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Research Article

Effects of Acupressure and Acupuncture-Like Transcutaneous Electrical Nerve Stimulation on Sleep Quality Among Pregnant Women

Ganiyu Sokunbi [1,*], Ibrahim U. Takai [2], Ifeoma B. Nwosu [3], Rasheedat Balarabe [1]

[1] Physiotherapy Department, Faculty of Allied Health WSciences, Bayero University Kano, Nigeria
[2] Obstrtrics and Gynaecology Department, Faculty of Clinical Sciences, Bayero University Kano, Kano, Nigeria
[3] Department of Medical Rehabilitation, Nnamdi Azikwe University, Nigeria

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ABSTRACT

Background: Despite the adverse consequences of poor sleep during pregnancy, relatively few safe interventions exist for improving sleep among pregnant women. Nonpharmacological interventions are increasingly gaining acceptance. However, the effects of acupressure and acupuncture-like transcutaneous electrical nerve stimulation (ACUTENS) have not been widely reported.
Objectives: The purpose of this study is to investigate the effects of low-frequency transcutaneous electrical nerve stimulation, otherwise known as ACUTENS, and acupressure on sleep quality among pregnant women.
Methods: Purposive sampling of 42 pregnant women with sleep disorders was conducted, and the participants were randomized into 3 groups, i.e., acupressure, ACUTENS, and usual care. interventions, which were carried out twice weekly for six weeks. The Pittsburgh Sleep Quality index was used to determine the overall sleep quality.
Results: The preintervention scores of sleep quality were 12.5 (3.75), 12.5 (4.0), and 13.0 (3.5) in the ACUTENS, acupressure, and usual care groups, respectively. The Kruskal–Wallis test did not show any significant difference in the preintervention sleep quality scores ($H = 0.379$, $p = 0.827$). Participants in the usual care group recorded the least improvement, with a score of 5.0 (2.25), the ACUTENS group recorded a score of 4.5 (3.0), and the greatest improvement was recorded in the acupressure group, with a score of 4.0 (2.2) after 6 weeks of intervention. The Kruskal–Wallis test did not show any significant difference in the postintervention sleep quality scores among the 3 groups ($H = 0.666$, $p = 0.717$).
Conclusion: This study showed that ACUTENS and acupressure as an adjunct to usual care are not more effective than usual care alone in improving sleep quality among pregnant women.

1. Introduction

Sleep is a physiological need of mankind, and the National Sleep Foundation has elucidated that 78% of pregnant women reported more sleep disturbances during pregnancy than at any other time in their lives [1]. This is because pregnant women undergo significant anatomical, physiological, and biochemical changes, and these changes affect their physical and emotional behaviors and, thus, may lead to sleep disturbances even in those without prior sleep disturbances [2]. Pregnant women particularly need sufficient sleep to nourish the development of their infants and for the energy they need for the labor and delivery process; however, the optimal sleep duration in pregnancy is unknown [3].

During pregnancy, the majority of women experience alteration in sleep owing to mechanical and hormonal factors and factors associated with physical changes of pregnancy, changes in maternal sleep architecture and pattern, snoring, sleep disordered breathing, and restless legs syndrome [4,5]. Furthermore, sleep changes during pregnancy may not return to the same sleep quality before pregnancy for years [6]. Sleep disturbances are experienced by pregnant women from as early as the first trimester, and they are even worse off in the second and third trimester [7–9]. As the

* Corresponding author. Physiotherapy Department, Faculty of Allied Health Science, Bayero University Kano, PMB 3011, Kano, Kano-State, Nigeria.
E-mail addresses: ganiyusokunbi@gmail.com (G. Sokunbi), ikakai.obg@buk.edu.ng (I.U. Takai), iphiedoc@gmail.com (I.B. Nwosu), Rashida34482971@gmail.com (R. Balarabe).

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pregnancy advances, the number and duration of sleep disorders increase [10,11].

Associations between disturbed sleep during pregnancy and antenatal depression have been shown [12-14]. Studies have also elucidated that pregnant women with depression have various types of insomnia symptoms and reduced sleep quality [12,13]. This relationship between sleep and depression can also be present before, during, and after pregnancy.

Despite the adverse consequences of poor sleep during pregnancy, relatively few safe interventions exist for improving sleep among pregnant women especially as sleep medication is not an electable option because of its likelihood of teratogenic and adverse fetal-neonatal effects [6,15,16]. Studies have indicated that nonpharmacological interventions are increasingly gaining acceptance, and more so, they are being recommended to tackle issues associated with pregnancy including poor sleep quality and insomnia [17]. Selective sleep enhancement programs and cognitive behavioral therapy are nonpharmacological interventions that have demonstrated potential to improve sleep quality in late pregnancy and early postpartum. Massage, acupuncture, aerobic exercise, yoga, and chiropractic are some of the commonly recommended nonpharmacological interventions to tackle some of the issues associated with pregnancy including sleep quality [18–20].

Acupuncture is a treatment derived from ancient traditional Chinese medicine in which fine needles are inserted at certain sites in the body for therapeutic and preventive purposes, whereas acupressure is performed without needles, but pressure is applied along acupuncture meridians to stimulate physiological functions using the palms, finger, and other parts of the therapist hand [20,21]. Although acupressure could be safely administered by any physiotherapists who have the knowledge of acupuncture meridian, acupuncture is not widely practiced in this part of the world mainly because it is not yet popular and has not gained wide acceptance as a treatment modality within the armamentarium of physiotherapy practice in Nigeria, in comparison with other physical modalities that physiotherapy uses for treatment. Transcutaneous electrical nerve stimulation (TENS) is a handheld portable machine that can be used for its analgesic and varying neurological and musculoskeletal stimulation purposes. TENS is widely used by physiotherapists globally, and it is often prescribed for the patient's self-help home treatment after the patient must have been properly trained on how to use it at home. Thus, we hypothesize that if acupuncture-like TENS (ACUTENS) and acupressure were to be applied at the same acupuncture points that have been found to be beneficial for sleep disorders, the same beneficial effects on sleep will be observed. The outcome of this study might stimulate further interest in the use of alternative therapy to chemotherapy in curbing the menace of sleep disorders among pregnant women and thus help to prevent negative health consequences associated with reduced sleep quality among pregnant women.

2. Materials and methods

2.1. Ethical considerations

Approval to carry out this study was obtained from the Ethics and Research Committee of Aminu Kano Teaching Hospital, Kano.

Participants in the study were briefed about the nature of the study and their intervention including its benefits, after which, they were properly briefed about the study, and their written informed consent was obtained, with the participants duly signing the informed consent form.

2.2. Participants

Purposive sampling of pregnant women with sleep disorders and either in their second or third trimesters, attending antenatal clinics of Aminu Kano Teaching Hospital, Kano, and Murtala Muhammad Specialist Hospital, Kano, was carried out, and these patients participated in this study. Other inclusion criteria were participants aged 18 years, and women who scored >5 as per the Pittsburgh Sleep Quality Index (PSQI) were identified as experiencing insomnia or poor quality of sleep. Women with depressive symptomatology (Beck Depression Index-II scores > 13), communication impairments, and cognitive and intelligence impairments were excluded from the study.

2.2.1. Sample size

The sample size calculation was based on the change of PSQI scores from a previous study wherein 11 participants were allocated into the acupressure and sham acupressure groups, and the study showed that at least a 2.70-point difference in PSQI scores between acupressure and sham acupressure has clinical significance [22]. Considering a dropout rate of ~20%, each group will take a minimum of 13 participants.

2.3. Data collection instrument

Demographic information such as age, occupation, the number of pregnancies, duration of pregnancy, and parity was recorded in the researcher-developed data form.

The PSQI questionnaire is a widely used self-reporting effective instrument used to assess the quality of sleep in adults. It differentiates “poor” from “good” sleep quality by measuring seven areas (components): subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleep medications, and daytime dysfunction over the last months. The PSQI has been shown to possess good psychometric properties, with a Cronbach α value of 0.70–0.83, and an overall strong validity [23]; hence, the PSQI was used to collect data on the quality of sleep from the participants.

The TENS device of NTRON 2600 (3M Monitoring electrode 2223; 3M Co., Ltd., USA) was used to provide low-frequency ACUTENS. Low-frequency TENS is a noninvasive TENS treatment form commonly used for analgesia effect via the similar route as acupuncture [24]. ACUTENS protocol includes burst train stimulation at a frequency of 2 Hz pulse and a width of 200 Us, at the highest tolerable intensity and the lowest rate possible (1 pulse/sec); the highest expected tolerable intensity for the participant is for 30 minutes, and the lowest possible pulse duration is 40 minutes.

2.4. Randomization and blinding

The participants were randomly assigned into one of the three groups, TENS, acupressure, and control group, via a computer-generated randomization schedule. Randomization, pre-intervention assessment, and postintervention assessment were carried out by a research officer who was blinded, i.e., neither involved in nor aware of the intervention the participants received in the study.

2.5. Outcome measure

The PSQI is a self-rated questionnaire used to measure general sleep quality. The PSQI was used in this study to determine the overall sleep quality, before and after 6 weeks of intervention. The PSQI comprises self-rated items and five other rated items. It

assesses sleep based on seven domains in the past month: sleep duration, sleep disorders, sleep onset latency, daytime dysfunction, sleep efficiency, use of medications to sleep, and overall sleep quality. Each domain is rated from 0 to 3; the accumulated scores of the seven domains constitute the total score of the PSQI (0–21). A total score of >5 indicates a poor quality of sleep. The PSQI has been found to possess good psychometric property, with a Cronbach α value of 0.83 [22,23].

2.6. Intervention

The intervention was carried out by a physiotherapist who was not involved in the outcome measure assessment but with more than 15 years of clinical experience in the use of TENS and acupressure and more than 10 years of experience with treatment using acupuncture.

2.7. Low-frequency TENS (ACUTENS) group

The participants' preparation, equipment preparation, and application of ACUTENS treatment were as described by Han et al and Sokunbi et al [24,25]. TENS electrodes were placed at the following acupuncture points, which have been documented to have facilitatory effects on sleep according to Park et al [26]: Gall Bladder 20 (GB20) and Gall Bladder 21 (GB21), Heart 7 (HT7), and Large Intestine 4 (LI4).

2.7.1. First position—GB20

The point is located at the top of the sternocleidomastoid muscle at the point where the trapezius and sternocleidomastoid muscles meet. One electrode each was placed both on the right and left side of the shoulder (Fig. 1A).

2.7.2. Second electrode—GB21

This point is located on the shoulder directly at the midpoint of a line connecting the spinous process of the 7th cervical vertebrae and the acromion at the highest point of the shoulder. One electrode each was placed both on the right and left side of the shoulder (Fig. 1A).

2.7.3. Third electrode—HT7

The point lies on the inner wrist crease, toward the ulnar (little finger) side and at about one-fifth of the distance across the wrist. It appears as a hollow at the base of the pisiform bone. One electrode each was placed both on the right and left side of the wrist (Fig. 1B).

2.7.4. Fourth electrode—LI4

The point lies on the dorsum of the hand, between the 1st and 2nd metacarpal bones, in the middle of the 2nd metacarpal bone on the radial side. One electrode each was placed both on the right and left side of the hand (Fig. 1C).

After placing the electrode and well securing at the acupuncture points, the following treatment parameters were selected on the TENS unit as described by Sokunbi and Bello [27].

i. Frequency of TENS waveform: 2 Hz
ii. Pulse duration: 200 microseconds
iii. Intensity was set to be as high as the patient can tolerate. Tolerance is defined as the level at which the patient asked the investigator to stop increasing the stimulation [27].
iv. Duration of treatment per session: 30 minutes

At the end of a treatment session, the control knobs were turned off, the position of the electrode wire was unplug from the TENS unit, and the battery was removed. The participants in this group were treated twice weekly for 6 weeks.

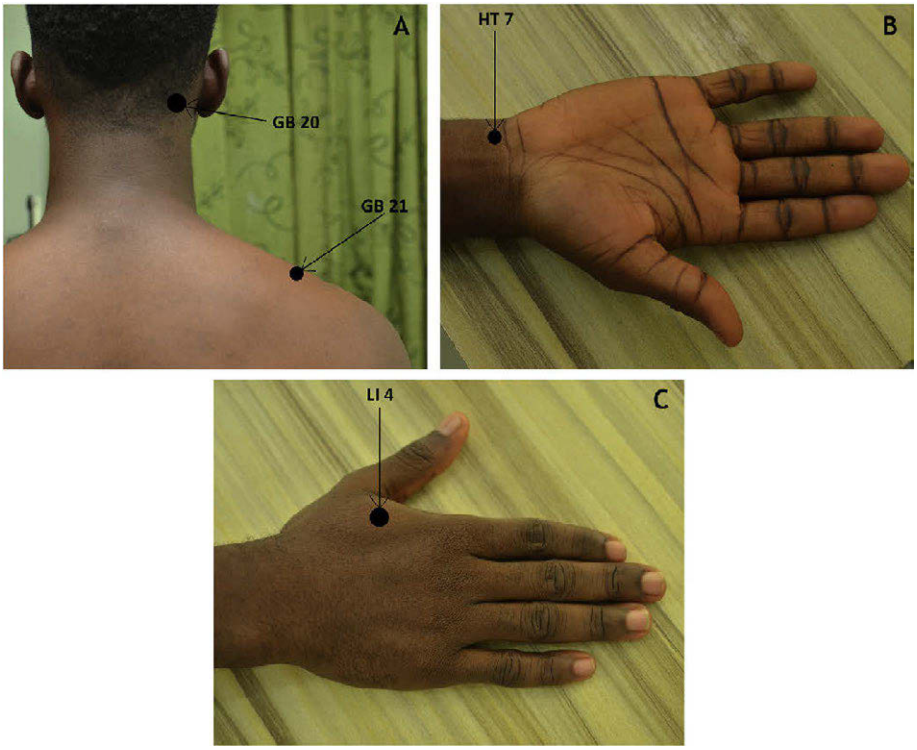

Figure 1. Acupuncture points used for acupressure treatment and ACUTENS electrode placement: (A) GB20 and GB21, (B) HT7, and (C) LI4. GB20 = Gall Bladder 20; GB21 = Gall Bladder 21; HT7 = Heart 7; L14 = Large Intestine 4.

2.8. Acupressure treatment group

2.8.1. Style of acupressure

Acupressure was carried out by applying thumb pressure at gallbladder, heart, and large intestine meridians at the selected acupuncture points (GB20, GB21, HT7, and LI4). As per systematic reviews of studies on the effects of acupuncture on insomnia and based on the clinical experiences of our principal investigator and coinvestigators, GB20, GB21, and LI4 are capable of relieving pain, discomfort, and tension around the neck and the shoulder. HT7 is one of the mostly reported acupoints for the treatment of insomnia, while LI4 has been widely reported as one of the strongest acupuncture points to move de qi round the body [20,21].

2.8.2. Reasoning for the acupressure treatment provided

Dry needling and other forms of acupuncture are not widely used as treatment modality in this part of the world unlike acupressure, which is safely practiced by trained physiotherapists all over the country. Thus, we hypothesize that if acupressure were to be applied at the same acupuncture points that have been found to be beneficial for sleep disorders, the same beneficial effects on sleep will be observed [20,21].

2.8.3. Extent to which treatment varied

Standard treatment was used, and there was no variation in treatment among patients.

2.8.4. Details of acupressure procedure

Patient preparation and points of treatment were as described for ACUTENS previously. The patients were instructed to close their eyes while continuously taking deep breaths in and out, while this was ongoing, the therapist used her thumb and placed firmly, but gently, and pressed up toward the skull at the gallbladder meridian and GB20 acupuncture point (acupoint), on the left side. The therapist maintained the hold for 15 minutes and then gently released the pressure after treatment. This procedure was repeated on the right GB20 acupoints and then on the right and left GB21 acupoints. Treatment at these acupuncture points helps to relieve headache, neck pain, and shoulder tension and promote general relaxation [28].

2.8.5. Type of response sought from the patients

Patients were expected to feel completely relax and specifically feel free from any form of tension around the neck and shoulder during the treatment.

2.8.6. Treatment regimen

The treatment was repeated twice weekly for six weeks [28-30].

2.8.7. Practitioner background

Acupressure was carried out by an experienced acupuncturist certified by the chartered society of acupuncturists (UK) and registered member of the Nigeria Society of Physiotherapy.

2.9. Usual care (control group)

The participants in this group were given a sleep guide, which is a form of set of instructions that are designed to help with sleep and promote healthy sleeping habits. The sleep guide contains information on how much sleep is needed by every individual on daily basis, factors that could affect sleep, or risk and/or risk factors for sleep disorders. It also contained information on the types of sleep disorders, delayed sleep syndrome, and insomnia-producing behavior that could affect quality of sleep and suggestions for inducing sleep (https://uhs.berkeley.edu/sites/default/files/insomnia). They were advised to read and observe the instructions for the period of six weeks when data collection was ongoing. Participants in the other groups (i.e., ACUTEN and acupressure) also received the same sleep guide instructions as the control group [29].

2.10. Data analysis

The statistical software program, namely, Statistical Package for the Social Sciences (SPSS), version 20.0 (SPSS INC., Chicago IL, USA), was used to analyze the data. Demographic and clinical variable data as well as the PSQI scores were summarized using mean, standard deviation, and median interquartile range (IQR), respectively. The Kruskal–Wallis test was used to determine the difference in the level of sleep quality between groups, whereas difference within the group was analyzed using the Wilcoxon signed-rank test. The correlation between each of gravida and parity with sleep quality was determined using the Spearman rank-order correlation. The level of significance was set at 0.05.

3. Results

3.1. Baseline characteristics

Fig. 2 shows the participants' flow chart from the beginning to the end of the study. A total of five (11.9%) participants were lost at postintervention assessment. Twenty-two (57.9%) of the participants were primigravida, and sixteen (42.1%) were multigravida. The highest number of children birthed by one participant (parity) was 10 (Table 1). There were no significant differences between the mean age (years), body mass index, and duration of sleep disorders in participants in the acupressure group, ACUTENS group, and the usual care group ($p > 0.05$). Before intervention, the lowest mean duration of 87.0 (33.4) days of sleep disorders was recorded by the participants in the usual care group, whereas the ACUTENS group recorded the highest score of 91.8 (14.2) days (Table 1).

3.2. Effects of ACUTENS and acupressure on quality of sleep

Table 2 shows comparison of the effects of interventions among the participants in different groups. It shows that the median (IQR) preintervention scores of sleep quality recorded were 12.5 (3.75), 12.5 (4.0), and 13.0 (3.5) in the ACUTENS, acupressure, and usual care groups, respectively. The Kruskal–Wallis test did not show any significant difference in the preintervention sleep quality scores ($H = 0.379$, $p = 0.827$).

Improvement in sleep quality with reduction in PSIQ scores was recorded after six weeks of intervention, with scores of 4.5 (3.0), 4.0 (2.2), and 5.0 (2.25) in the ACUTENS, acupressure, and usual care groups respectively. Participants in the usual care group recorded the least improvement after six weeks of usual care. However, the Kruskal–Wallis test did not show any significant difference in the postintervention sleep quality scores among the three groups ($H = 0.666$, $p = 0.717$).

Table 3 shows comparison of the average scores (median and IQR scores of sleep disorders) within groups. Improvement in sleep quality after six weeks of treatment was recorded in all the groups, regardless of the type of intervention, with a statistically significant difference in ACUTENS ($U = -2.66$, $p = 0.008$), acupressure ($U = -2.809$, $p = 0.005$), and usual care ($U = -2.558$, $p = 0.015$) groups.

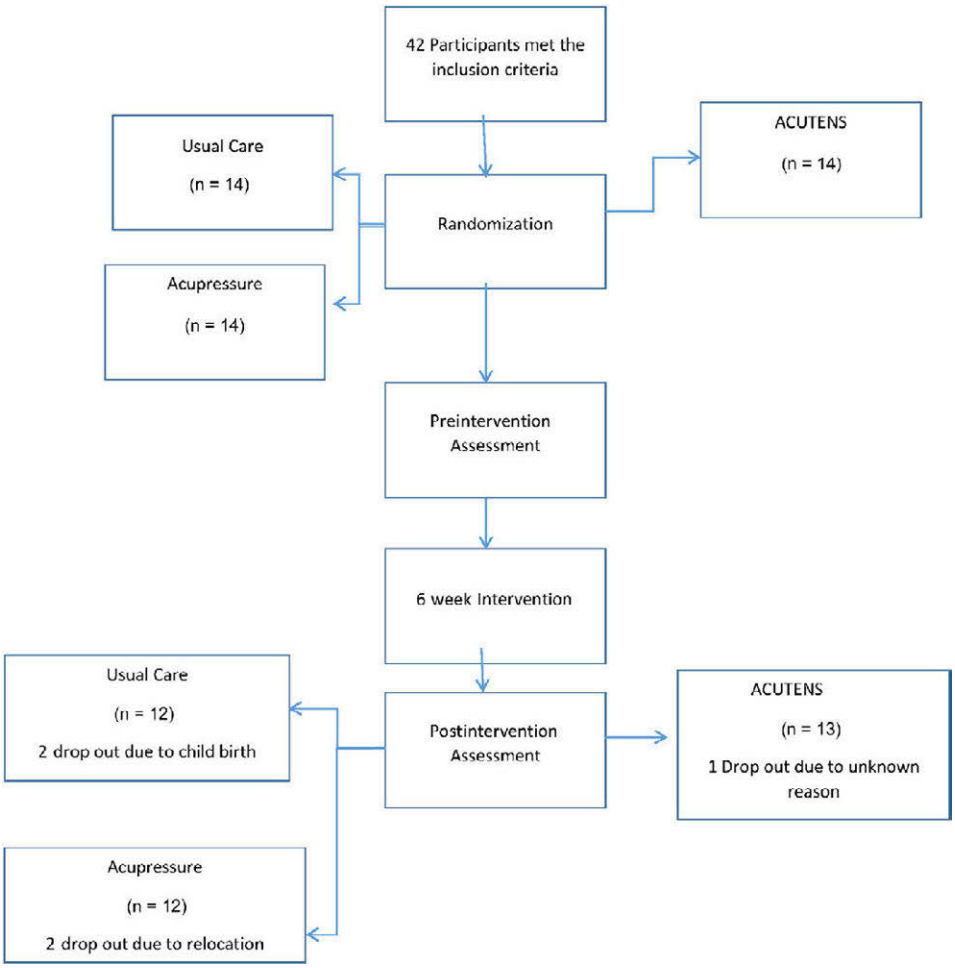

Figure 2. Participants' flowchart. ACUTENS = acupuncture-like transcutaneous electrical nerve stimulation.

Table 1
The baseline characteristics of the participants.

Groups	Age (years), X (SD)	Weight (kg), X (SD)	Height (m), X (SD)	BMI (Kg m^{-2}), X (SD)	DSD (days), X (SD)
ACUTENS (N = 14)	26.3 (7.16)	68.1 (16.44)	1.54 (0.68)	26.18 (4.49)	91.8 (14.2)
Acupressure (N = 14)	26.4 (5.56)	67.5 (22.27)	1.61 (0.55)	28.97 (8.27)	92.4 (2.27)
Usual care (N = 14)	28.0 (9.52)	60.3 (18.04)	1.58 (0.54)	26.32 (9.58)	87.0 (33.4)
F	0.95	0.256	0.832	0.04	0.177
p	0.91	0.777	0.449	0.996	0.839

	Minimum	**Maximum**
Parity	0.00	10.00
Gravida	**Frequency (N)**	**Percentage (%)**
Primigravida	22	57.9
Multigravida	16	42.1

ACUTENS = acupuncture-like transcutaneous electrical nerve stimulation; BMI = body mass index; DSD = duration of sleep disorders; SD = standard deviation.

Table 2
Comparison of the effect of intervention (low-frequency TENS [ACUTENS], acupressure, and usual care) on self-reported quality of sleep of participants among the groups.

PSQI scores	ACUTENS	Acupressure	Usual care	Kruskal–Wallis, H	*p*
Preintervention scores, median (IQR)	12.5 (3.75)	12.5 (4.0)	13.0 (3.5)	0.379	0.827
Postintervention score, median (IQR)	4.5 (3.0)	4.0 (2.2)	5.0 (2.25)	0.666	0.717

*Significance.
ACUTENS = acupuncture-like transcutaneous electrical nerve stimulation; IQR= interquartile range; PSQI = Pittsburgh Sleep Quality Index.

Table 3
Comparison of the effect of intervention on self-reported quality of sleep of participants within each of the groups.

PSQI Scores	ACUTENS	Acupressure	Usual care
Preintervention scores, median (IQR)	12.5 (3.75)	12.5 (4.0)	13.0 (3.5)
Postintervention score, median (IQR)	4.5 (3.0)	4.0 (2.2)	5.0 (2.25)
U	0.66	−2.809	−2.558
p	0.008*	0.005*	0.015*

ACUTENS = acupuncture-like transcutaneous electrical nerve stimulation; IQR = interquartile range; PSQI = Pittsburgh Sleep Quality Index.
* Significance.

4. Discussion

This study was designed to investigate the effects of acupressure, ACUTENS, and sleep guide on the quality of sleep among pregnant women. The results from the present study revealed significant difference in the effect of acupressure, with improvement in sleep quality among pregnant women. This is similar to the results of previous studies [28,29]. Significant differences in PSQI global scores and all sleep quality indices between the acupressure group and the control group among 48 patients with end-stage renal disease on hemodialysis were reported by Shariati et al [28]. However, in the study by Shariati et al [28], intervention was carried out for four weeks, and the number of sessions per week was not indicated. A study on the effects of auricular acupressure for insomnia in patients undergoing hemodialysis showed improvements in sleep quality and reduced consumption of sleep medications [28].

The findings from this present study showed that ACUTENS significantly increases sleep quality after six weeks of treatment. ACUTENS is another noninvasive, inexpensive, self-administered modality applied on the skin with the use of electrodes. Clinical experience suggests that TENS may be beneficial when used as an adjunct to pharmacotherapy in pain management. Presently, there is an overall consensus favoring the use of TENS, with authorities differing on its values in different clinical situations. However, it appears that not much study has been carried out on the effects of TENS on sleep quality. Another study by Bang et al [31] showed significant difference after application of low-frequency TENS on patients with chronic insomnia [31]. However, in the study by Bang et al [31], 54 participants who were aged 55 years and older with sleep problem were randomized, and TENS treatment was applied on the trapezium muscle for 30 minutes to 1 hour before taking their sleep medication and also before going to sleep, for 5 days a week for four weeks. Thus, in the study by Bang et al [31], it might not be possible to delineate what has really worked for insomnia, i.e., whether TENS or medications. Studies have shown increase in levels of beta-endorphins and met-encephalin with low-frequency TENS, which activates the opioid mechanism and thus provides pain relief by precipitating the release of an endogenous opiate (encephalin) in the midbrain [32]. Other possible explanation behind the efficacy of ACUTENS is that this particular mode of TENS could better stimulate nerves, thereby activating the spinal and midbrain neuronal pathways to activate opioid-releasing mechanisms [30-32].

Lack of significant difference among the groups of ACUTENS, acupressure, and usual care is an indication that all the 3 interventions have similarly improved sleep quality among pregnant women. However, it could be advised that usual care encompassing sleep hygiene could be combined with either ACUTENS and/or acupressure especially for pregnant women with sleep disturbance for treatment in the clinic and at home.

4.1. Limitations

It is possible if a follow-up assessment of the intervention effect is carried out to establish the long-term effect of intervention, the results in terms of lack of difference among the groups might be different. Other limitations in this present study arose from the fact that information on sleep quality was collected using the sleep quality questionnaire, which could have been subjected to recall bias. A measure of sleep quality by polysomnography or actigraphy could have been more objective. Thus, we recommend that future studies should strongly consider the use of polysomnography or actigraphy for more objective outcome follow-up assessments to established long-term effects of the interventions used in the present study.

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