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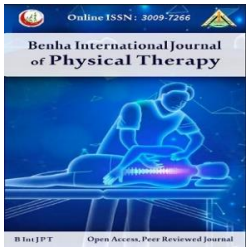

Original research

Effect of transcutaneous electrical acupoint stimulation versus aerobic exercise on iron deficiency anemic females

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Abstract

Background:Diminished counts of circulating red blood cells (RBC) and hemoglobin (Hb) concentrations are common in iron deficiency anemia (IDA). Both transcutaneous electrical nerve stimulation (TENS-A) at acupoints and aerobic exercise are effective in managing IDA.**Purpose:**comparing the effect of aerobic exercise (performed as treadmill walking exercise) and TENS-A in IDA women. **Methods:**Women (n = 60) with IDA were randomly allocated to the TENS-A group (n = 30) and the group of aerobic exercise (GAE, n = 30). In the TENS-A group, electrodes were applied over bilateral GB39 and SP6 acupoints. In the GAE, women with IDA received mildly intense aerobic exercise (treadmill walking exercise). To be noted, for 12 weeks, the session of exercise, or TENS-A, was 30 minutes and applied three times weekly. *Outcomes*: IDA women's concentration of Hb, count of RBC, and mean corpuscular volume (MCV) were recorded in both groups.**Results**:Between-group analysis of women with IDA revealed that the TENS-A group's Hb concentration and RBC count were significantly higher than the other group, GAE ($p < 0.01$). Following both treatments, TENS-A or aerobic exercise, there was no discernible change in MCV between the TENS-A and GAE groups ($p > 0.05$).**Conclusion:**In conclusion, TENS-A and aerobic exercise have a substantial positive impact on women's IDA; however, the effects of TENS-A were greater in Hb concentration and RBC count than those of aerobic exercise. suggesting its potential as a valuable treatment option alongside conventional therapies**.**

Keywords:Electrical stimulation, acupuncture points, treadmill exercise, anemia, women.

Introduction

A diminished quantity of circulating red blood cells (RBC) and a lower concentration of hemoglobin (Hb) is the standardized definition of iron deficiency anemia (IDA) which is a predominant cause of reduced transportation of

oxygen to tissues, inhibited iron reserves, and suboptimal effective function of iron-dependent enzymes.[1] Besides its high prevalence in one-third of the global population, IDA is highly reported in women of reproductive age.

Besides its negative impact on different physiological processes and functions in women, IDA is associated with poor birth outcomes/results and elevated rates of morbidity and mortality. [2]

The pharmacological treatment of iron deficiency anemia is needed to enhance patients' outcomes and quality of life in addition to lowering chances of repeated blood transfusion. [3]

Recently, non-pharmacological therapies of IDA received great attention from patients and clinicians. Acupuncture, termed "Zhen" - as one of the main therapeutic tools used in traditional Chinese medicine (TCM) [4] – is very helpful in improving anemia, Hb, and RBCS after prolonged blood loss or postpartum hemorrhage in women. [5]

Acupuncture has been endorsed and utilized by numerous populations across various countries As a unique option to standard medical approaches that can be applied manual puncturing or electroacupuncture [6] Unfortunately, the two methods involve some injury risk [7] , produce brief local trauma of tiny vessels, and induce phobia in some patients from the insertion of needles into their skin. Opposite to manual or electrical stimulation of acupoints by needling, transcutaneous electrical nerve stimulation over acupoints (TENS-A) is a technique that does not involve surgery or penetration, can be used without the occurrence of complications mentioned above of needling.[8]

It was reported that the applied treatment by acupuncture or TENS-A on the spleen 6 acupuncture point (San Yin Jao or SP6) and gall bladder 39 acupuncture point (Xuan Zhong or GB39) can improve anemia-associated low Hb, hematocrit, and physical/mental well-being. [9]

On the other hand, regular low- to moderate-intensity aerobic exercise - a sequence of bodily movement developed by the repeated contraction of skeletal muscle group(s) [10] - in the presence of aerobic oxygen metabolism – is documented to affect blood volume and hematological parameters [11] including Hb and RBC [1]. This is due to the fact that during aerobic physical training or activity, the working cells of skeletal muscles require an extra oxygen supply that is continuously transported via Hb. Consequently, besides the increase in blood volume, the regular performance of aerobic exercise not only induces the synthesis of Hb and RBC but also increases their levels. [12]

By exploring the potential synergistic effects of these therapies, the study seeks to provide evidence-based recommendations for incorporating aerobic exercise and TENS-A into comprehensive IDA treatment protocols.

Methods

Ethics

The committee concerned with the ethics of physical therapy research affiliated with Cairo University approved this IDA study (the number was P.T.REC/012/003900, Egypt). The patients with IDA understood the purpose and methods of this comparative study. The four authors followed the ethical requirements of Helsinki. All included patients with IDA provided written informed consent.

Criteria of inclusion/exclusion

Individuals with IDA were categorized as either included or excluded women with IDA according to the subsequent standards:

Inclusion criteria

- The serum concentrations of Hb in women with moderate IDA ranged from 8 to 10.9 g/dl.
- The age of participating women with IDA was twenty to thirty years old and their index of body mass was 18.5 to 24.9 kg/m2.
- Participated women were adherent to the by-physician-prescribed drugs and balanced diet for IDA which resulted from the heavy monthly bleeding of menstrual cycle.

Exclusion criteria

- IDA induced by any pathological disorder.
- The serum concentrations of Hb in women with < 8 g/dl.
- Presence of medical conditions/problems such as hypertension, heart problems, spleen disorders, respiratory/renal disorders, *etc*.
- Pregnant women.

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- Physical or orthopedic bony limitations that limit or restrict the participation in exercise program.
- Previous participation in complementary treatments/research within the last six months.

Randomization

Via the randomization technique of sealed envelopes, women (n=60) with IDA were randomly distributed into the TENS-A group (n=30) and group of aerobic exercise (n=30).

Applied treatments

In the TENS-A group, electrodes of the TENS device (Chattanooga device which was manufactured in the United States) were applied over bilateral GB39 and SP6 acupoints at a low frequency (10 Hz 200 ms^{-1}) for 30 minutes, 3 times weekly. [13]

In the aerobic exercise group, women with IDA received 30-minute mildly intense aerobic exercise (treadmill walking exercise) thrice weekly using a Taiwanese-made Perfect Fit electric treadmill. In the aerobic exercise group, women with IDA were trained at 55 to 65% of their maximal estimated heart rate). [14]

To be noted, the total duration of this comparative study was 12 weeks. During this duration, daily after the main meal, both groups additionally consumed one capsule of by-physician-prescribed ferrotron.

Outcomes

IDA women's concentration of Hb, count of RBC, and mean corpuscular volume (MCV) were recorded in both groups both before and after the interventions**.**

Statistical analysis

Age, weight, height, and BMI were compared using an unpaired t-test, as were MCV, RBC, and Hb levels between groups. A paired t-test was employed to evaluate the comparison between Hb, RBC, and MCV levels within each group before and after therapy. All tests were executed with a significance criterion of $p < 0.05$ utilizing SPSS version 25 (IBM SPSS, Chicago, IL, USA).

Results

Subject characteristics

Age, weight, height, and index of boy mass did not significantly differ across the TENS-A group or GAE ($p > 0.05$) **(Table 1).**

Table 1. Women's characteristics in the TENS-A group and GAE

	TENS-A group	**GAE**	**MD**	**t- value**	**p-value**
	Mean ± SD	**Mean ± SD**			
Age of IDA women (years)	25.33 ± 2.77	25.17 ± 3.38	0.16	0.21	0.84
Weight of IDA women (kg)	60.70 ± 6.94	58.50 ± 8.50	2.2	1.09	0.27
Height of IDA women (cm)	164.93 ± 8.28	163.70 ± 7.85	1.23	0.59	0.56
BMI of IDA women (kg/m^2)	22.27 ± 1.58	21.74 ± 1.95	0.53	1.16	0.25

IDA: Iron deficiency anemia; **TENS-A**: Transcutaneous electrical nerve stimulation over acupoint; **BMI**: Body mass index; **GAE**: Group of aerobic exercise.

Within-group comparison

The concentration of Hb and the count of RBC significantly increased after the application of 12-week TENS-A or aerobic exercise when compared to pretreatment ($p < 0.00$ 1), whereas women's MCV did not significantly improve after the application of TENS-A or aerobic exercise ($p > 0.05$).

Women with IDA in the TENS-A group experienced a percentage of improvement in their Hb concentration, RBC count, and MCV reaching 24, 30.42, and 0.04%, respectively. Women with

IDA in the aerobic exercise group experienced a percentage improvement in their Hb concentration, RBC count, and MCV reaching 16.11, 15.86, and 0.05%, respectively **(Table 2)**.

Between-group comparison

Before the application of TENS-A or aerobic exercise, Hb concentration, RBC count, and MCV did not significantly differ between groups of women with IDA ($p > 0.05$) **(Table 2)**.

After treatment, a comparison of between-group Hb concentration and RBC count showed that the TENS-A group's Hb and RBC were significantly higher than GAE ($p < 0.01$). Following the application of TENS-A or aerobic exercise, no discernible variation in the value of MCV between TENS-A or GAE (P value >0.05) **(Table 2)**.

Table 2. Values of Hb concentration, RBC count, and MCV of TENS-A group or GAE before and after treatment in women with IDA.

	TENS-A group	**GAE**			
	Mean ± SD	**Mean ± SD**	**MD**	**t- value**	**p value**
Hb (g/dl)					
Pre treatment	9.21 ± 0.52	9.25 ± 0.69	-0.04	-0.25	0.80
Post treatment	11.42 ± 0.55	10.74 ± 0.73	0.68	4.05	0.001
MD	-2.21	-1.49			
% of change	24	16.11			
t- value	-48.53	-20.43			
	p = 0.001	***p = 0.001***			
RBC (x 10^{12}/L)					
Pre treatment	3.55 ± 0.49	3.72 ± 0.58	-0.17	-1.27	0.21
Post treatment	4.63 ± 0.44	4.31 ± 0.41	0.32	2.95	0.004
MD	-1.08	-0.59			
% of change	30.42	15.86			
t- value	-9.45	-6.99			
	p = 0.001	***p = 0.001***			
MCV (fl)					
Pre treatment	81.18 ± 8.18	78.72 ± 7.71	2.46	1.19	0.24
Post treatment	81.15 ± 8.19	78.76 ± 7.77	2.39	1.16	0.25
MD	0.03	-0.04			
% of change	0.04	0.05			
t- value	0.90	-1.09			
	p = 0.37	***p = 0.28***			

IDA: Iron deficiency anemia; **TENS-A**: Transcutaneous electrical nerve stimulation over acupoint; **RBC**: Red blood cells; **BMI**: Body mass index; **Hb**: Hemoglobin; **GAE**: Group of aerobic exercise; **MCV**: Mean corpuscular volume.

Discussion

This comparative study's conclusions demonstrated that while MCV did not change in either women who received 12-week TENS-A or women who received 12-week aerobic exercise, women with IDA in the TENS-A group had a significantly higher improvement in their Hb concentration and RBC count than women with IDA in the aerobic exercise group.

In the recent acupuncture study published in 2023, the results of the daily acupuncture at urinary bladder 17 (UB17), liver 13 (Liv13), and GB39 acupoints supported our results despite the results showed limited effectiveness, with only 2-week acupuncture in improving HB concentration and red cell distribution width (RCDW) in anemic women. [15] To enhance effectiveness and achieve more substantial and lasting results, our study extended to three months.

In another 2-month study that was adherent to the presented results of Hb, a short-term improvement was observed in 53% of teenage girls (n=25) who received 10-minute acupressure every two days at stomach 36 and SP6 acupoints. [16] In contrast, our study involved a larger sample size and implemented 30-minute sessions over a 3-month period to yield more comprehensive results.

Again, two weeks of 30-minute needling of GB39, UB17, and Liv13 augmented by another 10-manual stimulation of the same points, a hands-on approach that combines needle insertion with manually adjusting them, five days a week in patients with dietary deficiency anemia significantly improved Hb and RDW. [17]These results were consistent with current 3-month study, which involved 30-minute TENS-A sessions at GB39 and SP6, three times a week, for females with IDA.

On the other hand, in accordance with the documented role of aerobic exercise in raising Hb concentration in this study's women with IDA who received aerobic exercise, another study published in 2021 reported that 30 minutes of moderate-intensity aerobic training applied thrice weekly for 12 weeks in anemic women significantly improved their Hb concentration . [18] In the current study, mild aerobic exercise was implemented specifically tailored for moderate anemia cases. Also, in college females, the regular performance of jogging exercise (as a form of aerobic exercise) significantly raised the student's Hb concentration. [12]

Lined with the current results, involving ten college students females in 1-hour moderate-intensity aerobic exercise (performed thrice weekly on a bicycle) along with the consumption of dietary supplements for two months accelerated the synthesis of Hb. [19]

Again, involving female patients with IDA in 30-minute moderate-intensity aerobic exercise (performed thrice weekly on a bicycle) along with the consumption of pharmacological supplements for three months significantly improved females' Hb concentration.[1] This is aligned with the current study, which showed that 30 minutes of mild treadmill exercise three times a week for three months similarly enhanced Hb levels.

Again, opposite to the presented results, possibly due to the limited sample size, brief study duration, and short session time. In the study for eight weeks of aerobic training was not sufficient to induce significant improvements in in Hb concentration, RBC, and mean corpuscular Hb in females with IDA. [20]

Contradicting the presented results, there was no significant change in the RBC of students affiliated with Nigeria's Nnamdi Azikiwe University after their engagement in a test of aerobic activity (the test was a 30-minute treadmill aerobic activity performed as a Bruce protocol). likely because the study utilized a single test session with a small sample size that included participants of both genders. [21]

Limitation

Besides follow-up to Hb concentration, RBC, and MCV, this study was limited by investigating the physical and mental status of participants that must be covered in future IDA research.

Conclusions

In conclusion, TENS-A and aerobic exercise have a substantial positive impact on women's IDA; however, the effects of TENS-A were greater in Hb concentration and RBC count than those of aerobic exercise. Thus, this comparative study may highlight the positive role of aerobic exercise and TENS-A in improving HB concentration and RBC count in women with IDA. Further research is necessary to refine TENS-A protocols, understand its long-term benefits in managing IDA and compare their effectiveness with that of Ferrotron.

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Conflict of interests

In this study applied on women with IDA, the authors report no conflict of interest.

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References

1- El Nahas E &Gabr A. Impact of aerobic exercise on iron deficiency anemia in girls. International Journal of Physiotherapy and Research. 2017; 5(5): 2399-2404.

2- Kumar S, Kapoor N & Manu K. An Observational Study of Anemia in Adult Age Group at a Tertiary Centre in Uttar Pradesh. European Journal of Molecular and Clinical Medicine. 2022; 9 (3): 9838-9846.

3- Abbruzzese L, Agostini V, Livraghi A, Manzini P, Marmifero M & Tirindelli C. How to implement of patient blood management pillar 1: An Italian expert opinion based on a “bundles” approach. Transfusion and Apheresis Science. 2020; 59 (5): 102874.

4- Matos L, Machado J, Monteiro F &Greten H. Understanding traditional Chinese medicine therapeutics an overview of the basics and clinical applications. Healthcare Journal. 2021; 9 (257): 1-32.

5- Xiong Y, Yuan C, Yu L, Qi D, Jun Z, Juan H, Yun G, Wen W, & Bo T. Exploring the mechanism of buxue yimu pill on hemorrhagic anemia through molecular docking, network pharmacology and experimental validation. Chinese Journal of Natural Medicines. 2021; 19 (12): 900-911.

6- Draz R, Serry Z, Rahmy A, Bardesi M, & Taha M. Electroacupuncture Versus Aerobic Interval Training on Liver Functions in Patients with Nonalcoholic Fatty Liver. The Journal of Alternative and Complementary Medicine. 2020; 26(1): 51-57.

7- Ismail A. M. A., & Abd El-Azeim A. S. Short-Term Intraocular Pressure Response to the Combined Effect of Transcutaneous Electrical Nerve Stimulation over Acupoint (Acu-TENS) and Yoga Ocular Exercise in Type 2 Diabetic Patients with Primary Open-Angle Glaucoma: A Randomized Controlled trial. Journal of Acupuncture and Meridian Studies, 2021; 14(5), 193-199.

8- Ismail A. M. A., Saad A. E., Abd-Elrahman N. A. F., & Elfahl A. M. A. Response of Lipid Profile to Laser Acupuncture along with Diet and Pilates Exercise in Obese Women with Systemic Lupus Erythematosus: A Randomized Controlled Trial. Journal of Acupuncture and Meridian Studies, 2023; 16(4), 152-158.

9- Ritonga M, Jalaluddin M, Sari W, Lubis T, Putri I, Sayuti N, Sayuti A, & Helmi T. Study of the effect of electroacupuncture combination in total erythrocyte, hemoglobin, and hematocrit values in domestic cat. 2nd International conference on veterinary, animal and environmental sciences (CVAES 2020). 2021; 12: 147-151.

10- Mohammed E & Kaba M. Perception of regular physical activities and factors affecting physical activities among adult government office worker in adama town, ethiopia: qualitative study. American Journal of Health Research .2021; (5) 9: 190-197.

11- ÇİÇEK G. The effects of different exercise types on hematological parameters in sedentary women. Journal of Education and Training Studies. 2018; 6(8): 96-101.

12- Sepriadi, Jannah K & Eldawaty. The effect of jogging exercise to improve hemoglobin levels. Journal of Physics. 2020; 1481(1): 1-4.

13- Nardi A, Hauck M, Franco O, Paulitsch F, Silva A & Signori L. Different frequencies

of transcutaneous electrical nerve stimulation on sympatho-vagal balance. Health Sciences. 2017; 39(1): 9-16.

14- Abd El-Kader M, Gari M, & Salah El-Den M. Impact of moderate versus mild aerobic exercise training on inflamatory cytokines in obese type 2 diabeteic patients: a randomized clinical trial.African Health Scinces. 2013; 13(4): 857-863.

15- Devi K, Mooventhan A, Mangaiarkarasi N & Manavalan N. Effect of Needling at Selected Acupuncture Points (GB39, BL17, LR13) on Hemoglobin Levels in Anemia: A Randomized Placebo Controlled Study. Journal of Acupuncture and Meridian Studies. 2023; 16 (6): 263-267.

16- Ningrum N& Setiawandari S. Effect of Acupressure at ST 36 & SP 6 Points on Hemoglobin Levels among Adolescent Girls: Preliminary Study. EMBRIO. 2022; 14 (2): 192-196.

17- Devi K. Effect of Selected Acupuncture Points (GB-39, BL-17, LV-13) on Hemoglobin Levels in Nutritional Deficiency Anemia: A Randomized Controlled study. (Doctoral dissertation, Government Yoga and Naturopathy Medical College, Chennai). 2022.

18- ELSHERIF A, ALY A & YOUSEF A. Effect of aerobic exercise on blood hemoglobin level and quality of life in postmenopausal anemic women: randomized controlled clinical trial. Journal of Life Science and Biomedicine. 2021; 11 (03): 53-57.

19- Tharani G, Preethi G, Kamatchi K, Yuvarani G, Vaishnavi G & Augustina S. Impact of Aerobic Exercise and Yoga Asanas along with Diet Supplements on Haemoglobin Level among Female Collegiate. Int. J. Life Sci. Pharma Res. 2021; 11 (1): 233-237.

20- Moghadam S, Aminaei M & Nikoei R. The Effects of Iron Ion Solution Consumption and Aerobic Training on Hematologic Factors among Iron Deficiency Anemia Female Patients. J Nutr Fast Health. 2022; 10(2): 121-128.

21- Chizoba O, Emmanuel M, Christopher A, & Kenneth A. Changes in white blood cell, red blood cell and platelet parameters following short term aerobic exercise in students of Nnamdi Azikiwe University, Nigeria. International Journal of Sport, Exercise and Health Research. 2020; 4(2): 73-78.

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