

## Auricular Acupuncture on Uterine Point on PGF<sub>2α</sub> Levels and First-Stage of Labor Duration among Primigravida Women

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### ABSTRACT

Duration of labor is influenced by four factors, including the power or uterus contraction. Labor contractions begin with a decrease in the progesterone hormone levels and an increase in the oxytocin hormone levels which is initiated by prostaglandins (PGF<sub>2α</sub>). Auricular acupuncture on uterine point is located in the triangular fossa which is innervated by the trigeminal nerve and the vagus nerve. Stimulation on the uterine point can send a wave of stimulation to the central nervous system in the posterior hypothalamus to produce oxytocin. This study aims to analyze the effectiveness of auricular acupuncture on uterine point on PGF<sub>2α</sub> levels and the duration of the first stage of labor among primigravida women. This was a true experimental study with a two-group pretest-posttest design. The total sample of the study was 48 women in labor who were selected through a randomized control trial and met the inclusion criteria of low-risk pregnancy. Data were analyzed using the Wilcoxon and Mann Whitney tests. The results of the study revealed that auricular acupuncture on uterine point significantly increased PGF<sub>2α</sub> levels ( $p=0.002$ ), ( $201.29 \pm 132.916$ ) compared to the deep-breath relaxation group  $132.08 \pm 93.530$ . Auricular acupuncture on uterine point was proven to shorten the duration of the first stage of labor ( $440.3 \pm 72.94$ ;  $440.00$ ) when compared to the deep breathing relaxation group ( $517.6 \pm 101.00$ ;  $507.50$ ) with a very significant difference ( $p=0.004$ ). In conclusion, auricular acupuncture on uterine point was effective in shortening the duration of labor by increasing PGF<sub>2α</sub> levels.

*Lama persalinan dipengaruhi oleh empat faktor, diantaranya faktor power atau kontraksi. Kontraksi persalinan diawali dengan penurunan hormone progesterone dan meningkatnya hormone oksitosin yang diinisiasi oleh prostaglandin (PGF<sub>2α</sub>). Akupunktur auricular titik uterus terletak pada trianggula fossa yang dipersarafi nervus trigeminus dan nervus vagus. Menstimulasi titik Uterus dapat mengirim gelombang rangsangan ke susunan saraf pusat pada hipotalamus posterior memproduksi Oksitosin. Tujuan menganalisis efektifitas akupunktur auricular titik Uterus terhadap PGF<sub>2α</sub> dan lama persalinan kala I primigravida. Metode penelitian true experimental design dengan metode two-group pretest-posttest design. Jumlah sampel penelitian 48 ibu inpartu kala I yang dipilih secara randomice control trial dan memenuhi kriteria inklusi primigravida resiko rendah. Data dianalisis menggunakan uji Wilcoxon dan Mann Whitney. Hasil penelitian akupunktur aurikular titik Uterus meningkatkan kadar PGF<sub>2α</sub> ( $p=0,002$ ), meningkat bermakna ( $201,29 \pm 132,916$ ) dibandingkan dengan kelompok relaksasi nafas dalam  $132,08 \pm 93,530$ ). Akupunktur aurikular titik Uterus memperpendek lama persalinan kala I ( $440,3 \pm 72,94$ ;  $440,00$ ) jika dibandingkan dengan kelompok relaksasi nafas dalam ( $517,6 \pm 101,00$ ;  $507,50$ ) sehingga ada perbedaan yang sangat bermakna ( $p=0,004$ ). Kesimpulannya akupunktur aurikular titik Uterus efektif memperpendek lama persalinan dengan meningkatkan kadar PGF<sub>2α</sub>.*

## Introduction

Prolonged labor is caused by abnormal cervical dilation. Slow cervical dilation is due to the absence of a fetal head descending which may press the cervix. At the same time, there is cervical edema which make it difficult for the cervix to dilate and causes an increase in secarea action. In addition, prolonged labor can also caused by abnormal uterine contractions. Abnormal contractions may lead to labor complications. In average, the duration of the first stage of labor in primigravida is 13.5 hours. The labor process is said to be prolonged in primigravida if the duration of the first stage of labor in the latent phase lasts more than 20 hours and the cervical dilation is less than 1.2 cm/hour. Based on data derived from the Indonesian Demographic and Health Survey in 2017, one of determinants of the incidence of prolonged labor is primigravida ( $p < 0.0001$ ) (Annisya, 2020). The indirect impact of prolonged labor is Maternal Mortality Rate (MMR). In East Java Province in 2020, MMR due to infections increased from 0.38% in 2019 to 1.42% (East Java Provincial Health Office, 2020).

To overcome prolonged labor, midwives usually provide active mobilization care, try to meet nutritional needs and complementary contraction stimulation such as deep breathing relaxation or acupressure (Latifah, 2022). If non-invasive measures are not successful, and the time limit for labor has been exceeds, a referral is made.

Auricular acupuncture is a part of non-pharmacological complementary therapy which has been developed as medical acupuncture. The complex nervous system, namely the great auricular nerve, the lesser occipital nerve from C2 and C3, the trigeminal nerve, the temporal auricular nerve, the facial nerve, the vagus nerve, and the glossopharyngeal nerve in the external ear underlie studies related to the trigeminal. Previous studies among primigravida women reported a significant difference in the duration of labor between the two groups,  $p = 0.008$  (first stage) and  $p = 0.001$  (second stage) (Mahboubeh Valiani, Masoumeh Azimi, Zahra Mohebbi Dehnavi & Pirhadi, 2018), which showed a faster duration in the intervention group. Furthermore, duration of the active phase was significantly shorter in auriculotherapy group than the control group ( $176.2 \pm 1$  min vs.  $342.8 \pm 87.2$  min,  $< 0.001$ ) (Mahboubeh Valiani, Masoumeh Azimi, Zahra Mohebbi Dehnavi & Pirhadi, 2018).

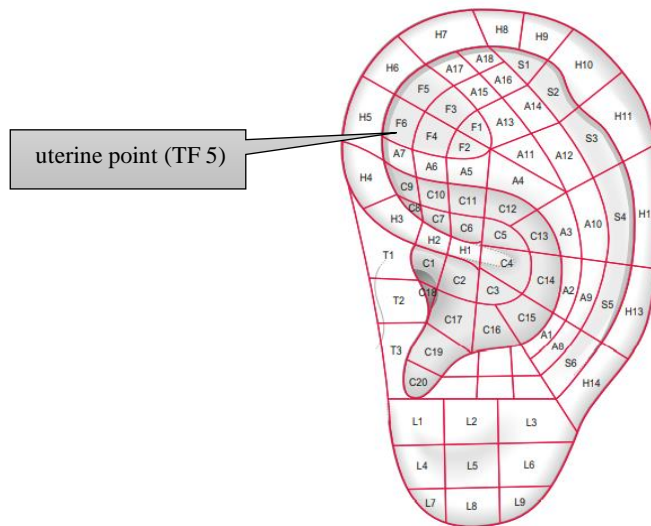
In this study, the researchers are intended to prove that auricular acupuncture on uterine point could affect the duration of labor by knowing whether there was a change in the levels of  $\text{PGF}_{2\alpha}$  as an oxytocin receptor that initiates uterine contractions.

## Methods

This was a true-experimental study with a two-group pretest-posttest design. The sample size was determined based on the number of term pregnant women who had an estimated due date in November 2021 to April 2022 at PMB Yefi Marliandiani Surabaya as many as 48 mothers. The samples involved women at the active phase of the first stage of labor that met the inclusion criteria, namely primigravida, gestational age between 38-41 weeks, Puji Rochyati's score was less than 6 or low risk pregnancy, and without complications. Women included in high-risk pregnancy and never had ANC were excluded from the study. Informed consent was taken from the subjects who were willing to give birth at the

PMB, when they visited the clinic for a third trimester pregnancy check. The study subjects were assigned into 2 groups, the intervention group that was given auricular acupuncture on uterine point and the control group that was given deep breathing relaxation. The independent variable was auricular acupuncture on uterine point. Meanwhile, the dependent variable was duration of active phase of the first stage of labor with the levels of prostaglandins ( $\text{PGF}_{2\alpha}$ ) as an intermediate variable.  $\text{PGF}_{2\alpha}$  was taken from 2 cc of venous blood samples of the study subjects by analysts, before and after treatment, analyzed at the GAKI laboratory, Universitas Diponegoro, Semarang after all serum samples were collected. Duration of labor was assessed by using observation sheets and partographs.

Auricular acupuncture on uterine point intervention was carried out immediately after the study subjects were examined and diagnosed at the latent phase of the first stage of labor with the cervical dilation of 4 cm until the end of the active phase of the first stage of labor ( $\varnothing$  9-10 cm). The administration of auricular acupuncture at the uterine point used a press needle at both the right and left ears of the study subjects in the triangular fossa (TF 5). Both ears in such area were given antiseptic of 70% alcohol, then the ear needle was placed at the uterine point, once every 30 minutes for 5 minutes the ear needle was stimulated clockwise to create deqi. The researchers administered auricular acupuncture to uterine point. Previously, researchers had carried out medical acupuncture training with LP3A certificate number SD40-20-07-0718. The control group was given deep breathing relaxation guided by a midwife who had attended Normal Childbirth Care (APN) training. Data were analyzed using the Wilcoxon and Mann Whitney tests. This study has been approved bases on ethical clearance issued by the Faculty of Medicine, Universitas Diponegoro No.352/EC/KEPK/FK-UNDIP/IX/2021.



**Figure 1.** Uterine point

## Results

The current study was conducted at the Private Practice Midwives (PMB) at Surabaya and Sidoarjo, which have been certified as Bidan Delima. The sample size was 48 respondents, with the following characteristics:

**Table 1.** Characteristics of Respondents

Characteristics	Auricular Acupuncture n=24	Deep breathing relaxation n=24	$\rho$ value
<b>Age</b>	24.0 $\pm$ 2.69; 24.5 (18-29)	24.7 $\pm$ 3.03; 24.5 (18-29)	0.4*
<b>Education</b>			
- Junior High School	1 (4.2%)	1 (4.2%)	0.4**
- Senior High School	22 (9.6%)	19 (79.2%)	
- Higher Education	1 (4.2%)	4 (16.7%)	
<b>Employment status</b>			
- Housewife	19 (79.2%)	22 (91.7%)	0.4**
- Teacher	1 (4.2%)	0 (0.0%)	
- Private	4 (16.6%)	2 (8.3%)	
<b>Gestational Age</b>	38.8 $\pm$ 0.98; 39.0 (37-40)	38.6 $\pm$ 0.88; 39.0 (37-40)	0.6***

\*unpaired t test

\*\* $\chi^2$  test

\*\*\*Mann-Whitney test

Data presented in table 1 showed that the mean age of the study subjects in the deep breathing relaxation group was slightly older, namely 24.7 $\pm$ 3.03 years compared to the auricular acupuncture group of 24.0 $\pm$ 2.69 years. The results of statistical tests showed that there was no significant difference in the mean age ( $\rho=0.4$ ). The level of education of the study subjects was mostly high school. The results of statistical tests showed that there was no significant difference in the distribution of the level of education between the auricular acupuncture group and the deep breathing relaxation group ( $\rho=0.4$ ).

Most of study subjects were unemployed or housewives. The results of statistical tests showed that there was no significant difference in the distribution of employment status in the auricular acupuncture group and the deep breathing relaxation group ( $\rho=0.4$ ). The mean gestational age in the auricular acupuncture group was slightly older, namely 38.8 $\pm$ 0.98 months compared to the deep breathing relaxation group of 38.6 $\pm$ 0.88 months. The results of statistical test showed that there was no significant difference in the mean gestational age ( $\rho=0.6$ ).

**Table 2.** Serum Prostaglandin (PGF<sub>2 $\alpha$</sub> ) Levels in the Auricular Acupuncture and Deep Breathing Relaxation Groups

PGF <sub>2<math>\alpha</math></sub> Level	Group		$\rho$ value
	Auricular Acupuncture (n=24)	Deep breathing relaxation (n=24)	
<b>Pre-test</b>			
$\bar{X} \pm SD$	199.00 $\pm$ 114.553; 168.00	159.17 $\pm$ 105.445; 141.00	0.2**
Median	(49-446)	(45-482)	
Min-max			
<b>Post-test</b>			
$\bar{X} \pm SD$	201.29 $\pm$ 132.916; 143.00	132.08 $\pm$ 93.530; 95.50	0.02**
Median	(52-476)	(39-330)	
Min-max			
<b>Delta</b>			
$\bar{X} \pm SD$	2.29 $\pm$ 47.065; 6.50	-27.08 $\pm$ 52.31; -19.500	0.02**
Median	(-112.0-141.0)	(-188.0-79.0)	
Min-max			
<b><math>\rho</math> value</b>	0.8 *	0.006 *	

\*Wilcoxon test

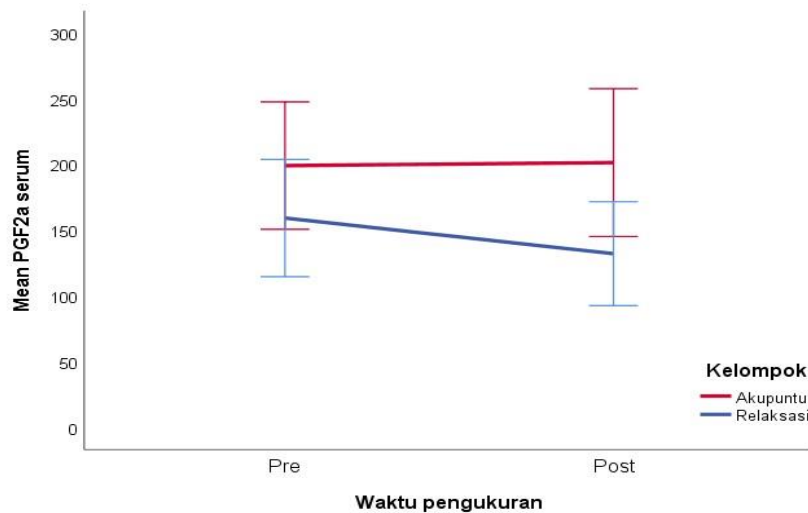
\*\*Mann-Whitney test

In table 2 it was shown that serum PGF<sub>2 $\alpha$</sub>  levels pre-treatment in auricular acupuncture group of 199.00 $\pm$ 114.553 pg/mL was higher compared to the deep breathing relaxation group of 159.17 $\pm$ 105.445 pg/mL, but the difference is not significant ( $\rho=0,2$ ). Post treatment, the serum levels of PGF<sub>2 $\alpha$</sub>  in the

auricular acupuncture group were  $201.29 \pm 132,916$  pg/mL, which was significantly higher than the deep-breathing relaxation group of  $132,08 \pm 93,530$  pg/mL ( $p=0.002$ ).

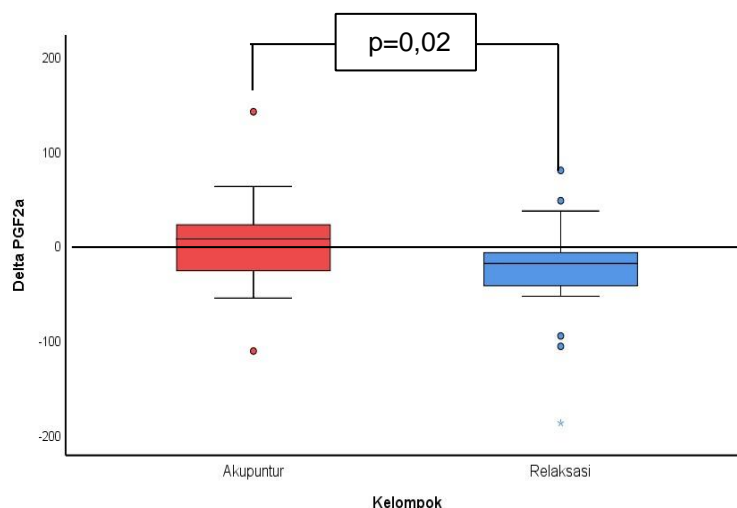
The mean serum delta  $PGF_{2\alpha}$  level in the auricular acupuncture group was lower but the value was positive by  $2.29 \pm 47.065$ . This indicated an increase in serum  $PGF_{2\alpha}$  levels. The results of statistical tests showed that the increase was not significant ( $p=0.8$ ). The mean serum delta  $PGF_{2\alpha}$  level in the deep breathing relaxation group was higher, but the value was negative by  $-27.08 \pm 52.31$ . This indicated a significant decrease in  $PGF_{2\alpha}$  levels in the deep breathing relaxation group ( $p=0.006$ ).

Changes in  $PGF_{2\alpha}$  serum levels of study subjects in the auricular acupuncture group and deep breathing relaxation during pre and post treatment are presented in Figure 2.



**Figure 2.** Changes in serum  $PGF_{2\alpha}$  levels of study subjects in the auricular acupuncture and deep breathing relaxation groups at pre and post treatment

Delta  $PGF_{2\alpha}$  levels in the auricular acupuncture and deep breathing relaxation groups are shown in Figure 3.



**Figure 3.** Serum delta  $PGF_2$  levels in the auricular acupuncture and deep breathing relaxation groups

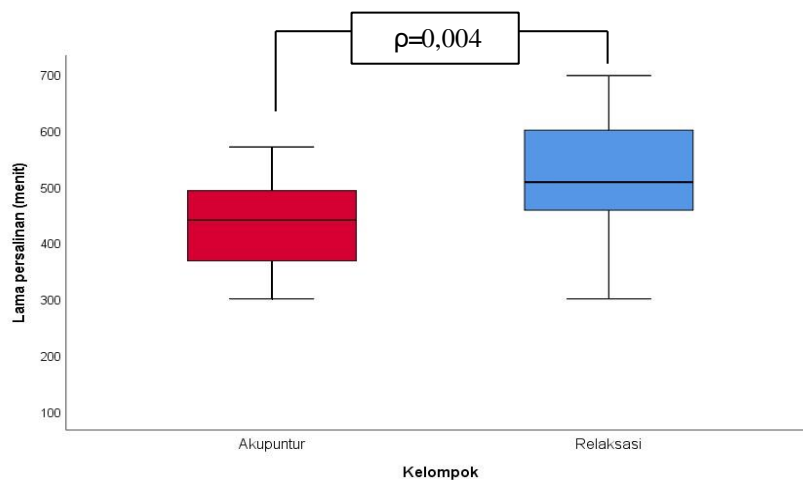
Figure 2 showed a significant difference between the serum delta  $PGF_2$  levels between the auricular acupuncture group and the deep breathing relaxation group ( $p=0.002$ ).

**Table 3.** Duration of labor (minutes) in the auricular acupuncture and deep breathing relaxation groups

Duration of labor		Group		p value
		auricular acupuncture	deep breathing relaxation	
Post	$\bar{X} \pm SD$	440.3±72.94; 440.00	517.6±101.00; 507.50	0.004*
	Median	(300-570)	(300-697)	
	Min-max			

\*Mann-Whitney test

The duration of labor in the auricular acupuncture group was shorter by 440.3±72.94; 440.00 when compared to the deep breathing relaxation group by 517.6±101.00; 507.50 which indicated a very significant difference ( $p=0.004$ ). The duration of labor in the auricular acupuncture and deep breathing relaxation groups is presented in Figure 4.



**Figure 4.** Duration of Labor in the Auricular Acupuncture and deep Breathing Relaxation Groups

**Table 4.** Duration of Labor in the AA Group and Deep Breathing Relaxation Group

Group	Duration of Active Phase of the First Stage of Labor	
	Abnormal (> 6 hours)	Normal (≤6 hours)
Deep breathing relaxation	18 (75.0%)	6 (25.0%)
Auricular acupuncture	8 (33, 0%)	16 (67.0%)

Value  $\chi^2=4.269p=0.03$

Control Event Rate (CER)=0.75 (75%)

Experimental Event Rate (EER)=0.33 (33%)

Absolute Risk Reduction (ARR)=75% – 33%=42%

Relative Risk Reduction (RRR)=(75.0 – 33.0)/75.0= 56%

Number Needed to Treat (NNT)=1/42=0.024=2

Relative Risk=3.0 (95% Confidence Interval/CI)=(1.44 to 6.23)

Data presented in table 4 indicated the incidence of abnormal duration of labor in the deep breathing relaxation group was 18 cases (75%) while in the auricular acupuncture it was 8 (33%). The absolute risk reduction or ARR was 42% and the relative risk reduction or RRR was 56%. Such findings indicated that auricular acupuncture had clinical benefits in reducing the incidence of abnormal duration of labor. The number of patients that must be given auricular acupuncture to prevent 1 occurrence of abnormal duration of labor was 2 people. The study findings also showed that auricular acupuncture had good economic value because it only requires 2 people who are given auricular acupuncture to prevent 1 case of abnormal duration of labor. Relative Risk (RR)=3.0 (95% CI 1.44-6.23) meant that auricular acupuncture treatment had three times clinical benefits compared to deep breathing relaxation in reducing the incidence of prolonged labor.

## Discussion

The results of this study indicated that there was no significant difference in the two groups related to age, level of education and the level of anxiety. Thus, there was a biased effect on the results of the analysis because changes in the dependent variable were due to the treatment given. The age of the study subjects ranged from 18-29 years, where the mean age of the Deep Breathing Relaxation group was slightly older than the AA group, but the difference was not significant ( $p=0.4$ ). Such finding indicated that the majority of the age of the study subjects was included in the reproductive age group which is physiologically still strong enough to withstand labor pain. Younger women have more intense pain sensory than mothers at an older age. Women at young age tend to have unstable psychological conditions that may trigger anxiety so that the pain experienced is getting stronger. Age is used as a determining factor for tolerance to pain. The results of the study conducted by Melese Siyoum regarding the relationship between age and labor pain reported an OR=5.85 (95% CI 2.14-15.98) and better pain control among women aged 19 to 24 years, almost six times than women aged more than 30 years. This is a possibility since the physical endurance of the women in labor in such age range is stronger than in the age group less than 18 years and those who are more than 30 years old (Siyoum & Mekonnen, 2019).

Most of study subjects in the two groups had the level of education of high school, but there was no significant difference ( $p=0.5$ ). The education level of the study subjects was related to access to information about labor pain. Mothers with low education are identical to the lack of knowledge, information and understanding about labor pain. The results of a study conducted by Ernawati Umar reported that the lowest level of pain was found in study subjects with higher level of education ( $p=0.028$ ) with an OR of 8,586 (95% C: 12,520-14,134) meaning that women in labor with junior high school education had an 8.5 times chance of experiencing labor pain compared to women with senior high school education (Umar, 2021).

The results of this study proved that the auricular acupuncture on uterine point intervention had a significant effect on the duration of active phase of the first stage labor among primigravida by 440.3 minutes, shorter than the control group. The difference in labor duration was statistically significant ( $p=0.004$ ). A previous study reported that auricular acupuncture was more effective in reducing labor pain and shortening the duration of labor compared to the body acupuncture group (Hawker, Mian, Kendzerska, & French, 2011). Another study compared auricular acupuncture and body acupuncture, reporting that auricular acupuncture was significantly effective in reducing labor pain and shortening the active phase of labor ( $p<0.001$ ) compared to the other 2 groups (Alimoradi, Kazemi, Gorji, & Valiani, 2020).

Duration of labor is influenced by 5 factors, including the power factor of uterine contractions. Uterine contractions cause labor pain so as to cause cervical ripening. Uterine contractions, cervical dilation and stretching of the pelvic floor, vagina and perineum during labor lead to uterine tissue ischemia. Uterine tissue ischemia damages cells or tissues and is followed by the release of various chemicals including prostaglandins, leukotrienes, thromboxane, histamine, bradykinin, P substance, and

serotonin. Cervical ripening is accompanied by invasion of the stroma by inflammatory cells where there are chemo-attractants that introduce inflammatory cells into the cervix. The inflammatory process is related to cytokines, and in labor cytokines play a role in 3 processes, namely cervical ripening, stimulation to weaken amniotic membranes until rupture and increase myometrial contractions. Interleukins are molecules that mediate communication between leukocytes (Dubicke et al., 2010; Bowen, Chamley, Keelan, & Mitchell, 2002; Romero, 2002). Proinflammatory cytokine interleukins (IL)-1beta, IL-6, IL -8, and tumor necrosis factor (TNF) alpha were identified in reproductive tissues during labor.

Interleukin-1 $\alpha$  and TNF influence the decidua to produce prostaglandins, especially PGE<sub>2</sub> and PGF<sub>2 $\alpha$</sub> . Prostaglandin F<sub>2 $\alpha$</sub>  acts on the myometrium in the formation of cell-to-cell gap junctions and oxytocin receptors so that depolarization will spread to the myometrium, resulting in an increase in intracellular calcium ions. Calcium binding to calmodulin activates myosin-like chain kinases on actin and myosin cause myometrial fiber shortening and contraction (Dubicke et al., 2010; Schlembach et al., 2009). In fetal membranes, IL-6 and TNF alpha are expressed by stromal cells, decidua, infiltrating leukocytes, and extravillous trophoblast. Interleukin 8 as one of the pro-inflammatory interleukins plays a role in mediating the infiltration of inflammatory cytokines into the myometrium during labor.

Increased prostaglandins as oxytocin receptors will eventually affect the production of oxytocin. Oxytocin has both direct and indirect actions. The direct action of oxytocin in the myometrium produces regular and effective contractions, while the indirect action of oxytocin on the decidua will increase the production of prostaglandins (PGF<sub>2 $\alpha$</sub> ) (Thornton, Browne, & Ramphul, 2020; Jordan & Singer, 2006). In this study, auricular acupuncture on uterine point was proven to increase the PGF levels, so that uterine contractions remain strong, and this further affected the duration of labor.

## Conclusions

Auricular acupuncture on uterine point was effective in decreasing the duration of labor by increasing the levels of prostaglandins (PGF<sub>2 $\alpha$</sub> ). Further research with a larger sample size is needed, so that it can be applied primary health care facilities. Such practice should be easily accessible by the community, especially women in labor to shorten the duration of labor and reduce the length of care. The results of this study can be applied at broader scope and replicated in multidisciplinary research.

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