ± SD)

Data	Group 1 (Pre-test)	Group 2 (Pre-test)	Group 1 (Post-test)	Group 2 (Post-test)
Body Fat (%)	49.17 ± 9.36	49.86 ± 9.36	41.33 ± 7.86	45.61 ± 5.18
Free Fatty Acids (μmol/L)	645.44 ± 37.21	656.73 ± 41.35	784.82 ± 57.18	693.27 ± 52.37
Body Mass Index (kg/m²)	27.93 ± 3.18	27.77 ± 4.28	26.25 ± 2.69	26.89 ± 2.59

Values are presented as Mean ± SD.

The results of body composition data analysis in Group 1 and Group 2 using the Paired t-test are presented in Table 3.

Table 3. Data analysis of body composition using the paired t-test

Datas	Significant	
	Group 1	Group 2
Pre-test body fat – Post-test body fat	*0.022	0.248
Pre-test free fatty acids – Post-test free fatty acids	*0.001	0.137
Pre-test body mass index – Post-test body mass index	*0.014	0.126

*There is a significant difference in the Paired test ($p<0.05$)

4. Discussion

This study aimed to evaluate the effects of acupuncture electromuscle stimulation on body composition in overweight women. The findings showed significant changes in body fat, free fatty acids, and body mass index ($p<0.05$) in group 1, which received acupuncture electromuscle stimulation intervention. These findings suggest that acupuncture electromuscle stimulation can provide an additive effect to conventional physical exercise by increasing fat loss and improving body mass index. Previous studies have also reported that electromuscle stimulation can increase muscle activation and energy expenditure, thus contributing to greater fat mass reduction compared to exercise alone [17].

In terms of free fatty acids, both groups showed an increase after the intervention, indicating increased lipolysis. However, the increase was statistically significant only in Group 1. This suggests that acupuncture electromuscle stimulation may further stimulate the mobilization of free fatty acids during exercise. The increase in free fatty acid levels after the intervention may reflect increased utilization of fat as an energy substrate, which has previously been associated with improved metabolic outcomes [18,19]. Interestingly, BMI showed a significant decrease only in group 1. Although BMI is a relatively crude measure compared to body composition analysis, these findings support the idea that acupuncture electromuscle stimulation may contribute to weight management by complementing the effects of exercise. Similar results have been reported in studies showing that electromuscle stimulation increases muscle contraction and energy expenditure [20].

Overall, the findings of this study highlight the potential role of acupuncture electromuscle stimulation. The significant reductions in body fat and BMI, along with significant increases in free fatty acids in the acupuncture electromuscle stimulation group, provide evidence that this intervention may be more effective than exercise alone. However, several limitations need to be considered. The relatively small sample size and short intervention duration may limit the generalizability of the findings. Furthermore, diet, physical activity outside the intervention, and sleep patterns can influence body composition and should be controlled for or recognized as major limitations.

Future studies should use larger sample sizes, longer follow-up periods, and more comprehensive metabolic assessments to confirm these findings and explore the underlying mechanisms. Furthermore, investigating the combination of acupuncture electromuscle stimulation with various exercise modalities and intensities could provide valuable insights into optimizing body composition.

5. Conclusions

Physical training with stimulating using acupuncture electro muscle stimulation can decrease body fat, body mass index, and increase free fatty acids. Therefore, acupuncture with electric muscle stimulation can be used as alternative method to maintain body composition. However, diet, physical activity outside the intervention, and

sleep patterns can influence body composition and should be controlled for or recognized as major limitations.

Author Contributions: "Conceptualization, N.W.K. and R.I; methodology, P.Y.P; software, T.J.; validation, F.Y.W. and M.Y.; formal analysis, N.A.; investigation, R.S.D.; resources, T.J.; data curation, A.J.F.L; writing—original draft preparation, N.W.K.; writing—review and editing, N.A. and A.L.; visualization, S.P.B.; project administration, N.A.; funding acquisition, N.W.K."

Acknowledgement

Authors would like to thank the Rector of Universitas Negeri Surabaya, Indonesia and ALPTKNI LPTK 2024 with contract number B/ 43880 /UN38.III.1/LK.04.00/2024 for supporting research grant.

References

1. Yoo, H.-J. et al. Effects of electrical muscle stimulation on core muscle activation and physical performance in non-athletic adults: A randomized controlled trial. Medicine (Baltimore). 102, e32765 (2023).
2. Loaiza, L. A., Yamaguchi, S., Ito, M. & Ohshima, N. Electro-acupuncture stimulation to muscle afferents in anesthetized rats modulates the blood flow to the knee joint through autonomic reflexes and nitric oxide. Auton. Neurosci. 97, 103–109 (2002).
3. Park, H.-K., Na, S. M., Choi, S.-L., Seon, J.-K. & Do, W.-H. Physiological Effect of Exercise Training with Whole Body Electric Muscle Stimulation Suit on Strength and Balance in Young Women: A Randomized Controlled Trial. Chonnam Med. J. 57, 76–86 (2021).
4. Lebiedowska, A., Hartman-Petrycka, M. & Błońska-Fajfrowska, B. How reliable is BMI? Bioimpedance analysis of body composition in underweight, normal weight, overweight, and obese women. Ir. J. Med. Sci. 190, 993–998 (2021).
5. Coman, M. et al. Body Composition and Cardiorespiratory Fitness Characteristics Among Female University Students : A Cross-Sectional Study. Balneo PRM Res. J. 15, 1–17 (2024).
6. 6. Holmes, C. J. & Racette, S. B. The Utility of Body Composition Assessment in Nutrition and Clinical Practice: An Overview of Current Methodology. Nutrients 13, (2021).
7. Heymsfield, S. B. et al. Are Lean Body Mass and Fat-Free Mass the Same or Different Body Components? A Critical Perspective. Adv. Nutr. 15, 100335 (2024).
8. Hall, J. E. Guyton e Hall, Fisiologia Medica. Guyton E Hall, Fisiologia Medica (2012). doi:10.1016/B978-88-214-3229-3/00001-6.
9. Hurt, R. T., Kulisek, C., Buchanan, L. A. & McClave, S. A. The obesity epidemic: challenges, health initiatives, and implications for gastroenterologists. Gastroenterol. Hepatol. (N. Y). 6, 780–792 (2010).
10. Ahmed, S. K. & Mohammed, R. A. Obesity: Prevalence, causes, consequences, management, preventive strategies and future research directions. Metab. Open 27, 100375 (2025).
11. Kıskaç, M., Soysal, P., Smith, L., Capar, E. & Zorlu, M. What is the Optimal Body Mass Index Range for Older Adults? Ann. Geriatr. Med. Res. 26, 49–57 (2022).
12. Nuttall, F. Q. Body Mass Index: Obesity, BMI, and Health: A Critical Review. Nutr. Today 50, 117–128 (2015).
13. Frood, S., Johnston, L. M., Matteson, C. L. & Finegood, D. T. Obesity, Complexity, and the Role of the Health System. Curr. Obes. Rep. 2, 320–326 (2013).
14. Petrie, J. R., Guzik, T. J. & Touyz, R. M. Diabetes, Hypertension, and Cardiovascular Disease: Clinical Insights and Vascular Mechanisms. Can. J. Cardiol. 34, 575–584 (2018).
15. Haqq, A. M., Kebbe, M., Tan, Q., Manco, M. & Salas, X. R. Complexity and Stigma of Pediatric Obesity. Child. Obes. 17, 229–240 (2021).
16. Bacchini, D. et al. Bullying and Victimization in Overweight and Obese Outpatient Children and Adolescents: An Italian Multicentric Study. PLoS One 10, e0142715 (2015).
17. Hioki, M., Takahashi, H., Saito, A., Imai, M. & Yasuda, H. Effect of electromyostimulation training on intramuscular fat accumulation determined by ultrasonography in older adults. Eur. J. Appl. Physiol. 123, 271–282 (2023).
18. Qin, Y., Chen, H., Liu, X., Wu, J. & Zhang, Y. Effects of whole-body electromyostimulation training on upper limb muscles strength and body composition in moderately trained males: A randomized controlled study. Front. public Heal. 10, 982062 (2022).
19. Lee, M.-C., Ho, C.-S., Hsu, Y.-J., Wu, M.-F. & Huang, C.-C. Effect of 8-week frequency-specific electrical muscle stimulation combined with resistance exercise training on muscle mass, strength, and body composition in men and women: a feasibility and safety study. PeerJ 11, e16303 (2023).
20. Doucet, B. M., Lam, A. & Griffin, L. Neuromuscular electrical stimulation for skeletal muscle function. Yale J. Biol. Med. 85, 201–215 (2012).