Research Paper

A Comparative Study on the Effects of Transcutaneous Electrical Nerve Stimulation at Acupoints on the Progress and Duration of Labor in Nulliparous Women

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ABSTRACT

Background: Fear and anxiety during labor are common among nulliparous women and may contribute to prolonged labor stages. Transcutaneous electrical nerve stimulation (TENS) is known for its anxiolytic effects, acting through the activation of inhibitory pathways in the central nervous system. This study aims to compare the effects of TENS at the Hugo and Sanyinjiao acupressure points on labor progression and duration in nulliparous women.

Methods: This randomized clinical trial involved 123 nulliparous women referring to an educational-therapeutic center in Zanjan City, Iran. The participants were randomly assigned to three groups of 41 each: The Hugo group, the Sanyinjiao group, and the control group. The intervention began when cervical dilation reached 4 cm and labor pains started, and continued through the active phase of the first and second stages of labor. TENS was applied at acupressure points according to group allocation. Labor duration and clinical assessments were recorded using a standardized labor progress checklist. Statistical analyses were conducted using R software, version 4.2.2, employing analysis of variance (ANOVA) or the Kruskal-Wallis test, with Dunn correction applied for multiple comparisons. A $P<0.05$ was considered statistically significant.

Results: The mean duration of the first stage of labor significantly differed among the groups ($P=0.002$), with the Hugo group showing an average of five hours (interquartile range [IQR]: 4.75–6) compared to 6 hours (IQR: 5–7) in the Sanyinjiao and control groups. The second stage of labor also showed a significant difference in duration ($P<0.001$), with a mean duration of 15 min (IQR: 10–16.25) in the Hugo group, 37.5 min (IQR: 30–60) in the Sanyinjiao group, and 30 min (IQR: 20–60) in the control group.

Conclusion: The application of TENS at specific acupressure points, such as Hugo's point, can effectively reduce labor duration. However, the findings revealed that the second stage of labor was longer in the Sanyinjiao group compared to the control group, which may be related to a different physiological response at this point or the method of intervention, warranting further studies in the future.

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Highlights

- Fear and anxiety during labor may prolong its stages, especially in first-time mothers.
- This study compares the impact of the TENS at Hugo and Sanyinjiao acupressure points on labor duration and progress.
- TENS at the Hugo point significantly shortened the first and second stages of labor.
- The use of TENS at the Sanyinjiao point prolonged the second stage of labor, indicating the need for further investigation.

Plain Language Summary

Fear and anxiety can make labor longer, especially for women giving birth for the first time. One way to help manage this stress is through transcutaneous electrical nerve stimulation (TENS), a method that uses gentle electrical currents on specific points of the body. This study investigated the effectiveness of TENS when applied to two special acupoints, called Hugo and Sanyinjiao, in first-time pregnant women. The results showed that women who received TENS at the Hugo point had shorter labors, while those who received it at the Sanyinjiao point had a longer second stage of labor. So, TENS can be helpful if used in the right spot.

Introduction

Labor pain is typically characterized as sharp and progressively intensifying discomfort experienced during childbirth (Lennon, 2018). Fear stimulates sympathetic nerves, increases catecholamines (epinephrine and norepinephrine), and thus causes more severe pain and prolongs the first and second stages of labor. This condition increases dissatisfaction with the normal delivery experience and increases the risk of elective caesarean section in subsequent labors (Dashe et al., 2018). Labor consists of four stages. The first stage includes the latent and active phases, during which the cervix dilates from 0 to 10 cm (with the active phase starting at 6 cm and involving stronger, more regular contractions); the second stage lasts from full cervical dilation (10 cm) to the delivery of the fetus and is characterized by intense contractions and maternal pushing; the third stage involves delivery of the placenta; and the fourth stage is the immediate postpartum period lasting up to 2 h (Cunningham et al., 2014). The first and second stages of labor should not be prolonged (Dashe et al., 2018). The prolongation of labor stages causes stress, anxiety, and fear, especially fatigue in mothers during labor, thereby decreasing their self-efficacy. In addition to that, anxious mothers may experience increased bleeding during labor, and their anxiety can delay the start of breastfeeding (Tan et al., 2021; Asadi et al., 2015).

Nulliparous women, who have not experienced prior childbirth, often have longer and more variable labor durations compared to multiparous women, making them a key population for labor intervention studies (Zhang et al., 2010). Complications from prolonged labor cause 8% of maternal deaths in developing countries, contributing to perinatal mortality (3.5%) and higher rates of mortality in women under 15 years of age (27.3%) and over 15 years of age (7.9%) (Pergialiotis et al., 2020; Gaudernack et al., 2020). For the fetus, complications of prolonged labor include head pressure, oxygen deficiency, low Apgar scores, and increased risks of asphyxia or death. Furthermore, prolonged labor is associated with instrumental deliveries, low umbilical cord pH, higher cesarean section rates, and postpartum infections (Frey et al., 2012; Grantz et al., 2018; Quiñones et al., 2018).

Pharmacological and non-pharmacological interventions can help reduce pain and labor duration (Tabatabaeichehr & Mortazavi 2020). Given the side effects of pharmacological approaches for both mother and fetus, many mothers are opting for non-pharmacological methods that do not have complications during labor. Several non-pharmacological techniques have been suggested, including the use of a transcutaneous electrical nerve stimulation (TENS) machine. This device is used to selectively activate specific groups of nerve fibers, triggering mechanisms that lead to pain relief. During labor, electrodes are placed over myotomes (a group of muscles innervated by a single spinal nerve), trigger points, and acupoints (Tabatabaeichehr & Mortazavi 2020; Ganji et al., 2014).

The basis of acupressure is acupoints and operates according to the gate control theory of pain. This theory suggests that stimulating large nerve fibers, which transmit impulses to the spinal cord, helps to close the 'gates' of pain transmission, thereby reducing the sensation of pain. Additionally, acupressure balances the body's energy and alleviates pain by applying pressure to specific points (Zhang & Li, 2021). It also stimulates the release of endogenous opioids such as endorphins and enkephalins. It increases the levels of neurotransmitters like serotonin and norepinephrine, which play key roles in modulating pain perception and mood (Ma et al., 2022). In various studies, acupressure has been shown to impact conditions such as insomnia, dysmenorrhea, and breast cancer in different areas of research (Dincer & Oskay, 2023; Yeung et al., 2012; Harorani et al., 2023).

Two of the most important acupoints are Hegu and Shenjiao. Hugo is located between the first and second metacarpal bones on the dorsum of the hand (Figure 1). Sanyinjiao is situated on the inner side of the lower leg, approximately 4 finger-widths above the medial malleolus (Figure 2) (Najafi et al., 2018; Dabiri & Shahi, 2014). Many studies have evaluated the effect of acupoint stimulation at the Hugo (L14) and Sanyinjiao (SP6) points on the progression of active labor in mothers, specifically during the first and second stages (Dehcheshmeh & Rafiei, 2015; Zhang & Li, 2021; Smith et al., 2020). The results indicate a reduction in labor pain, duration of labor stages, number of cesarean sections, rate of oxytocin use, and an increase in maternal satisfaction, as well as earlier breastfeeding initiation. Further, some women may feel discomfort or irritation from the TENS device, but there are no harmful side effects for the mother or fetus (Mehri et al., 2019). Some methods have been utilized to stimulate the acupressure points, such as using electric pads from a TENS machine on these points to relieve labor pain, without any complications for mothers (Njogu et al., 2021).

Based on the results of a systematic review, acupressure may decrease the labor duration, especially the first stage, but further studies should be conducted in this area since there are few studies on the labor duration by using TENS at Hugo and Sanyinjiao acupressure points (Mollart et al., 2015). Salehian and colleagues reported a significant reduction in the duration of the first (active) stage of labor using acupressure point stimulation. However, this intervention did not affect the duration of the second stage of labor, and no significant difference was observed between the groups (Salehian et al., 2011). Based on the results of another study, the use of TENS at certain acupressure points could not decrease the duration of labor (Mehri et al., 2019). While TENS offers advantages in labor progression and complication reduction, the optimal placement of electrodes has been defined inadequately. Further research is warranted to explore its efficacy at specific acupressure points, such as Hugo and Sanyinjiao. In this study, a clinical trial was conducted to compare the effect of using TENS in Hugo and Sanyinjiao acupoints on the progress rate and duration of the first and second stages of labor in nulliparous women who had visited a hospital in Iran.

Materials and Methods

Design, setting, and sample

The present study was a double-blind randomized controlled clinical trial involving 123 nulliparous pregnant women who visited the delivery ward of Ayatollah Mousavi Hospital in Zanjan (a province in the Northwest of Iran) from October 2022 to May 2023.

The inclusion criteria were as follows: Aged 18–35 years, nulliparous, with a body mass index (BMI) below 30 kg/m^2, and a height above 150 cm. Other criteria included no pelvic stenosis based on the examination of a single specialist, a gestational age of 37–42 weeks, singleton pregnancy, cephalic presentation, and spontaneous onset of uterine contractions, membrane rupture duration of less than 6 hours, cervical dilation of 3–5 cm upon arrival, and an education level of at least the fifth grade. Additional requirements included Iranian nationality, no underlying diseases (e.g. cardiovascular conditions, epilepsy, skin lesions, or surgical scars at the electrode site), no history of drug addiction, and no use of analgesics within three hours before or during the study. The exclusion criteria included non-cooperation during the intervention or any adverse events leading to withdrawal from the study.

The sample size calculation was based on a previous study (Aghamohammadi et al., 2011) using the following formula. The value of $Z_{1-\beta}$, which equals 0.84, represents the Z-score corresponding to the test power. Also, the value of $Z_{1-\alpha/2}$ equals 1.96, corresponding to a significance level of 0.05 for a two-tailed test. The standard deviation of the duration of the first stage of labor in the three study groups) Hugo and Sanyinjiao's TENS group and the sham TENS group) is 43 (i.e. δ), with a maximum significant difference of 15 (i.e. d) between the sample and the population value of pregnant women (Aghamohammadi et al., 2011). Using these parameters, the required sample size was initially calculated as 111 participants. To compensate for a possible 10% sample

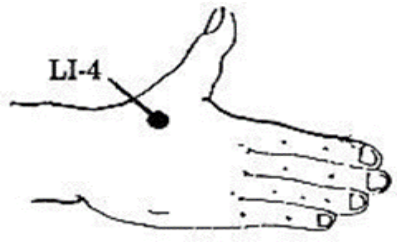

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Figure 1. The acupoint LI4 (Hugo) (Source: Shutterstock, 2025)

attrition, the sample size increased to 123 participants, with each of the three study groups including 41 participants (Equation 1).

$$1.\quad n_0 = \frac{\left[Z_{1-\frac{\alpha}{2}} + z_{1-\beta}\right]^2 (\delta^2)}{d^2} = \frac{(1.96 + 0.84)^2 * 43^2}{15^2} = 64$$

$$n = \sqrt{k}.n_0 = \sqrt{3}\times = \text{n}=\sqrt{3}*64=111$$

The participants were randomly assigned to three groups: Hugo (LI4), Sanyinjiao (SP6), and a control group (n=41 per group). A simple randomization process was employed, where each participant selected one of three sealed envelopes containing the group assignment. Neither participants nor researchers were aware of the contents of the envelopes (double-blind). Unique codes were assigned to participants, written on small pieces of paper, and randomly drawn from a box to ensure an unbiased selection process (Figure 3).

Intervention

Participants who provided written consent received the TENS intervention using a two-channel portable device (Bergis brand, model Max Tens 2000), powered by batteries and equipped with two pairs of electrodes. The electrodes were placed in the delivery room by trained midwives who were not members of the research team to maintain blinding and prevent researcher bias. For the Hugo and Sanyinjiao groups, the device was set to a continuous flow of 100 Hz/min with a pulse width of 250 µs. The device was alternately turned on for 20 min and off for 20 min until cervical dilation reached 10 cm. For the Hugo group, the electrodes were placed on the Hugo acupoints of both hands; for the Sanyinjiao group, the electrodes were placed on the Sanyinjiao acupoints of both feet, and in the control group, the electrodes were similarly placed on either the Hugo (n=21) or Sanyinjiao (n=20) acupoints, but the device was turned off and set to zero voltage.

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Figure 2. The acupoint SP6 (Sanyinjiao) (Source: Shutterstock, 2025)

All participants underwent vaginal examinations conducted by a single midwife every 1–2 hours as required. In cases of simultaneous labor, the midwife performed the intervention on another mother using a second TENS device, although such occurrences were rare.

Outcomes

Labor progress was assessed through vaginal examination and measurement of cervical dilation, effacement, and fetal position. The durations of the first and second stages of labor were recorded by midwives approved by the research team using a labor process progress sheet.

Data collection tools

Data were collected using a demographic and midwifery questionnaire and a researcher-made checklist for recording examinations. The demographic and obstetric questionnaire included age, duration of marriage, place of residence, education level, occupation, household income, pregnancy intention, participation in birth preparation classes, potential allergies to the TENS machine, and last menstrual period (LMP). Gestational age was determined based on the LMP and confirmed by first-trimester ultrasound findings documented in participants' medical records. The checklist, which is a standard and valid tool developed by the Ministry of Health and Medical Education of Iran in 2025 for assessing labor process, included information on cervical dilation, effacement, fetal station, fetal membrane condition, contraction frequency (manually evaluated), and the durations of the first and second labor stages. Ten faculty members reviewed these tools for content and face validity, and minor adjustments were made based on their feedback.

Data analysis

Data were analyzed using R software, version 4.2.2. Descriptive statistics, including frequency distributions, percentages, means, and standard deviations, were used to summarize the data. Analytical statistics included

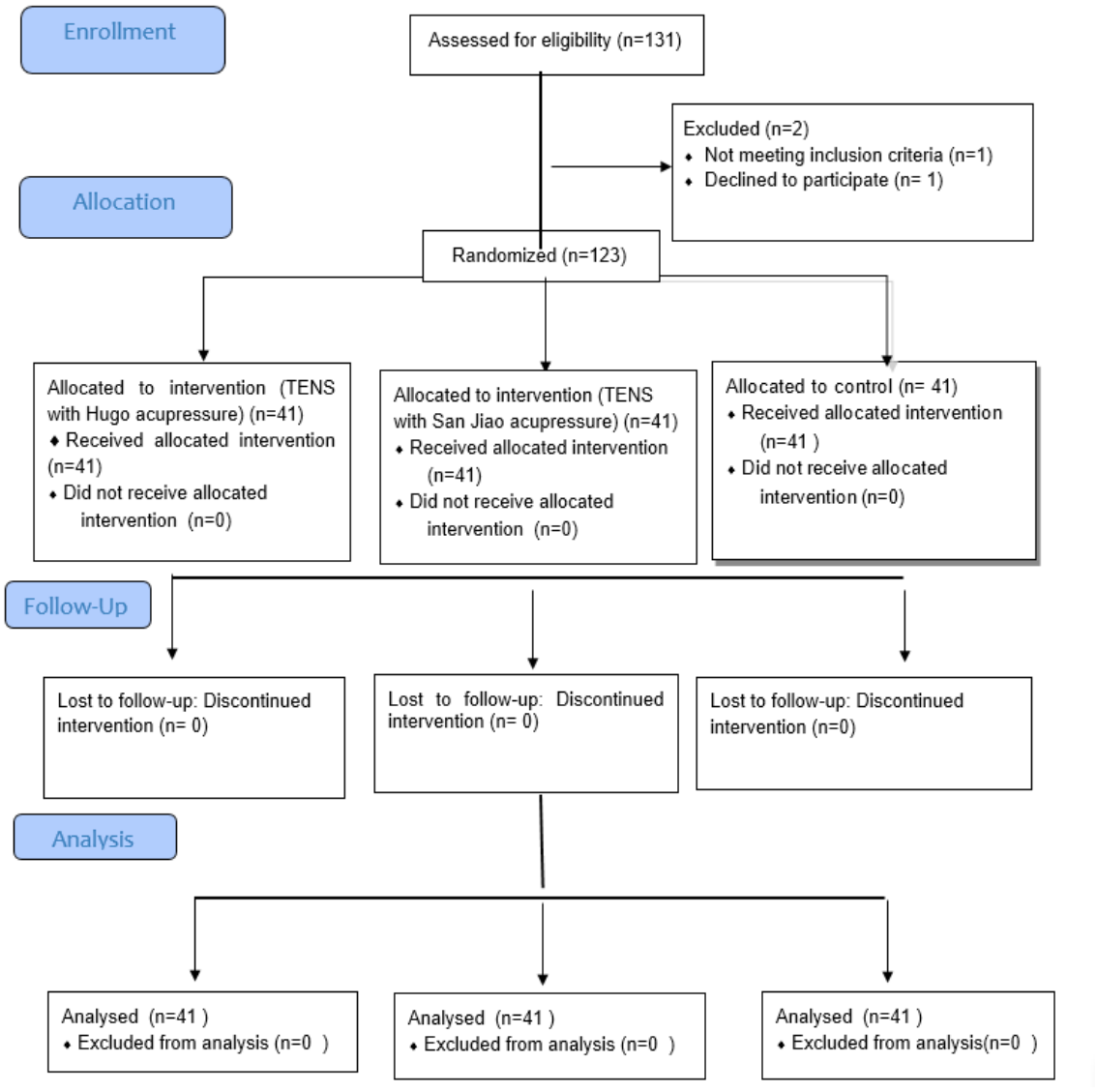

Figure 3. CONSORT study flowchart

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analysis of variance (ANOVA) and the Kruskal-Wallis test, with post hoc multiple comparisons performed using the Dunn test. The Fisher exact test was employed to assess the relationship between groups and categorical variables. A significance level of <0.05 was applied, and analyses were conducted to identify statistically significant differences in labor progress metrics, including the number of vaginal examinations.

Results

Participants' characteristics

Table 1 summarizes the demographic characteristics of the participants, categorized into three groups: Hugo, Sanyinjiao, and control. The mean age of the participants in the Hugo group was 24.24±5.28 years, in the Sanyinjiao group 23.6±5.17 years, and in the control group 23.53±5.3 years. No significant differences were found among the three groups regarding demographic and obstetric variables, including age, duration of marriage, gestational age (based on both last menstrual period and first-trimester ultrasound), and pregnancy intention (P>0.05). Additional variables reported in Table 1 showed no significant differences among the groups.

Description and comparison of active phase and expulsion stage duration across the groups

The study evaluated the duration of the active phase (from 4–5 cm to 10 cm dilation) and the expulsion phase (second stage) across the three groups: Hugo, Sanyinjiao, and control (Table 2, Figures 4 and 5).

Table 1. Patients' characteristics and pregnancy variables by group (n=123)

Variables	Level	Mean±SD/No. (%)			P
		Group			
		Hugo (n=41)	Sanyinjiao (n=41)	Control (n=41)	
Age (y)	-----	24.24±5.28	23.6±5.17	23.53±5.3	0.792
Marriage duration (y)	-----	3.22±1.72	3.91±1.68	3.19±1.68	0.080
Residence	Urban	24(58.54)	22(53.65)	22(53.65)	0.880
	Rural	17(41.46)	19(46.34)	19(46.34)	
Education	Elementary	0(0)	1(2.43)	1(2.43)	0.781
	Less than a diploma	22(53.66)	23(56.09)	19(46.34)	
	Diploma	14(34.15)	11(26.82)	16(39.02)	
	Bachelor's degree	5(12.2)	5(12.19)	5(12.19)	
	Master's degree	0(0)	1(2.22)	0(0)	
Spouse's education	Elementary	0(0)	0(0)	1(2.43)	0.990
	Less than a diploma	19(46.34)	15(36.58)	16(39.02)	
	Diploma	16(39.02)	17(41.46)	17(41.46)	
	Bachelor's degree	6(14.63)	8(19.51)	7(17.07)	
	Master's degree	0(0)	1(2.43)	0(0)	
Job	Housewife	31(75.61)	34(82.92)	33(80.48)	0.391
	Part-time employee	5(12.2)	2(4.87)	3(7.31)	
	Employee	2(4.88)	5(11.11)	5(12.19)	
	Student	3(7.32)	0(0)	0(0)	
Spouse's job	Unemployed	0(0)	0(0)	0(0)	0.336
	Self-employed	32(78.05)	31(75.6)	35(85.36)	
	Employee	8(19.51)	10(24.39)	6(13.95)	
	Student	1(2.44)	0(0)	0(0)	
The decision to become pregnant	Unintended	0(0)	0(0)	3(7.31)	0.323
	Mistimed	14(34.15)	12(29.26)	14(34.15)	
	Intentional	27(65.85)	29(70.73)	24(58.53)	
Income	Low	2(4.88)	1(2.43)	2(2.43)	0.784
	Average	25(60.98)	30(73.17)	26(63.41)	
	Above average	14(34.15)	9(21.95)	12(29.26)	
	High	0(0)	1(2.43)	1(2.43)	
Gestational age by last menstrual period (w)	-----	39.51±0.68	39.36±0.88	39.42±0.82	0.663
Gestational age in ultrasound (w)	-----	38.8±0.64	38.96±0.77	38.93±0.91	0.640

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Note: The mean of numeric variables across different groups was compared using the ANOVA. To assess the association between categorical variables and group, the Fisher exact test was employed.

Table 2. Comparing the duration of the first stage (active phase) and second stage of labor between groups

Variables	Group			P
	Hugo (n=41)	Sanyinjiao (n=41)	Control (n=41)	
	Median (IQR)			
Duration of the 1st stage of labor (active phase) (h)	5 (4.75,6)	6 (5,7)	6 (5,7)	0.002
Duration of the second stage of labor (min)	15 (10, 16.25)	37.5 (30, 60)	30 (20, 60)	<0.001

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The median (interquartile range [IQR]) was reported for each group. The Kruskal-Wallis test was used to compare the distribution of the duration of the first and second stages of labor between the three groups: Hugo, Sanyinjiao, and control. Multiple comparisons were performed using the Dunn test correction.

The duration of the active phase (4–5 cm to 10 cm dilation) differed significantly among the groups (Hugo < Sanyinjiao, Hugo < control; P=0.002 for both comparisons). The median duration in the Hugo group was 5 h (interquartile range [IQR]: 4.75–6), compared to 6 h (IQR: 5–7) in both the Sanyinjiao and control groups. Post hoc analysis confirmed a significantly shorter duration in the Hugo group compared to the Sanyinjiao (P<0.001) and control groups (P<0.001).

The duration of the expulsion phase (10 cm dilation to delivery) also varied significantly among the groups (P<0.001). The Hugo group showed a median duration of 15 min (IQR: 10–16.25), while the Sanyinjiao and control groups exhibited longer durations of 37.5 min (IQR: 30–60) and 30 min (IQR: 20–60), respectively. Post hoc analysis indicated significantly shorter durations in the Hugo group compared to the control (P<0.001) and Sanyinjiao groups (P<0.001).

Table 3 presents a detailed comparison of childbirth progress indicators among the three study groups during labor. Variables measured hourly include cervical dilatation (cm), cervical effacement (%), and fetal station (relative to ischial spines, scale -3 to +3). Most variables showed statistically significant differences between groups (P<0.05). Specifically, the Hugo group exhibited significantly greater effacement percentages and more advanced fetal station positions compared to the control group at multiple time points. Cervical dilation progressed faster in the Hugo group from the second hour onward compared to the control group. The Sanyinjiao group generally demonstrated intermediate values between the Hugo and control groups. All measurements are reported as medians with IQR. These findings suggest that TENS application at the Hugo acupoint may accelerate labor progression compared to other groups. Median times to reach 10 cm dilation were 6 h for the Hugo group and 7 h for both the Sanyinjiao and control groups, indicating similar labor progress between the Sanyinjiao and control groups, while the Hugo group showed a slightly shorter duration.

Discussion

The findings of this study demonstrate that applying TENS at the Hugo point significantly reduces the duration of both the active and expulsion phases of labor in nulliparous women. In contrast, its application at the Sanyinjiao point lacks a similar impact.

Aghamohammadi et al. (2011) utilized TENS at both Hugo and Sanyinjiao points simultaneously in nulliparous women. They found a significantly shorter first stage of labor in the TENS group compared to the placebo group, aligning with the findings regarding the Hugo point in this study. However, there are methodological differences between studies, particularly in the timing of intervention and study design. In another study, the pads of the TENS machine were placed in the lumbar and sacral regions. Based on the results, the duration of the first phase of labor was significantly shorter in the TENS group than in the control group, which is in line with the results of the present study conducted among nulliparous women. However, no significant difference was reported between the two groups regarding the duration of the third stage (Shahoei et al., 2017), which is not in line with that of the present study. The reason for the difference may be related to the difference in the method used in these studies and the location of the TENS pads. In Shahoei's study, the electrodes were placed over the lumbar and sacral regions, whereas in the present study, they were applied to specific acupressure points (Hugo and Sanyinjiao).

Table 3. Comparing the childbirth stage details by groups (Hugo, Sanyinjiao, and control) during labor

Variables	Median (IQR)				P
	Group				
	Total (n=123)	Hugo (n=41)	Sanyinjiao (n=41)	Control (n=41)	
Dilatation at the 1st hour (cm)	4 (4,4)	4 (4, 4)	4 (4, 4)	4 (4, 4)	0.584
Effacement at the 1st hour (%)	50 (40, 50)	50 (50, 60)	40 (40, 50)	40 (40, 50)	0.0001
Station at the 1st hour (-3 to +3)	-3 (-3, -2)	-3 (-3, -2)	-3 (-3, -2)	-3 (-3, -2)	0.526
Dilatation at the 2nd hour (cm)	5 (5, 5)	5 (5, 6)	5 (4, 5)	5 (4, 5)	0.0032
Effacement at the 2nd hour (%)	50 (50, 60)	60 (50, 60)	50 (50, 60)	50 (50, 60)	0.057
Station at the 2nd hour (-3 to +3)	-2 (-3, -1)	-1 (-2, -1)	-2 (-3, -2)	-2 (-3, -1)	0.0001
Dilatation at the 3rd hour (cm)	6 (5, 6)	6 (6, 7)	6 (5, 6)	6 (5, 6)	0.0001
Effacement at the 3rd hour (%)	60 (60, 70)	70 (60, 80)	60 (60, 60)	60 (60, 70)	0.0002
Station at the 3rd hour (-3 to +3)	-1 (-2, 0)	-1 (-1, 0)	-2 (-2, -1)	-1 (-2, -1)	<0.001
Dilatation at the 4th hour (cm)	7 (6, 8)	7.5 (7, 8)	7 (6, 8)	6 (6, 7)	0.0002
Effacement at the 4th hour (%)	70 (60, 80)	80 (70, 80)	70 (60, 80)	70 (60, 70)	0.0002
Station at the 4th hour (-3 to +3)	0 (-1, 0)	0 (0, +1)	-1 (-2, 0)	-1 (-2, 0)	<0.001
Dilatation at the 5th hour (cm)	8 (7, 10)	9 (8, 10)	8 (7, 9)	7.5 (7, 8)	<0.001
Effacement at the 5th hour (%)	80 (80, 100)	90 (80, 100)	80 (70, 90)	80 (70, 87.5)	<0.001
Station at the 5th hour (-3 to +3)	0 (-1, +1)	+1 (+1, +2)	-1 (-1, 0)	0 (-1, +1)	<0.001
Dilatation at the 6th hour (cm)	9 (8, 10)	10 (9, 10)	9 (7, 10)	9 (7, 10)	0.0001
Effacement at the 6th hour (%)	100 (80, 100)	100 (100, 100)	100 (80, 100)	90 (80, 100)	<0.001
Station at the 6th hour (-3 to +3)	+1 (0, +2)	+3 (+2, +3)	0 (-1, +1)	0 (-1, +1)	<0.001
Dilatation at the 7th hour (cm)	10 (8.5, 10)	10 (10, 10)	10 (9, 10)	10 (8, 10)	0.158
Effacement at the 7th hour (%)	100 (90, 100)	100 (100, 100)	100 (90, 100)	100 (90, 100)	0.361
Station at the 7th hour (-3 to +3)	+1 (0, +3)	+3 (+2, +3)	+1 (0, +2)	+1 (0, +2)	0.0002

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Note: Median (IQR) was reported for each variable across different groups. The Kruskal-Wallis test was used to compare the distribution of numeric variables among the three study groups: Hugo, Sanyinjiao, and control. Multiple comparisons were performed using the Dunn test correction.

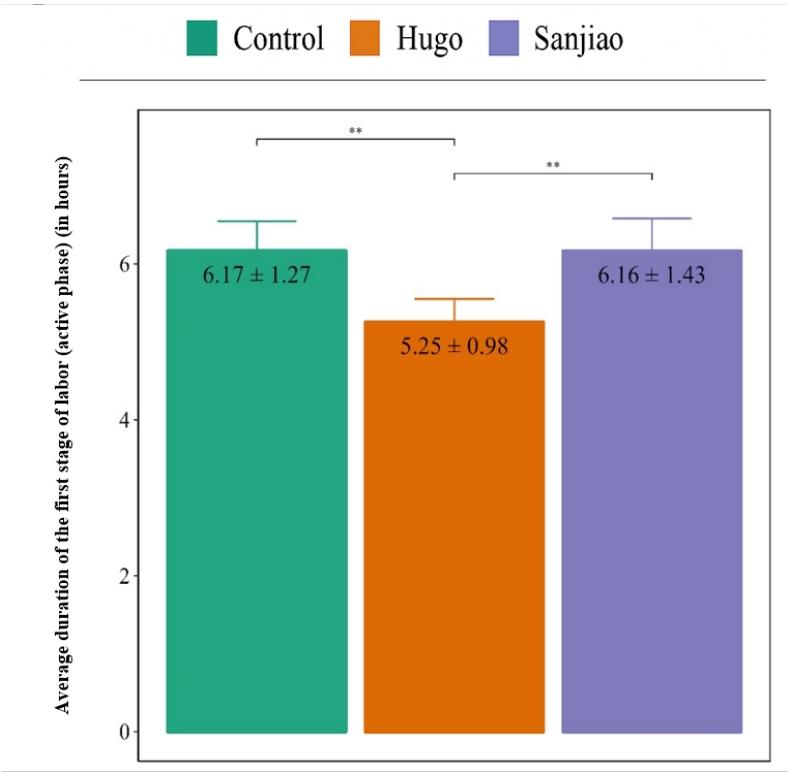

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Figure 4. Variation in the average duration of the first stage of labor (active phase) among the three study groups

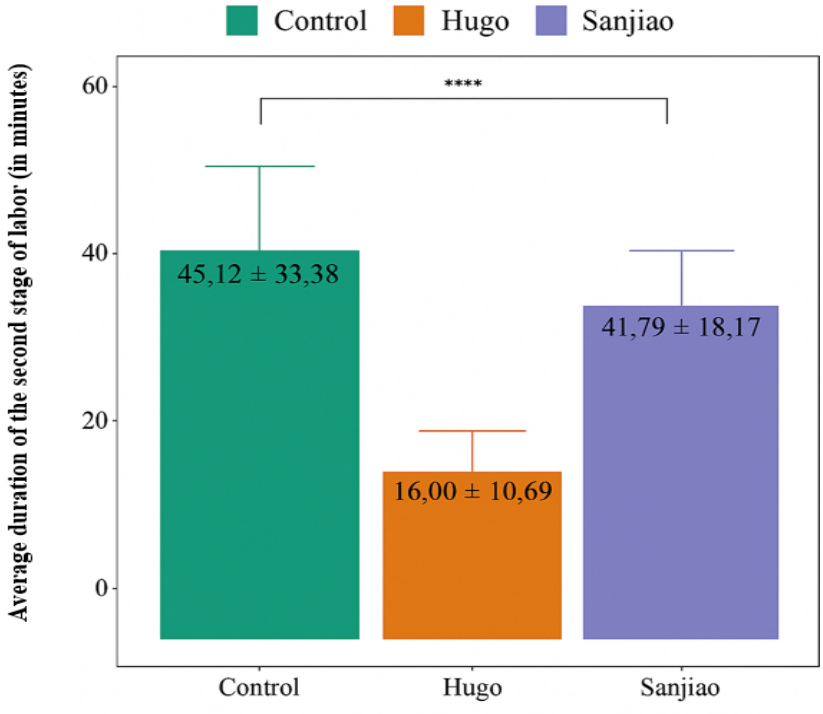

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Figure 5. Variation in the average duration of the second stage of labor among the three study groups

Moradi et al. (2022) reported the duration of the first stage of the active phase of labor in nulliparous women, which showed no significant differences among the three groups: The TENS group, the placebo group, and the psychological counseling group. However, there was a significant difference in the duration of the second stage of the active phase, as well as in the total duration of the active phase, among the three groups, which is in line with our findings. An interventional study involving 160 nulliparous women evaluated the effect of TENS at four points (BL19, PC6, B12, and L14) on labor duration. The duration of labor was significantly shorter in all four groups than in the control group, but no statistically significant difference was reported among the four intervention groups (Peng et al., 2010). Other studies reported a significant reduction in the duration of the active phase of labor while using TENS in the Hugo point (Dong et al., 2015; Njogu et al., 2021; Santana et al., 2016).

In the present study, applying TENS at the Hugo acupoint significantly reduced the duration of labor stages compared to the other two groups. However, Rasaeean et al. (1995) reported that TENS did not shorten labor duration. Additionally, there was a gradual decrease in the effectiveness of TENS from dilatation of 1-8 cm. Similarly, a systematic review and meta-analysis demonstrated that while TENS significantly reduced labor pain, it did not affect the duration of labor (Thuvarakan et al., 2020). The results were inconsistent with those of the present study, and this difference may be due to variations in the placement area of the TENS pads, the type of TENS device used, and the frequency and voltage of the TENS device. The usage of either high or low-frequency TENS system parameters explains this finding. These parameters increase β-endorphins and methionine-enkephalin concentration and the production of inhibitory neurotransmitters such as gamma-aminobutyric acid (GABA) and serotonin, but exhibit a reduction in neurotransmitter release (aspartate and glutamate). These natural analgesic substances inhibit the production of catecholamines (Chalermkitpanit et al., 2017).

This study adhered strictly to the principles of controlled trials to ensure accuracy and reliability. Data collection was carefully performed following standardized protocols to ensure the accuracy and reliability of the results. The labor progress checklist used in this study was developed and validated based on the standards set by the Iranian Ministry of Health and Medical Education (2025). However, the study population was limited to nulliparous women. Future research is suggested to include multiparous women to enable comparisons of labor stage durations between nulliparous and multiparous women. This study did not investigate neonatal outcomes after delivery, which should be addressed in future interventional studies.

Conclusion

This study evaluated the effect of TENS at Hugo and Sanyinjiao acupoints on labor progression and duration in nulliparous women. The results showed that TENS, especially at the Hugo point, significantly reduced the duration of the first and second stages of labor and improved cervical dilation, effacement, and fetal descent. However, the findings also revealed that the second stage of labor was longer in the Sanyinjiao group compared to the control group, which may be due to different physiological responses at the Sanyinjiao point or variations in the method of intervention, indicating the need for further investigation. These findings suggest that TENS can be used as a safe, low-cost, and non-invasive method in maternity education and clinical practice to promote normal childbirth. For healthcare managers, supporting such interventions may improve maternal satisfaction and reduce unnecessary cesarean sections. Future studies are recommended to explore other acupoints, TENS parameters, and long-term maternal outcomes.

Ethical Considerations

Compliance with ethical guidelines

This article is a part of a research project and has been approved by the Ethics Committee of Zanjan University of Medical Sciences, Zanjan, Iran (Code: IR.ZUMS.REC.1398.100). All study procedures were in accordance with the protocol of the Regional Ethical Research Committee and the 1964 Declaration of Helsinki. After being informed about the study objectives, written consent was obtained from all women. They were told that their participation was voluntary, confidential, and anonymous, and they had the right to withdraw from the research at any time. This study was registered in the Iranian Registry of Clinical Trials (IRCT) (Code: IRCT20220221054085N1).

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Authors' contributions

Conceptualization: Sanaz Fayazi; Study design: Sanaz Fayazi, Mina Abbasi, and Tahereh Shams Ghoreishi; Data acquisition: Masoumeh Amani; Writing the original draft: Sanaz Fayazi and Masoumeh Amani; Data interpretation, review and editing: Mina Abbasi and Tahereh Shams Ghoreishi, Masoumeh Amani, and Sanaz Fayazi.

Conflict of interest

The authors declared no conflict of interest.

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