RESEARCH PAPER

Effect of Transcutaneous Electrical Acupoint Stimulation (TEAS) on Dysmenorrhea Among Autoimmune Disease Women

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Abstract:

Background: Autoimmune rheumatic diseases (ARDs) are a set of systemic autoimmune illnesses that principally affect soft tissues, joints, and bones. Immune dysregulation and inflammation may contribute to the development of menstruation-related disorders among women with ARDs. Transcutaneous Electrical Acupoint Stimulation (TEAS) exerts multi-level immunomodulatory and neuroendocrine effects that can potentially alleviate systemic pain and inflammation in autoimmune diseases, involving Rheumatoid Arthritis (RA) and Systemic Lupus Erythematosus (SLE).

Purpose: This research was conducted to determine the effect of (TEAS) on dysmenorrhea among autoimmune disease women. **Subjects:** Fifty-two women diagnosed with RA or SLE experienced severe dysmenorrhea and exacerbation of illness symptoms throughout the menstruation. Participants aged 25 to 40 years, with a BMI varying from 18.5 to 30 kg/m², were randomized and equally split into two groups.

Group (A) underwent TEAS in addition to NSAID for 3 consecutive menstrual cycles (n=26). Group (B) received the same NSAID for 3 consecutive menstrual cycles (n=26)**. Material and Methods:** Inflammation was evaluated by Erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP), while pain was assessed by Pain disability index (PDI). Results: Intra-group analysis for Group A indicated no statistically significant variations in CRP, ESR, and PDI pre-intervention ($p > 0.05$). Post-intervention, a statistically significant reduction was noted in CRP and PDI ($p < 0.05$), although ESR exhibited no statistically substantial change ($p > 0.05$). **Conclusion:** TEAS is considered a harmless, non-invasive therapy producing a greater improvement in pain and other symptoms during menstruation in women with autoimmune diseases.

Keywords: Autoimmune rheumatic diseases, Dysmenorrhea, Transcutaneous Electrical Acupoint Stimulation, Rheumatoid arthritis, Systemic lupus erythematosus **How to cite this article:** Okeil LM, Kamel DM, Youssef AM, Kamel HA, Abdo FA. Effect of Transcutaneous Electrical Acupoint Stimulation (TEAS) on Dysmenorrhea Among Autoimmune Disease Women. Int J Drug Deliv Technol. 2026;16(68s):1063-1073. DOI: 10.25258/ijddt.16.68s.125

1. Introduction

Autoimmune rheumatic diseases (ARDs), systemic inflammatory illnesses impact joints and connective tissues, result in significant morbidity and diminished quality of life. Prevalent varieties encompass rheumatoid arthritis (RA), ankylosing spondylitis, and systemic lupus erythematosus (SLE) [1]. RA is a persistent inflammatory condition that predominantly impacts the synovial joints, resulting in cartilage and bone deterioration and, at times, impairing extra-articular tissues. Its development is modulated by genetic and epigenetic variables, as well as environmental stimuli including smoking, dust exposure, and changes in the microbiome.[2]

SLE is a multi-system autoimmune disease identified by the presence of autoantibodies targeting nuclear structures, resulting in immune complex deposition and subsequent tissue destruction [3]. Reports of overlap syndromes such as “Rhupus” (coexisting RA and SLE) describe gynecologic manifestations, including dysmenorrhea and

ovarian cysts, preceding autoimmune onset. These findings suggest a close interaction between immune, hormonal, and neuroinflammatory mechanisms in women with RA and SLE, potentially predisposing them to more severe or prolonged menstrual pain compared with healthy controls[4]

Studies indicate that hormonal fluctuations during the menstrual cycle influence immune activity in women with SLE and RA, leading to increased pain and disease flares, particularly in the perimenstrual phase. This interaction may contribute to worsened dysmenorrhea in these patients.[5] Female sex hormones, particularly estrogen, may exacerbate cutaneous manifestations of lupus by enhancing inflammatory pathways. Estrogen increases toll-like receptor expression in macrophages and may promote autoimmune activation in predisposed individuals.[6]

Recent evidence indicates that acupuncture and its electrical variants (electroacupuncture; Transcutaneous electrical acupoint stimulation (TEAS)) produce analgesia in primary dysmenorrhea through multilevel mechanisms, including reduction of prostaglandin-mediated uterine hypercontractility, modulation of neuroendocrine and autonomic pathways, and reorganization of central pain-processing regions [7]

TEAS is a noninvasive alternative to traditional acupuncture that uses surface electrodes instead of needles, reducing discomfort and infection risk. It has been extensively utilized in clinical settings as an effective modality for pain management [8].

Clinically, TEAS is considered safe, cost-effective, and easy to administer, with minimal adverse effects limited to mild transient skin irritation. Its needle-free design supports home use and suitability for needle-averse or immunocompromised patients, with trials demonstrating efficacy in primary dysmenorrhea and other pain conditions.[9] Transcutaneous Electrical Acupoint Stimulation (TEAS) exerts immunomodulatory and neuroendocrine effects that may reduce inflammation and pain in autoimmune disorders, including RA and SLE. It activates afferent nerve fibers and the HPA axis, leading to the release of endogenous opioids and neurotransmitters that promote analgesia and decrease inflammatory signaling [10]

Clinical trials and meta-analyses of acupuncture for RA consistently identify a core set of acupoints, with ST36 (Zusanli) being the most frequently used, alongside LI4, LI11, SP6, LR3, and GB34. ST36 appears in most studies due to its well-documented anti-inflammatory and immunomodulatory effects[11]. Electroacupuncture protocols for RA commonly combine ST36 with limb points such as LI4 and LI11 to address both local joint pain and systemic inflammation [12]. Frequently selected acupoints for managing gynecological conditions include SP6 (Sanyinjiao), CV4 (Guanyuan), LI4 (Hegu), and ST36 (Zusanli), which have been associated with improved uterine blood flow, hormonal regulation, and pain relief [7]

In a study, acupuncture combined with herbs demonstrated a significantly superior impact on RA symptoms, with notable changes across all variables among the two groups. This approach inhibited the inflammatory response and enhanced immunological function by utilizing the following acupoints: ST36, GB33, EX-LE4, EX-LE5, SI11 SJ4, ST5, LI4, GB34, GB31, BL18, BL20, BL23, ST34, RN6, RN4, DU14, LI11 SI9, LI15, SJ14, BL36, GB30, BL54, KI6, BL60, SP10, GB40, BL62 [13]

Although clinical trials in SLE are limited, existing RCTs commonly employ systemic regulatory acupoints to modulate immune function and alleviate constitutional symptoms. Frequently used points include ST36 and SP6, often combined with BL23, GV20, and LI4 depending on the therapeutic focus [14]. Earlier pilot RCTs and feasibility research in SLE likewise used ST36 together with local/distal point sets to address pain, fatigue, and sleep, supporting the repeated use of ST36 and SP6 in lupus trials [15,16,17].

Recent high-quality reviews highlight ST36 as the most evidence-supported acupoint due to its anti-inflammatory properties, involving stimulation of the vagal anti-inflammatory route and downregulation of Toll-like receptor 4 / nuclear factor kappa-light-chain-enhancer of activated B cells (TLR4/NF-κB) signaling. LI4 and LI11 are primarily selected for analgesic and cytokine-modulating effects, while SP6 and BL23 are used to regulate systemic and gynecologic functions and alleviate fatigue [18].

TEAS has emerged as a promising non-invasive intervention with potential analgesic and anti-inflammatory properties. Although, its significance in managing dysmenorrhea in women with autoimmune diseases has not been adequately investigated. Therefore, this research was conducted to examine the efficacy of TEAS in reducing menstrual pain and inflammatory markers in

females experiencing dysmenorrhea linked to autoimmune disorders.

2. Patients and Methods

Patients were allocated from the rheumatology department at El Fayoum University Hospital from May 30, 2025, to November 30, 2025. The Ethical Committee of the Faculty of Physiotherapy, Cairo University, has authorized the study (No: P.T.REC/012/004759). Additionally, the protocol was recorded on clinical trial.gov under ID NCT06976151. Participants were thoroughly briefed on the research's nature and objectives, treatment protocols, and were permitted to pose questions prior to granting written informed consent.

A. Inclusion criteria:

Fifty-two women contributed to this study according to the specified criteria:

All participants were diagnosed with an autoimmune disease in terms of RA, SLE, or Rhupus according to a laboratory investigation and clinical assessment, suffering from sever pain during menstruation (dysmenorrhea) and flare up of disease symptoms. They were aged between 25 and 40 years, and their BMIs varied from 18.5 to 30 kg/m^2.

B. Exclusion criteria:

Exclusion criteria were secondary dysmenorrhea, cardiac or respiratory diseases, vaginal infection, anaemia, and any other autoimmune diseases rather than RA and SLE.

Assessment procedures:

The evaluation was conducted prior to the commencement of the trial and subsequent to the completion of the third menstrual cycle for each participant.

The Pain Disability Index (PDI) is a seven-item, self-administrated scale designed to assess the extent of pain-associated impairment, irrespective of pain location or associated disease. The questions are evaluated using a numerical scale from 0 to 10, where 0 signifies no disability, and 10 signifies maximum disability. The overall values of the seven items correspond to a cumulative score of the PDI, which spans from 0 to 70, with elevated scores indicating greater restriction of pain to routine tasks. The PDI assesses familial and domestic obligations, leisure activities, social involvement, job, sexual conduct, self-care, and life-sustaining activities [19]

The erythrocyte sedimentation rate (ESR) quantifies the extent at which red blood cells (RBCs) precipitate in anticoagulated blood during one hour, functioning as an indirect indicator of inflammation. Increased acute-phase proteins enhance RBC aggregation and accelerate sedimentation; however, the ESR may also be affected by non-inflammatory variables like anemia, age, gender, and plasma protein composition [20].

A typical “rule” for ESR in adults is: for men: age/2 (mm/hr); for females: (age + 10)/2 mm/hr. The values given in some sources: men < 15–20 mm/hr, females < 20–30 mm/hr (young adults) but values rise with age[21]

C-reactive protein (CRP) :CRP is a hepatic acute-stage protein released in reaction to cytokines (especially IL-6) during inflammation, tissue damage and infection,.It binds to phosphocholine on damaged cells or microbes, activates complement, and helps phagocytosis — so it has a direct significance in the inflammatory/immune response[20]. Normal CRP: < 10 mg/L (or < 1.0 mg/dL) in many labs. For high-sensitivity CRP (hs-CRP) used in cardiovascular risk, normal might be < 3 mg/L[22]

Blood samples were obtained at baseline (before the initiation of treatment, just before the first menstrual cycle) and after completion of the intervention (at the end of the third menstrual cycle) to evaluate inflammatory markers in both groups (A and B). The treatment protocol was administered over three consecutive menstrual cycles.

B. Treatment Procedures

Fifty-two women participants diagnosed with RA or SLE were randomized and equally split into two groups (A & B)

Group (A) (study group) comprised 26 women (11 SLE and 15 RA) who received TEAS combined with non-steroidal anti-inflammatory drugs (NSAIDs) in the form of Diclofenic 20mg/day, while Group (B) (control group) comprised 26 women (12 SLE and 14 RA) who received only NSAIDs in the form of Diclofenic 20mg/day. (Fig. 1)

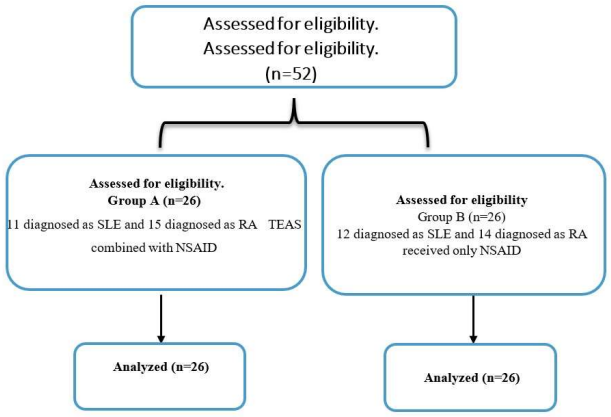


Fig (1): The study's flow chart

A. Electric stimulator Duo 400

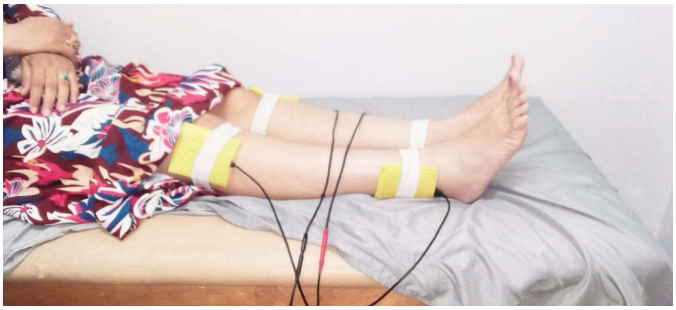
The Gymna Duo 400 is an electrotherapy apparatus that administers several current modalities via independent channels. In the present research, we employed continuous stimuli with an adjustable pulse frequency of 2-10 Hz and a pulse duration of 10-120 µs. The stimulation intensity may be increased based on patient tolerance and utilized in the current trial as a strategy to attain pain relief and alleviate symptoms during menstruation. Incrementally increase the electrical current intensity to a noticeable level, then decrease it to a sub-painful threshold. The intensity of electrical stimulation should not be highly uncomfortable.

This device applied an electrical current at the acupuncture points bilaterally; these acupoints include LI4, GB34, LI11, GB39, and ST 36. The treatment protocol was applied over three consecutive menstrual cycles, with three sessions per week. Each session lasted 30 minutes, with 6 minutes of continuous stimulation delivered to each acupoint. The intervention was paused during the menstrual period and resumed afterward.

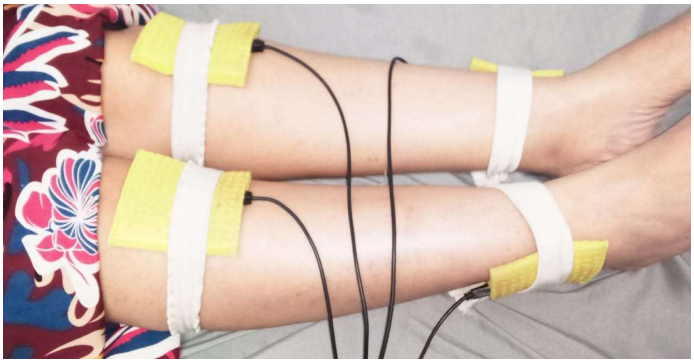
The acupuncture points utilized in this study are as follows: **LI11 (Large Intestine 11)**, situated in the depression at the external edge of the transverse cubital region, in the middle between LU5 (chive) and the humeral lateral epicondyle; **LI4 (Large Intestine 4)**, located between the bases of the thumb and index finger, (Fig.2); **GB34 (Gall Bladder 34)**, found on lateral aspect of the lower leg, 7 cuns above the tip of the lateral malleolus along the anterior margin of the fibula; **ST36 (Stomach 36)**, positioned on the tibialis anterior muscle, 4 finger width under the kneecap and 1 fingerbreadth laterally from the anterior tibial crease; and GB39 **(Gall Bladder 39)**, situated at the lateral leg, three cuns over the tip of the lateral malleolus, along the anterior fibular border (Fig. 3&4).[23]

Fig(2): Both LI11 and LI 4 on both hands

Fig(3): GB34 and GB39 on both lower limbs



Fig(4): ST36 and GB 39 on both lower limbs

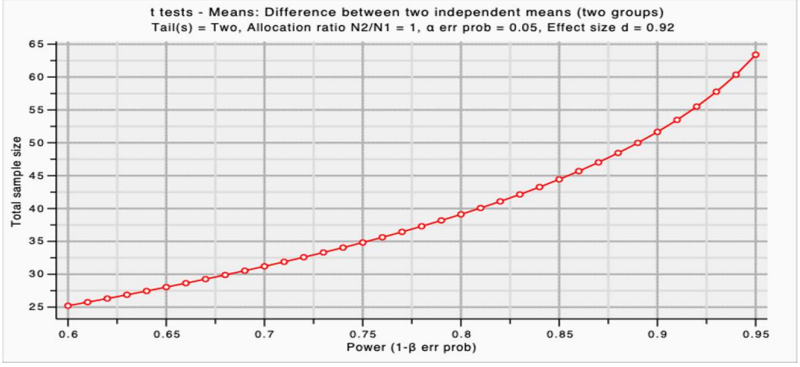


B. Non-Steroidal Anti-inflammatory Drugs (NSAIDs):

Every participant in both groups (A and B) was administered NASID as Diclofenac 20 mg/ day during menstruation for 3 consecutive menstrual cycles.

NSAIDs are the predominant medications employed in the management of dysmenorrhea. They alleviate menstrual discomfort by diminishing uterine pressure and lowering PGF2alpha concentrations in the menstrual fluid. Although not specific to diclofenac 20 mg, a large comparative study found that oral diclofenac sodium is similarly effective to other NSAIDs (like piroxicam) in reducing pain scores in primary dysmenorrhea [24]

Sample size was estimated utilizing G*POWER statistical software (version 3.1.9.2; Universitat Kiel, Germany) based on numerical pain rating scale data derived from Bai et al., 2017, who reported a significant effect of TENS therapy for alleviating pain in females with primary dysmenorrhea. and indicated that the optimal needed size of every group is 26. The calculations were done utilizing α=0.05, power=80%, allocation ratio N2/N1 =1, and effect size = 0.92.



Sample size calculation

Statistical analysis

• Data were represented by mean± SD. The unpaired t-test was employed to verify the subjects' demographics of both groups.

• To determine if the data distribution was normal, the Shapiro-Wilk test was employed.

• MANOVA was applied to analyze the effects of the evaluated variables ESR, CRP, and pain disability index within and among groups

• Data was analyzed via version 20 - SPSS (SPSS Inc., Chicago, Illinois, USA). P was deemed significant if it was ≤ 0.05.

Results and Discussion:

Physical characteristics of the participants

As displayed in Table 1, no statistically significant variations were noted across the two groups' mean values for women's age, weight, and height ($p>0.05$). Data were examined for the existence of extreme scores, homogeneity of variances, and the normalcy assumption. All evaluated variables had a normal distribution, regarding the Shapiro-Wilk test ($p>0.05$).

Table 1. Subjects' demographic data in both groups

Demographic data	Group A (n=26)	Group B (n=26)	t-value	p-value
Age (years)	32.5±4.93	32.27±5.04	0.11	0.914
Weight (kg)	66.37±8.78	66.21±5.84	0.05	0.960
Height (cm)	163.58±5.33	164.73±5.8	-0.49	0.627

Data was represented as mean ± standard deviation, p- value: significance

Data analysis and statistical design:

<u>Overall impact of treatment on the evaluated variables</u>

The impact of intervention on the evaluated variables was examined using MANOVA. Treatment * time had a statistically significant interaction effect ($p = 0.001$), and time had a statistically significant effect ($p = 0.001$). Additionally, a statistically significant treatment impact was detected ($p=0.001$).(Table 2).

2- MANOVA table for the impact of intervention on the evaluated variables

MANOVA table			
	f-value	p-value	η^2
Interaction effect (treatment * time)	*25.11*	*0.001*	0.881
Effect of time	*23.84*	*0.001*	0.875
Effect of treatment	*9.34*	*0.001*	0.733

F value: Mixed MANOVA F value

p value: Probability value

η2: partial eta square

Comparison between groups:

CRP- mean levels did not change statistically significantly across both groups pre-intervention (p = 0.284), but there was a statistically significant variation with superiority of the study group after intervention (p = 0.010).

The mean ESR values after the first hour before and after intervention did not change statistically significantly across both groups (p = 0.134 and 0.160, respectively).

The PDI: Before intervention, no statistically significant variation was noted across both groups' mean PDI scores (p=0.634), but after the intervention, a statistically significant variation was detected, favoring the study group (p=0.001).

Table 3. Mean ±SD of measured variables before and following intervention of the two groups.

Measured variables	Study group A Mean ±SD	Control group B Mean ±SD	MD (95% CI)	P-value[1]	η^2
CRP (mg/l)					
Pre study	11.96 ± 8.48	16.42 ± 10.93	-4.46 (-12.9, 3.98)	0.284	0.054
Post study	8.98 ± 4.5	17.8 ± 9.8	-8.82 (-15.3, -2.3)	0.010*	0.274
MD (95% CI)	2.98 (0.15, 5.79)	-1.4 (-4.3, 1.56)			
% of change	25%	8.5%			
P-value	0.040*	0.337			
ESR (mm/hr)					
Pre study	40.5 ± 11.75	29.63 ± 20.8	10.86 (-3.62, 25.3)	0.134	0.104

Post study	38.17 ± 13.6	28.73 ± 13.37	9.44 (-4.03, 22.9)	0.160	0.092
MD (95% CI)	2.33 (-0.33, 5)	0.9 (-1.88, 3.69)			
% of change	5.8%	3%			
P-value	0.084	0.505			
PDI score					
Pre study	40.25 ± 3.02	39.54 ± 3.95	0.71 (-2.33, 3.74)	0.634	0.011
Post study	29.42 ± 2.31	39.45 ± 3.6	-10.03 (-12.6, -7.4)	0.001*	0.753
MD (95% CI)	10.83 (9.04, 12.62)	0.09 (-1.78, 1.96)			
% of change	27%	0.02%			
P-value	0.001*	0.920			

SD: standard deviation, CI: Confidence interval, p-value: significant level within group, p-value[1]: significant level across groups, *: significant, η^2: partial eta square

Discussion

The present findings demonstrated a significant reduction in inflammatory markers (CRP and ESR) and pain-associated disability, as evaluated by the Pain Disability Index (PDI), during menstruation in patients with RA and SLE. In addition, significant improvements were observed in joint mobility, muscle strength, and endurance following treatment compared to baseline. These findings indicate that TEAS has a significant impact on dysmenorrhea and associated functional outcomes in women with autoimmune diseases

It was highlighted that TENS and electrostimulation can alleviate pain and enhance function in arthritis and persistent painful conditions. Some evidence also suggests anti-inflammatory properties, involving reducing pro-inflammatory cytokines, comprising IL-6 and TNF [25]. Electroacupuncture (EA), when combined with standard RA treatment, has been detected to inhibit pro-inflammatory cytokines, including IL-17, and regulate bone metabolism markers. It may alleviate symptoms, improve quality of life, and serve as a promising adjunct therapy in RA management [26]

Gu et al. [27] found that TENS in conjunction with acupoint stimulation had a superior impact in alleviating labor pain relative to usual care. This effect was evident in critical outcome measures, comprising the VAS score and improved maternal childbirth well-being. In the present study, we demonstrated a significant impact on the PDI following treatment.

TEAS likely reduces CRP/ESR via vagal-mediated cholinergic anti-inflammatory pathways, inhibition of NF-κB signaling, and minimize pro-inflammatory cytokine production (IL-6, TNF-α) — IL-6

downregulation directly reduces hepatic CRP production [28]

Chuang et al [29] reported that EA in addition to standard RA-treatment reduced IL-17 (a pro-inflammatory cytokine) and regulated bone metabolism markers. EA has the probability to reduce suffering and enhance the quality of life (QoL) for RA sufferers. It is a promising adjunct therapy for augmenting the efficacy of clinical treatments. **Feng et al [30]** evidence from rheumatoid arthritis research also supports the anti-inflammatory and sedative properties of EA and related electrical acupoint stimulation modalities. A systematic review comprising 17 RCTs involving 1,317 RA patients found that electroacupuncture combined with medication significantly improved pain scores, DAS28, CRP, and ESR compared with medication alone ($p < 0.05$). The study concluded that electroacupuncture may enhance clinical outcomes and reduce inflammatory activity in RA patients.

Wang et al. [31] concluded that electroacupuncture exhibited the greatest efficacy for alleviating RA pain. Sham acupuncture on the same acupoints may diminish the perceived efficacy of acupuncture and is not advisable as a placebo control. RCTs involving 704 people were examined; EA (SMD: –1.42; 95% CI: [–1.87, –0.98]) and conventional acupuncture (SMD: –1.11; 95% CI: [–1.49, –0.73]) indicated superior efficacy relative to traditional treatment and non-acupoint sham therapy. The collective ranking curve indicated that EA was the most efficacious for pain alleviation (97.7%), succeeded by conventional acupuncture (75.1%), non-acupoint sham (29.1%), same sham acupoints (28.6%), and traditional therapy (19.5%).

Liu et al. [32] executed a systematic review to explore the efficacy as well as safety of acupuncture and moxibustion in the management of primary dysmenorrhea (PD). The analysis included 22 RCTs and demonstrated that acupuncture and moxibustion significantly reduced menstrual pain intensity compared with control interventions. The pooled results of 13 trials involving 675 participants showed significant improvement in Visual Analog Scale (VAS) scores, while additional studies using the Cox Menstrual Symptom Scale (CMSS) also reported marked reductions in dysmenorrhea symptoms. Furthermore, the review concluded that acupuncture-related therapies were generally safe and associated with fewer adverse events, supporting their potential as effective non-pharmacological interventions for PD management.

TEAS typically uses frequencies of 2–100 Hz and in the current study use 2-10 Hz with intensity adjusted to patient tolerance, producing a mild, non-painful tingling sensation. Sessions last 20–30 minutes, administered 2–3 times weekly over 1–3 menstrual cycles, targeting acupoints such as SP6, CV4, LI4, and ST36 for pain relief and hormonal regulation [7]. The study was designed to compare real electroacupuncture with sham treatment in alleviating menstrual pain severity and improving QoL. Outcome measures included pain intensity, psychological status, and treatment safety. However, as this article represents a study protocol, no clinical outcomes or final results were reported. The authors highlighted the need for rigorous clinical trials to establish evidence for electroacupuncture as a non-pharmacological treatment for dysmenorrhea.

Strengths and Limitations

The present study has numerous strengths. It is among the limited studies investigating the impact of TEAS on dysmenorrhea in females with autoimmune illness, particularly RA and SLE. The study incorporated both subjective and objective outcome measures, including the PDI and inflammatory markers such as CRP and ESR, which enhanced the clinical validity of the findings. In addition, the intervention protocol was standardized and applied over three consecutive menstrual cycles, allowing better evaluation of the therapeutic effects of TEAS on menstrual pain and inflammation.

Nevertheless, certain limits must be recognized. The limited sample size may limit the applicability of the outcomes to a wider population. Additionally, the absence of long-term follow-up limits the assessment of sustained treatment effects after completion of the intervention. The research also depended partly on self-reported measures, which might be affected by subjective perception and placebo effects. Additionally, not all registered outcome measures were included in the final analysis, which may introduce potential reporting bias. Therefore, additional large-scale RCTs with extended follow-up durations are recommended to ensure the effectiveness of TEAS in women with autoimmune-related dysmenorrhea

Conclusion:

These findings highlight the potential role of TEAS, a safe, non-invasive, and less

expensive therapy, that produces a greater improvement in pain and other symptoms during menstruation in women with autoimmune disease, who were diagnosed with RA & SLE. Upon completion of this study, the results will advocate for the inclusion of TEAS in managing pain and exacerbating symptoms during menstruation in women with autoimmune diseases. Future research should elucidate the long-term impacts of TEAS, increase patient numbers, and broaden the variety and diversity of acupoints utilized.

Conflict of interest: No conflict of interest.

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Data access: Original data is available upon request.

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