# Effect of Left Lateral Position combined with Zhiyin Point Acupressure on Maternofetal Physiological Parameters during Non-Stress Test

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**Abstract**

A non-stress test (NST) is a graphical recording of changes in fetal cardiac activity, uterine contractions, and fetal movement. The present study **aimed** to assess the effect of left lateral position combined with Zhiyin Point acupressure on maternofetal physiological parameters during non-stress test. **Materials and Method: Design:** A comparative quasi experimental research design was used. **Setting**: the current study was conducted at the fetal monitoring room in antenatal maternal child health clinic at Naser medical center, in Damanhour city. **Subjects**: A convenient sample of 80 women was recruited according to inclusion criteria. **Tools:** Four tools were used for data collection: structure interview schedule, non-stress test recording strip (CTG graph), fetal physiological parameters and maternal physiological parameters assessment sheets. **Results**: higher basal fetal heart rate (FHR), increased mean of FHR accelerations, and fetal movement among combined group than left lateral group with highly statistically significant differences between them. Reactive non-stress test was significantly increased in combined group than left lateral group P= (0.047). In addition, there were statistically significant differences ($P<0.05$) between the two groups regarding maternal pulse, systolic and diastolic blood pressure. **Conclusion**: left lateral position combined with Zhiyin point acupressure were associated with significant increase in baseline FHR, acceleration, fetal movement and non-stress test reactivity. The combined intervention also associated with significant difference in maternal physiological parameters related to heart rate, systolic and diastolic blood pressure. **Recommendation** Application of Zhiyin Point acupressure with left lateral position during non-stress test is recommended in prenatal clinics.

**Keywords:** Left lateral position, Non-stress test, Zhiyin point acupressure

## Introduction:

Several antepartum fetal surveillance approaches are now in use to reduce perinatal mortality and morbidity which is one of the goals of prenatal care. Fetal movement evaluation, non-stress test, contraction stress test, fetal biophysical profile, and umbilical artery doppler velocimetry are among these approaches. The prenatal non-stress test (NST) is a technique for assessing fetal well-being during pregnancy and prior to the onset of labor. A non-stress test is a graphical recording of changes in fetal cardiac activity, uterine contractions, and fetal movement (**Pirhadi & Valiani, 2017)**

The NST is an efficient technique for assessing a wide range of possible pregnancy problems, including preterm pregnancy, multiple gestation, intrauterine growth restriction (IUGR), prolonged gestation, Rh sensitization, and anomalies. Moreover, NST is performed to minimize the occurrence of fetal compromise at delivery due to placental insufficiency. NST is a non-invasive, low-cost approach that does not necessitate the start of uterine contractions. It can be performed in the outpatient clinic without any adverse effects for the mother and fetus **(Singh et al., 2020; Kaviani 2016).**

A non-stress test is used for pregnant women who are more than 28 gestational weeks. The test is called "non-stress" since the fetus is not put under any stress during the procedure. Electronic monitoring is used in this procedure to record the fetal heartbeat. NST determines the relationship between the fetal neurological conditions with cardiovascular reflex responses. The fetal heartbeat is accelerated in response to fetal movement, which is the basis for NST. Increase in fetal heartbeat caused by movement indicates normal pH and fetal status **(Guler et al., 2019; Kaur et al., 2017)**

Fetal parameters as the baseline fetal heart rate (FHR), acceleration, deceleration and fetal

movement as well as baseline variability are all crucial components of NST. The baseline fetal heart rate (FHR) is assessed over a time period of 5-10 minutes, illustrated as beats per minute (b/m) and normal value is 120 -160 b/m. Accelerations are transient increases in FHR of 15b /m or more above the baseline and lasting 15 seconds. Decelerations are transitory drops in FHR of more than 15 b/m below baseline that last at least 15 seconds. The baseline variability is estimated by the difference in b/m between the highest peak and lowest trough of fluctuation in one minute segments of the trace. Variability is specified by the distance between (0) and (25) number of heartbeats based on bpm. So, in lack of variability, the distance cannot be measured, in mild variability, it is measured to 5 bpm or less, while average variability, the distance is 6-25 bpm and marked variability is above 25bpm (**Cunningham et al., 2014; Gabbe et al., 2012)**.

The non-stress test might be interpreted as reactive or non-reactive. At least two FHR accelerations lasting at least 15 seconds and reaching at least 15 beats/minute over the established baseline heart rate within a 20-minute period are required for a reactive NST. The test is called nonreactive if it does not fulfil these requirements after 40 minutes. The lack of two fetal heart rate accelerations using the 15-by-15 criteria in a 20-minute time period characterizes a "nonreactive" NST **(Şener et al., 2021; Taskın, 2016)**

Various methods of non-pharmacological interventions have been studied to improve the parameters of the fetal health tests assessment. Moving the fetus, extending the test time, vibroacoustic stimulation of the fetus prior to the test, changing the mother's position, and applying acupressure are some of these methods **(Mahboubeh et al., 2013).**

The hemodynamics of maternal and feto-placental circulation are undoubtedly influenced by maternal position during NST. However, the position of the mother during the test is a significant consideration that should be included in the practical guidelines. Nurses usually place pregnant women in the supine position because it is easier to administer the test in this posture. A study was conducted to see if maternal posture influenced non-stress test results. The result shows that there was more non- reactivity in supine position ($p = 0.01$) **(Maneesha, 2013)**. During a pregnancy, the gravid uterus exerts pressure on the vena cava and the right iliac artery, left lateral position is used as a possible alternative to relieve this pressure. The cardiac output and the venous return will increase that makes placental perfusion easier **(Siby & vinsi, 2019)**.

On the other hand, acupressure is a complementary therapy in which fingers are used to apply pressure on certain points on the skin in order to stimulate and induce the body's innate self-healing mechanisms. One of the acupoints used in acupressure is Zhiyin (BL67). The stimulation of this point has been proven to help the fetus to move by activating the fetus's adrenocortical hormone. This spot is located on the bladder meridians and situated on the outer surface of the pinky toe hangnail. However, this has not been proven in all the studies conducted about the issue **(Leticia et al., 2015)**. Another study reported a significant increase in the number of FHR accelerations during acupuncture with stimulation of Zhiyin acupoint **(Littleton & Engebretson, 2013; Mahboubeh et al., 2013)**.

As non-stress test is conducted by nurses in outpatient and inpatient department. Maternity Nurses play a vital role in non-stress test as they explain the technique and ask the pregnant woman to empty her bladder prior to the test. Apply the two external monitor belts to the woman after placing her in the proper posture. They note the date and time of the test, as well as the purpose for the test and the mother's vital signs. Over period of 15 to 30 minutes, they get a baseline fetal monitor strip. During the test, look for evidence of fetal activity as well as an increase in the fetal heart rate. They interpret the non-stress test as a reactive or nonreactive. They assist the woman off the table after the test and provide instructions on how to recognize and respond to warning signs and symptoms **(Ricci et al., 2012)**.

**Significance of the study**

Non-stress tests are used in the third trimester of pregnancy to check the health of the fetus. The researchers discovered that

pregnant women are frequently positioned in the supine position for non-stress test in most hospitals because this position allows for easier administration of the test. Supine posture, on the other hand, induces aortocaval compression, which reduces blood flow to the fetus, resulting in non-reactive consequences. Also, based on the key fact that fetal heart rate acceleration in response to external stimuli has the same predictive value as spontaneous fetal heart rate acceleration **(Li X et al., 2009)**. So, it appears logical to use external stimuli such as acupressure to accelerate and facilitate NST results. Moreover, in response to the limited number of studies on evaluating the effect of left lateral position and Zhiyin point acupressure on maternofetal physiological parameters during non-stress tests. The current study was undertaken to assess the effect of left lateral position combined with Zhiyin point acupressure on maternofetal physiological parameters during non-stress test.

**Aim of the study:**

The current study aimed to assess the effect of left lateral position combined with Zhiyin point acupressure on maternofetal physiological parameters during non-stress test.

**Research hypotheses:**

Maternal physiological parameters exhibit significant difference during Non-Stress Test among women assume combined left lateral position with Zhiyin point acupressure than those who assume left lateral position only.

Fetal physiological parameters exhibit significant difference during Non-Stress Test among women assume combined left lateral position with Zhiyin point acupressure than those who assume left lateral position only.

**Operational definition:**

Zhiyin **point acupressure**

This point is known as Zhiyin, or reaching yin or the bladder 67 point (BL67) located on the lateral side of the end of the small toe, 1 cun from the corner of the nail.


**Bladder point 67**

**Maternal Physiological Parameters**

They are blood pressure, pulse and respiration. Pulse is checked by pressing the radial artery for 1 minute, respiration-by watching the chest movement for 1 minute. Blood pressure is monitored by sphygmomanometer.

**Fetal Physiological Parameters**

They include fetal heart rate, movement, and acceleration with the help of a machine called cardiotocograph.

**Materials and Method**

**Materials**

**Design:**

A comparative quasi experimental research design was used where the effect of two independent variable (left lateral position and acupressure) on dependent variables (maternofetal physiological parameters) was assessed during non-stress test.

**Setting:**

This study was conducted at the fetal monitoring room in antenatal maternal child health clinic at Naser medical center in Damanhur city. This setting was selected because of the availability of non-stress test machine and the satisfactory number of subjects.

**Subjects:**

A convenient sample of 80 pregnant women who attended the previously mentioned setting was included in the study**.** All subjects were selected according to the following eligibility criteria:-

1) ≥32 weeks of gestation and before onset of labor
2) Normal course of pregnancy and free from any medical disease as cardiovascular, kidney, diabetes mellitus and hypertension.
3) From 20 to 35 years old
4) Single pregnancy
5) Normal fetus free from intra uterine growth retardation
6) Willing to participate in the study.

Epi -Info program was used to estimate the sample size. Each one of the 80 eligible pregnant women was randomly assigned into two equal groups.

**Tools:**

Four tools were used for data collection

**Tool I: Structure interview schedule:-**

The researcher developed this tool to collect basic information about the study participants. It had two parts:

- **Part I: Socio-demographic data** such as: age, educational level, current residence and occupation.
- **Part II: Reproductive history** such as gravidity, parity, abortion, last menstrual period, expected date of delivery, gestational age, number and reasons of current ante-natal visits.

**Tool II: Non stress test recording strip (CTG graph)**

It includes a visual representation of the FHR correlating to fetal movement, it was printed from cardiotocography machine.

**Tool III: Fetal physiological parameters**

The researchers developed this tool for recording the fetal physiological parameters as a baseline fetal heart rate, number of accelerations and decelerations, number of fetal movements, baseline variability as well as reactivity of NST. This sheet included also the non-stress test interpretation.

**Based on Cunningham et al., 2014), interpretation of Non-stress test was:**

**1- Reactive (normal):**

- At least two fetal movements in 20 min.
- Acceleration of the FHR by at least 15 beats/min above the baseline rate, and last for at least 15 seconds.
- Presence of variability of at least 10 beats/min.
- A baseline FHR rate within the normal range (120 – 160 bpm).

**2-Non-reactive (abnormal):**

It Includes any trace with no or insufficient FHR acceleration (less than 15 beats per minute).

**Tool IV: Maternal physiological parameters assessment sheet:** It was developed by the researcher for recording systolic and diastolic blood pressures, pulse rate and respiratory rate during the NST.

**Method:**

**The study was executed according to the following steps:**

1. Before conducting the research, the Ethical Research Committee of the Faculty of Nursing, Damanhour University, gave its approval about the study.
2. The researchers completed a three-day (18-hour) acupressure therapy training programme at The Arab African Union, Supreme Body for Complementary Medicine that is affiliated to the Ministry of Culture and Investment in the governorate of Alexandria, and they received an accredited certificate.
3. The data collection was conducted from the beginning of November 2020 to the end of March 2021. The researchers went to the setting of data collection two days per week from 9.00 a.m until 2.00 p.m.
4. After explaining the study's goal to the Dean of the Faculty of Nursing at Damanhour University, permission to conduct the study was obtained.

5. A team of five experts in obstetric and gynecologic nursing examined the data collecting tools for comprehensiveness and appropriateness. The team confirmed the validity content of the tools. In addition, the researchers checked the accuracy of the devices used before data collection.
6. The researchers asked the pregnant women who met the study's inclusion criteria to participate in the study after explaining the study's objectives and procedure and obtained their written consent.
7. A pilot study was conducted on eight puerperal women (who were not included in the study population) to determine the feasibility of the study as well as the tools' relevance, clarity, and application. Tools were reviewed, redeveloped, and made suitable for use after a few changes.
8. The recruited pregnant women were assigned randomly and equally into two groups:

   - **Group 1: left lateral position group** (40) participants

   - **Group 2: combined group (**left lateral position + acupressure) (40) participants.

9. Before the procedure, each woman of both groups was interviewed individually to collect basic data and their physiological parameters using tool (I&IV).
10. The fetal monitoring room was comfortable, relaxing and quiet.
11. **For group (1) Left lateral position group** :

- Every woman was instructed to empty her bladder to maintain comfort and to eat a meal at least 2 hours before the test.
- Every woman was asked to lie down on the left lateral position and the CTG machine was attached.
- Non-stress test was recorded for 20 minutes.
- Monitoring of maternal and fetal parameters was accomplished

12. **For group (2) Combined acupressure group**: The researchers repeated the same steps as in left lateral group plus after 5 minutes from attaching the machine's transducers, the researcher applied firm pressure with massage at the Zhiyin (BL67) acupoint with thumb and index finger for 10 minutes (5 minutes for each foot).
13. For both groups, brachial blood pressure was measured again in the woman's dependent arm using an automated cuff. In order to allow for hemodynamic equilibrium, this measurement was performed at least 5 minutes after assuming women's positioning. Also, maternal pulse and respiration are measured for the two groups.
14. The fetal movement was marked by women among the two groups through pressing the remote control button.
15. After implementing the procedure, maternal and fetal physiological parameters are recorded and interpreted by the researchers using tools (II, III and IV).
16. Comparison of maternal and fetal parameters between the two groups were made to determine which application is more effective (more fetal NST reactivity) during Non-stress test.
17. For analysis, data was loaded into SPSS version 23. The data was analyzed using descriptive statistics such as number, percentage, mean, and standard deviation. In order to compare the two groups, Chi-square, Fisher exact, and paired t-test were performed. At 0.05, the test results are considered significant.

**Ethical considerations:**

For each selected subject, the researcher get the participant's written informed consent, maintained the subject's privacy and data confidentiality. The right of participants to withdraw at any time was considered.

**Limitation of the study:**

The effect of acupressure on high-risk pregnant women cannot be evaluated because this study was conducted on healthy participants.

**Results:**

**As shown in table (1),** the age of 62.5% of the participants in the left lateral group were 20 to less than 25yrs compared to 37.5% of combined group. In addition, 40.0% of the left lateral group were illiterate or read &write compared to 50% of combined. Moreover, the majority of participants in the left lateral and combined group 95% and 97.5 % respectively

were housewives. There was no significant difference in the sociodemographic data among the two groups.

Regarding the reproductive history, **Table (2)** reveals that 42.5 % of the left lateral group had 2-4 pregnancies compared to 50% of combined group. In addition, 37.5% of the left lateral group were multipara compared to 20% of combined group. There is no significant difference between the left lateral and combined group in relation to their reproductive history

**Table (3)** shows that most of the left lateral group (87.5%) and the majority of the combined one (97.5%) had 32-35 weeks of gestation. Moreover, 80% and 92.5% from both groups respectively had more than 4 antenatal visits, 87.5% of left lateral and 95% of combined visited the antenatal clinic for routine follow up. No statistically significant differences was observed between them

**As presented in table (4),** it was observed that all (100%) of the combined group had normal basal line fetal heart rate range (120-160 bm) compared to 95% of left lateral group and a statistically significant difference was observed between them, P = (0.016). Moreover, the mean number of acceleration of left lateral group was (1.70±1.742) compared to (2.43±1.87) of combined group. There was a highly statistically significant difference between the left lateral and combined group, P < (0.001). In addition, the mean number of fetal movement among left lateral group was (3.25±2.959) compared to (4.50±3.22) among combined group. However, the differences were statistically significant, P = (0.001).

**Table (5)** reveals that 10% of left lateral group had lack of fetal heart rate variability compared to only 2.5% of combined group. Slightly more than half (52.5%) of left lateral group had moderate variability compared to 70% of combined group. Regarding to marked FHR variability, 12.5% of left lateral group had marked variability compared to 7.5% of combined group. The differences between the left lateral and combined group were not statistically significant P = (.3178).

**Table (6)** illustrates that the majority (97.5%) of combined group had reactive non-stress test result compared to 85 % among the left lateral group. Nonreactive non-stress test result was observed among (2.5% &15%) of combined and left lateral group respectively. There was a statistically significant difference between the left lateral and combined groups, P = (0.047).

**Table (7)** shows statistically significant differences (P<0.05) between the two groups concerning maternal pulse rate, systolic BP and diastolic BP during the intervention. On the contrary, no significant difference was observed regarding the maternal respiratory rate between the two groups.

**Table (1):** Distribution of the participants according to socio-demographic data

| Socio-demographic characteristics | Lt.lateral group (n=40) | | Combined group (n=40) | | $\chi^2$ (P-value) |
|---|---|---|---|---|---|
| | No | % | No | % | |
| **Age in years** | | | | | |
| ▪ 20 < 25 | 25 | 62.5 | 15 | 37.5 | 22.571 P(0.068) |
| ▪ 25 < 30 | 8 | 20 | 16 | 40 | |
| ▪ 30 + | 7 | 17.5 | 9 | 22.5 | |
| **Level of education** | | | | | |
| ▪ Illiterate / Read &write | 16 | 40.0 | 20 | 50 | 1.694 P (.638) |
| ▪ Primary /preparatory | 9 | 22.5 | 7 | 17.5 | |
| ▪ Secondary school | 12 | 30 | 12 | 30.0 | |
| ▪ University or higher | 3 | 7.5 | 1 | 2.5 | |
| **Current residence** | | | | | |
| ▪ Rural | 25 | 62.5 | 20 | 50 | 1.270 P (.184) |
| ▪ Urban | 15 | 37.5 | 20 | 50 | |
| **Occupation** | | | | | |
| ▪ House wife | 38 | 95 | 39 | 97.5 | .3.013 P (0.222) |
| ▪ Working | 2 | 5 | 1 | 2.5 | |

$\chi^2$: **Chi square test** *: Statistically significant at $p \leq 0.05$

**Table (2):** Distribution of the participants according to reproductive history.

| Reproductive history | Lt.lateral group (n=40) | | Combined group (n=40) | | $\chi^2$ (P-value) |
|---|---|---|---|---|---|
| | No | % | No | % | |
| **Gravidity** | | | | | |
| ▪ Primigravida | 15 | 37.5 | 18 | 45 | 4.116 P (0.127) |
| ▪ 2-4 | 17 | 42.5 | 20 | 50 | |
| ▪ 5+ | 8 | 20.0 | 2 | 5 | |
| **Parity** | | | | | |
| ▪ Nullipara | 15 | 37.5 | 18 | 45 | 3.069 P(.215) |
| ▪ Primipara | 10 | 25 | 14 | 35 | |
| ▪ Multipara | 15 | 37.5 | 8 | 20 | |
| **Number of abortion** | | | | | |
| ▪ No abortion | 32 | 80 | 33 | 82.5 | 2.349 P (.503) |
| ▪ Once | 5 | 12.5 | 5 | 12.5 | |
| ▪ Twice | 1 | 2.5 | 2 | 5 | |
| ▪ Three or more | 2 | 5 | 0 | 0.0 | |

$\chi^2$: Chi square test *: Statistically significant at $p \leq 0.05$

**Table (3):** Distribution of the participants according to history of current pregnancy

| History of current pregnancy | Lt.lateral group (n=40) | | Combined group (n=40) | | $\chi^2$ (P-value) |
|---|---|---|---|---|---|
| | **No** | **%** | **No** | **%** | |
| **Current week of gestation** | | | | | |
| ▪ 32-35 weeks | 35 | 87.5 | 39 | 97.5 | 4.849 P (.303) |
| ▪ 36-39 weeks | 5 | 12.5 | 1 | 2.5 | |
| **Number of ante-natal visits** | | | | | |
| ▪ Less than 4 visit | 8 | 20 | 3 | 7.5 | 5.601 P (0.061) |
| ▪ More than 4 visit | 32 | 80 | 37 | 92.5 | |
| **Reason of antenatal visit** | | | | | |
| ▪ Routine follow up | 35 | 87.5 | 38 | 95 | 3.123 P (.373) |
| ▪ No fetal movement | 2 | 5 | 0 | 0 | |
| ▪ Abdominal pain | 3 | 7.5 | 2 | 5 | |

$\chi^2$: Chi square test FE: Fisher Exact *: Statistically significant at $p \leq 0.05$

**Table (4):** Distribution of the participants according to fetal physiological parameters

| Fetal physiological parameters | Lt.lateral group (n=40) | | Combined group (n=40) | | *Significant Test* (P-value) |
|---|---|---|---|---|---|
| | **No** | **%** | **No** | **%** | |
| **Fetal heart rate** | | | | | |
| ▪ 120-160 b/m | 38 | 95 | 40 | 100 | 26.211 P (.016)* |
| ▪ Less than 120 b/m | 2 | 5 | 0 | 0.0 | |
| **Number of acceleration** | 1.70±1.742 | | 2.43±1.87 | | 37.548 (p<0.001**) |
| **Number of fetal movement** | 3.25±2.959 | | 4.50±3.22 | | 13.538 (p=0.001*) |

$\chi^2$: **Chi square test** FE**: Fisher Exact** *: Statistically significant at $p \leq 0.05$
**: Highly statistically significant at $p < 0.001$

**Table (5):** Distribution of the participants according to FHR variability

| Non-stress test variability | Lt.lateral group (n=40) | | Combined group (n=40) | | $\chi^2$ (p-value) |
|---|---|---|---|---|---|
| | No | % | No | % | |
| ▪ **Lack of variability** | 4 | 10 | 1 | 2.5 | 3.522 P (.3178) |
| ▪ **Mild variability (<5 b/m)** | 10 | 25 | 8 | 20 | |
| ▪ **Average variability (6-25 b/m)** | 21 | 52.5 | 28 | 70 | |
| ▪ **Marked variability (>25 b/m)** | 5 | 12.5 | 3 | 7.5 | |

$\chi^2$: Chi square test FE: Fisher Exact *: Statistically significant at $p \leq 0.05$

**Table (6):** Distribution of the participants according to non-stress test reactivity

| Non-stress test Reactivity | Lt.lateral group (n=40) | | Combined group (n=40) | | $\chi^2$ (p-value) |
|---|---|---|---|---|---|
| | No | % | No | % | |
| • **Reactive** | 34 | 85 | 39 | 97.5 | 3.913 P=(0.047)* |
| • **Non-reactive** | 6 | 15 | 1 | 2.5 | |

$\chi^2$: Chi square test FE: Fisher Exact *: Statistically significant at $p \leq 0.05$

**Table (7):** Distribution of the participants according to maternal physiological parameters

| Vital signs | Lt.lateral group (n=40) | Combined group (n=40) | *Significant Test* |
|---|---|---|---|
| | Mean±SD | Mean±SD | t (p value) |
| **Pulse rate** | | | |
| ▪ Before | 79.98±1.84 | 80.33±3.30 | .240 (0.625) |
| ▪ During | 78.15±3.55 | 77.15±3.55 | 5.459 (0.022)* |
| **Systolic blood pressure** | | | |
| ▪ Before | 116.00±5.4 | 115.88±6.8 | .591 (0.444) |
| ▪ During | 115.50±5.03 | 107.25±9.05 | 15.195 (0.000)** |
| **Diastolic blood pressure** | | | |
| ▪ Before | 74.38 ±4.82 | 76.500 ±5.90 | .291(.591) |
| ▪ During | 73.37 ±5.59 | 73.75 ±6.279 | 4.921 (0.029)* |
| **Respiratory rate** | | | |
| ▪ Before | 19.43±1.24 | 19.53±0.81 | 1.118(.294) |
| ▪ During | 19.10±1.15 | 18.70±1.244 | .186 (0.668) |

*: Statistically significant at $p \leq 0.05$ **: Highly statistically significant at $p < 0.001$

## Discussion

Non-Stress Test (NST) is one of the most current modalities to test fetal wellbeing. It provides fetal surveillance in the antepartum and intrapartum periods with lowest possible rate of unnecessary obstetrical intervention. It is particularly well suited for the application by nurse practitioners and midwife. Recently, various alternative procedures are used during NST applications to improve test results **(Esin, 2014)**. In the current study, the researchers compared between left lateral position and combined it with Zhiyin point acupressure. There are very limited number of studies conducted about combination of those two interventions (left and acupressure) to explore their effect.

According to the results of the current study, it can be noticed that the study groups were matching in almost all of their socio-demographic characteristics, reproductive and present history. However, this consistent profile of the participants was useful in limiting extraneous factors, which could interfere with the effect of the intended intervention. It also helped in understanding and securing the reliability and relevance of the forthcoming results of the current study.

The study achieved its proposition in illustrating that combined intervention is an

efficient way in improving maternofetal parameters during NST. Although the left lateral position has less effective results than the combined intervention but it also gave worthy findings related to fetal parameters during non-stress test because left lateral position might displace the uterus from the inferior vena cava and thus improve gas exchange and maternal hemodynamics and reactive fetal heart rate **(O'Brien & Warland, 2014)**.

These findings are relatively congruent with **Ibrahim et al., (2021)** who claimed a higher fetal heart rate (FHR), increased accelerations, and fetal movement in the left lateral position. **Tabatabaeichehr et al., (2019)** found that, the mean difference of the baseline heart rate variables, the number of increase in the basal heart rate of the fetus and the number of fetal movements were statistically significant among acupressure group. **EL Sayed and Mohamedy (2016)** reported that, the number of accelerations and number of fetal movements in left lateral position was significantly higher than supine and semi fowler positions. In addition, **Kaviani et al., (2016)** concluded a significant increase in fetal heartbeat accelerations during application of acupressure in the intervention group compared to the control group (P=0.019). However, according to the relevant literature, these resemblance of the previous results among the previous studies may be due to that uteroplacental perfusion and fetal heart rate patterns are optimized in the left lateral and semi-fowler positions (Jacob 2012). In addition, it seems that stimulation of Zhiyin point may lead to increase in fetal movement by activating adrenocortical of the fetus and thus improve the results of non-stress test. **(Pirhadi and Valian 2017)**

Although **Mucuk and Bülbül, (2021)** observed that, the number of accelerations was 5.0, 4.5, and 4 in the left lateral, semi-fowler and supine position respectively, they partially contradicted our study as they observed that, there were no significant differences of basal heart rate (p = 0.497) and reactivity time (p = 0.421). Based on the results of **Pirhadi and Valian, (2017),** who assessed effect of BL67 points stimulation on fetal heart rate parameters and fetal movements during non-stress test, they explained that, the mean baseline of fetus heart rate before and after the application of BL67 points stimulation was not significantly different. Also, **Samuel et al., (2015)** mentioned that sitting position was an effective mean for improving fetal physiological parameters like baseline fetal heart rate (p = 0.034) and acceleration (p=0.001) than lateral positions. According to **Mahboubeh et al., 2013**, who compared vibro-acoustic stimulation and acupressure effects in non-stress test results and its parameters among pregnant women, they mentioned that interventions on **Zhiyin** acupoint had no influence on the number of FHR accelerations. **Maneesha (2012)** exhibited that, there was no significant difference in the mean fetal heart rate, movement, and acceleration during non -stress test in the three different positions (lateral, sitting and supine). The disparity between the results of the current study and the results of the other studies could be explained by the different maternal positions used in each study and the inclusion criteria of the participants as in some of these studies, they included high risk mothers.

The present study revealed that, there was no statistically significant difference between the left lateral and combined group regarding non-stress test variability. This result is partially in harmony with **Ibrahim et al., (2021)**, who illustrated that, there is no significant difference between the three positions regarding FHR variability. However, this finding is contradicted to **Elsayed and Mohamady (2016)**,who found that all (100%) the women in left lateral position had average variability followed by semi fowler (98.6%) and finally supine (97.2%) positions. In addition, **Essa and Hafez, (2018)** mentioned that there was a statistically significant difference between the three positions, left lateral provided more fetal variability followed by semi fowler position in comparison with supine position. The difference between the current study results may be attributed to the study design's differences and sample technique.

Regarding non-stress test reactivity, the present study revealed that, there was a statistically significant difference between the left lateral and combined group, P= (0.047).

This result is partially in line with **Essa and Hafez** (2018) and **Elsayed and Mohamady,** (2016) who reported that incorporating left lateral position during non- stress test enhanced more non-stress reactivity than those placed in supine and semi-fowler's positions. **Kaviani et al, (2016)** found that, the application of acupressure on Zhiyin acupoint increased the accelerations of FHR and led to reactive NST results. On the other hand, the present study is dissimilar to the study of **Ibrahim et al., (2021),** they concluded that no statistically significant differences (P>0.05) were observed regarding NST reactivity in the three positions**. Kiratli et al., (2018)** studied the effect of different maternal positions on reactivity of the non-stress test, they didn't reveal a significant difference among the three groups. **Kaur et al., (2015)** did not observe significant difference in reactivity of NST between left lateral and sitting position. Also, **Mahboubeh et al., (2013)** reported that no significant difference in percentages of reactivation of NST in the vibro-acoustic and acupressure groups after intervention.

Regarding the maternal parameters, It is noteworthy to show statistically significant differences (P<0.05) between the two groups concerning maternal heart rate, systolic BP and diastolic BP. On the contrary, no significant difference was observed in the maternal respiratory rate (p= 0.668).This could be equipped with the fact that pregnant woman hemodynamics improved in response to different body positions such as left lateral position. As aortocaval compression occurs during supine position when the pregnant uterus exerts backwards force, thus causing a reduction in venous return, cardiac output and arterial blood pressure **(Humphries et al., 2019).**

In this context**, Ibrahim et al., (2021)**, asserted that left lateral and semi-fowler positions were associated with a more favorable maternal hemodynamic parameters. Eventually, **EL Sayed and Mohamedy (2016)** revealed that a highly statistically significant difference in maternal systolic blood pressure, diastolic blood pressure and pulse rate in left lateral and semi-fowler positions were more favorable and within normal range than in the supine position during the non-stress test. The previously mentioned study done by **Samuel R et.al (2015)** found that there were significant changes in maternal physiological parameters like maternal systolic (p=0.001), diastolic (p=0.001) blood pressure and pulse rate (p=0.001) between left lateral and sitting position. **Esin (2014)** recommended the lateral recumbent or semi-sitting positions during NST, especially for pregnant women after 32 weeks of pregnancy to avoid maternal supine hypotension and discomfort. In contrast, **Kiratli et al., (2018)** explained that maternal systolic and diastolic blood pressure levels between baseline and at 10 minutes were not significantly different (p>0.05) while maternal heart rate values were significantly different in semi fowler's than left lateral position (p=0.027).

## Conclusion

The present study results indicated that the left lateral position combined with Zhiyin point acupressure were associated with significant increase in baseline FHR, acceleration, fetal movement and non-stress test reactivity. The combined intervention also associated with significant difference in maternal physiological parameters related to heart rate, systolic and diastolic blood pressure.

## Recommendations

1. Application of Zhiyin point acupressure with left lateral position during non-stress test is recommended in prenatal clinics.
2. This study can be replicated on a bigger sample size to ensure that the findings are generalizable.

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