ORIGINAL RESEARCH ARTICLE

The effect of different positions during non-stress test on maternal hemodynamic parameters, satisfaction, and fetal cardiotocographic patterns

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Abstract

Maternal position is one of the most important factors to be considered during Non-Stress Test (NST). It should be a part of practice guidelines, where the appropriate maternal position reduces test-related errors and false-positive results. This study aimed to investigate the effect of different maternal positions during NST on maternal hemodynamic parameters, satisfaction, and fetal Cardiotocographic (CTG) pattern. A quasi-experimental research design was conducted at NST clinic, outpatient department/ Maternal and Children hospital at Najran city, Saudi Arabia. The study comprised a convenience sample of 118 low-risk pregnant women in their third trimester of pregnancy. Data was collected from January to June 2020. All women were assessed in the three different positions; supine, left lateral, and semi-fowler position concerning CTG pattern, maternal hemodynamic parameters, and satisfaction. The study results indicated a higher Fetal Heart Rate (FHR), increased accelerations, and fetal movement in the left lateral position, followed by a semi-fowler position compared to the supine position with statistically significant differences. No statistically significant differences (P>0.05) were observed regarding FHR variability and NST reactivity in the three positions. In addition, there were statistically significant differences (P<0.05) between the different maternal positions regarding maternal heart rate, systolic Blood pressure (BP), diastolic BP, and maternal satisfaction. The current study concluded that left lateral and semi-fowler positions were associated with a more favorable CTG pattern, maternal hemodynamic parameters, and satisfaction than the supine position. Left lateral and semi-fowler positions during the NST test should be standardized to reduce practical variations among health care providers, which, in turn, may reduce the need for unnecessary, expensive, and even hazardous interventions. *(Afr J Reprod Health 2021; 25[1]: 81-89).*

Keywords: Cardiotocographic Pattern, Hemodynamic Parameters, Non-Stress Test, Positions, Satisfaction

Résumé

La position de la mère est l'un des facteurs les plus importants à prendre en compte lors du test sans stress (NST). Cela devrait faire partie des directives de pratique, où la position maternelle appropriée réduit les erreurs liées aux tests et les résultats faussement positifs. Cette étude visait à étudier l'effet de différentes positions maternelles pendant le NST sur les paramètres hémodynamiques maternels, la satisfaction et le schéma cardiotocographique fœtal (CTG). Une conception de recherche quasi-expérimentale a été menée à la clinique du NST, au service de consultation externe / à l'hôpital maternel et infantile de la ville de Najran, en Arabie saoudite. L'étude comprenait un échantillon de convenance de 118 femmes enceintes à faible risque dans leur troisième trimestre de grossesse. Les données ont été recueillies de janvier à juin 2020. Toutes les femmes ont été évaluées dans les trois postes différents; position couchée, latérale gauche et semi-fowler concernant le schéma CTG, les paramètres hémodynamiques maternels et la satisfaction. Les résultats de l'étude ont indiqué une fréquence cardiaque fœtale (FCF) plus élevée, des accélérations accrues et des mouvements fœtaux en position latérale gauche, suivis d'une position semi-fowler par rapport à la position couchée avec des différences statistiquement significatives. Aucune différence statistiquement significative (P> 0,05) n'a été observée concernant la variabilité FHR et la réactivité du NST dans les trois positions. De plus, il y avait des différences statistiquement significatives (P <0,05) entre les différentes positions maternelles concernant la fréquence cardiaque maternelle, la tension artérielle systolique (TA), la TA diastolique et la satisfaction maternelle. L'étude actuelle a conclu que les positions latérales gauches et semi-fowler étaient associées à un modèle CTG plus favorable, des paramètres hémodynamiques maternels et une satisfaction que la position couchée. Les positions latérales gauche et semi-fowler pendant le test NST doivent être standardisées pour réduire les variations pratiques entre les prestataires de soins de santé, ce qui, à son tour, peut réduire le besoin d'interventions inutiles, coûteuses et même dangereuses. *(Afr J Reprod Health 2021; 25[1]: 81-89).*

Mots-clés: Schéma cardiotocographique, paramètres hémodynamiques, test sans stress, positions, satisfaction

Introduction

Although pregnancy is considered a normal biological event, 6-33% of pregnant women experience pregnancy complications. Some of these complications are related to the mother, fetus, or both. Pregnant women need to receive appropriate Antenatal Care (ANC) to promote maternal and fetal health[1,2]. ANC aims to detect and prevent potential problems that affect pregnancy. Based on the World Health Organization (WHO), ANC is "the care provided by health care professionals for pregnant women to ensure the better health status for the mothers and their fetus." ANC has a significant impact on maternal and fetal health by providing preventive and curative services[3]. Moreover, it has positive implications for fetal health, including reducing perinatal mortality rates and low birth weight through antenatal fetal surveillance[4].

The Non-Stress Test (NST) is considered one of the most effective methods for evaluating fetal well-being during the prenatal period by using an electric fetal monitor that continuously records the Fetal Heart Rate (FHR). It is a non-invasive, simple, and emergency diagnostic procedure that is easily interpreted. NST is an assessment tool that can be done in the third trimester of pregnancy and take about 20 to 45 minutes. It can be done in the outpatient clinic without any adverse effects for the mother and fetus[5,6].

Fetal heart rate acceleration during fetal movement is the most important feature of the NST test. NST recognize the association of the fetal neurological condition with cardiovascular reflex responses. FHR acceleration one of the factors that indicated the progressive fetal compromise when it disappeared from Cardiotocographic (CTG) recording. The NST interpretation follows a systematic approach that includes: baseline FHR, beat to beat variability, acceleration, and deceleration[7].

The interpretation of the NST is described as reactive or non-reactive. The reactive NST criteria are at least two FHR accelerations of 15 beats/minute above the baseline FHR and lasting at least 15 seconds. A healthy fetus has this acceleration every 20 to 30 minutes of active sleep and rarely takes more than one hour. If the NST is non-reactive, it should be repeated for another 20 minutes to distinguish whether the fetus is in a period of prolonged quiet sleep from fetal hypoxia[7,8].

Nemours studies reveal different results regarding maternal position during CTG. Aluş *et al.* conducted a randomized control trial to compare the effect of different maternal positions on CTG results. They examined CTG results in supine, left lateral, semi-fowler, and sitting position. They concluded that the supine position has the lowest non-reactivity on the CTG. Furthermore, it was associated with numerous discomforts such as breathing difficulties and back pain[9].

Moreover, Cito *et al.* evaluated NST results on different maternal positions. They investigated a 1055 NST for 368 pregnant women. They stated that the NST should be encouraged in the sitting position as the reactivity was more rapidly noted[10]. A recent study conducted by Essa and Hafez investigated the impact of three different maternal positions during CTG. They reported that the left lateral position during CTG had favorable results in CTG reactivity and mother comfort compared to supine and semi-fowler's position[11].

Significance of the study

Numerous factors contribute to false-positive results. Maternal position is one of the most important factors to be considered during NST. It should be a part of practice guidelines, where the appropriate maternal position reduces test-related errors and false-positive results. In most health centers, pregnant women are placed in a supine position during NST for reasons related to the ease of application. However, a supine position causes inferior vena cava compression that causes postural hypotension, interferes with fetal blood supply, and may lead to false non-reactive results. Consequently, inappropriate decisions may be taken regarding the mode and time of delivery[11]. Therefore, the current study was conducted to determine the optimal maternal position that can be used during NST without any adverse effects on the mother and her fetus, which contributes to reduce the rate of unnecessary interventions.

Aim of the study

The study aimed to investigate the effect of different maternal positions during non-stress test on maternal hemodynamic parameters, satisfaction, and fetal CTG pattern.

Research hypothesis

There are significant differences between different maternal positions (supine, left lateral, and semi-fowler position) during NST concerning maternal hemodynamic parameters, satisfaction, and fetal CTG pattern.

Methods

Operational definition

Maternal position in this study means the positions assumed during the NST procedure as supine, left lateral, and semi-fowler.

Study design and setting

A quasi-experimental research design was followed to conduct this study at NST clinic, outpatient department/ Maternal and Children hospital at Najran city, Saudi Arabia. The study comprised a convenience sample of 118 low-risk pregnant women in their third trimester of pregnancy.

The sample size was calculated using open Epi-info calculator version 3. The following parameters were used to calculate the sample size. two-sided significance level: 95%, power analysis: 80%, percent of unexposed with outcome: 5%, percent of exposed with outcome:25%, odds ratio: 6.3, risk/prevalence ratio: 5, and risk/prevalence difference: 20. The total sample size = 118.

Inclusion criteria

Gestational age 32 weeks or more, at 30 weeks of gestation, the fetus nervous system becomes completely developed, including the sympathetic and parasympathetic nervous system. Borsani *et al.* stated that the maturation of the fetus nervous system associated with fetal movement resulted in NST reactivity. Therefore, the current study included gestational age from 32 weeks and more[12].

Free from supine hypotensive syndrome precipitating factors (polyhydramnios, macrosomic baby, multiple pregnancy). Thus, blood return to the maternal heart will be decreased, resulted in supine hypotension. The placenta blood supply will be severely affected by supine hypotension and may influence NST reactivity. So, the current study excluded these cases[13,14].

Free from intrauterine growth retardation is assumed to be correlated with a delay in both sympathetic and parasympathetic maturation. This may result in discrepancies between the nervous system maturation and gestational age that affect NST reactivity[15].

Not in labor, free from any medical diseases, free from pregnancy-induced diseases, and accepting to participate in the study.

Data collection instruments

Data collection was done using the following instruments.

Instrument I: Socio-demographic and obstetric history interview schedule. It was developed by the researchers to collect socio-demographic data such as age, residence, educational level, marital condition. It also included data regarding obstetric history, such as gestational age, gravity, parity, number of antenatal visits, and medical history.

Instrument II: Non-stress test recording sheet. This sheet was printed by a cardiotocography machine, which contains a graphic presentation of the FHR corresponding to the fetal movement.

Instrument III: Cardiotocography interpretation sheet. The researchers developed this sheet after reviewing the relevant literature. It assessed the FHR baseline, acceleration, deceleration, and variability. It also included a part about the assessment if the FHR is reactive, uncertain reactive, or non-reactive. The CTG will be considered: *Reactive* if the baseline is normal (110-160 b/m), normal acceleration (around 15 b/m for 15 seconds), and at least two fetal movements in 20 minutes with long-term variability amplitude. *Non-reactive* if baseline may be within or outside the normal range, no acceleration, too long acceleration, or too high acceleration with no fetal movement, and absent or minimal variability. *Uncertain reactivity* if the FHR is abnormal, acceleration of lower than 15b/m.

Instrument IV: Maternal hemodynamic parameters assessment sheet. The researchers developed this part after reviewing the current literature. It was used to register the maternal pulse, systolic BP, diastolic BP, and respiration during the NST at different positions.

Instrument V: Visual analogue satisfaction scale: This scale consisted of a horizontal line scored from 1 to 10 and associated with a face picture reflecting facial expressions associated with different satisfaction degrees. On this scale, zero means extremely unsatisfied, one to lower than four means unsatisfied, four to lower than seven means neutral, seven to lower than ten means satisfied, and ten means extremely satisfied. The scale was adapted and translated into the Arabic language[16].

The researchers prepared the instruments; then, it was examined for content validity by a panel of 5 experts in maternity nursing and biostatistician. The instrument's items were scored on a 5-point Likert scale. Responses choices ranged from one (not relevant at all) to five (completely relevant). A reliability Instrument V conducted by Cronbach's alpha test (r= 0.875).

Data collection and analysis

A pilot study was carried out on 10% (12 women) to ascertain the tool's clarity and applicability then the necessary changes were undertaken. The data collection begins from January to June 2020. Each woman was interviewed individually to take informed consent, collect basic data, and explain the procedure. Then she was asked to evacuate the bladder to promote comfort and avoid interruptions during the procedure. The woman was helped to assume one of three positions (supine, left lateral, or semi-fowler) based on her preferences, then CTG was applied. Twenty minutes later, the position was changed. All women were assessed in the three different positions concerning CTG, maternal physiological parameters, and satisfaction. Data from CTG interpreted by the researchers using instrument III.

Data was entered into SPSS version 23 for investigation. Descriptive statistics were used to analyze data as number, percentage, mean, and stander deviation. Chi-square, Fisher exact, Monte Carlo, repeated ANOVA, and paired t-test were used to test differences between the three maternal positions (supine, left lateral, and semi-fowler). Test results are considered significant at 0.05.

Results

As shown in Table 1, the study participant demographic characteristics revealed that more than one-third (39.8) read and write, and only 3.4% of them had a university education. The majority of the study participants (86.4) were housewives. The mean age of the study participants was 31.05±12.20, and the mean BMI was 31.83±6.51. As regard obstetrics history, the mean gravidity, parity, abortion, and gestational period were 5.25±3.16, 3.63±2.86, 0.61±1.3, and 35.14±2.27, respectively.

CTG pattern and reactivity were elaborated in Table 2. It displayed statistically significant differences ($P<0.05$) in the mean baseline FHR, number of accelerations, and fetal movement throughout the repeated measures. This indicated higher FHR, increased accelerations, and fetal movement in the left lateral position followed by semi-fowler position.

Table 3 shows no statistically significant differences *($P>0.05$)* regarding FHR variability and NST reactivity using McNemar's test in the three positions.

Table 4 shows statistically significant differences ($P<0.05$) between the different maternal positions concerning maternal heart rate, systolic BP, diastolic BP, and maternal satisfaction. On the contrary, no significant difference was observed in the maternal respiratory rate ($F= 1.663$ $p= 0.258$).

Discussion

The responsibility of maternity nurses is to provide care with minimal discomfort for the mother and fetus. Fetal cardiotocography is a frequently used procedure to ensure fetal wellbeing. Routinely, it is performed in a supine position to help in the practical issue. Supine position is mostly associated with different maternal and fetal discomforts especially, after 32 weeks of gestation. In the supine position, the inferior vena cava is compressed between the heavy uterus, and the vertebral column resulted in decreasing blood return to the heart and, consequently, supine hypotension[17]. Furthermore, the supine position leads to a decrease in blood

Table 1: Demographic characteristics and obstetrical history (n= 118)

Demographic characteristics and obstetrical history	No(%)		
Education			
Illiterate	36(30.5)		
Read and write	47(39.8)		
Secondary education	31(26.3)		
University education	4(3.4)		
Occupation			
Working	16(13.6)		
Housewife	102(86.4)		
	(Mean±SD)	**CI 95%**	
		Lower	**Upper**
Age	31.05±12.20	28.8261	33.2756
Body mass index (BMI)	31.83±6.51	30.6497	33.0225
Gravidity	5.25±3.16	4.6698	5.8218
Parity	3.63±2.86	3.1135	4.1576
Abortion	0.61±1.3	0.4051	0.8153
Gestational age in weeks	35.14±2.27	34.7214	35.5498

Table 2: Comparisons of fetal CTG pattern during different maternal position (n= 118)

CTG pattern	Supine (Mean ±SD)	Left lateral (Mean ±SD)	Semi-fowler (Mean ±SD)	*F within subject effect*	*P*	*F within subject contrast*	*p*
Baseline FHR	130.03±10.59	139.12±127.16	132.40±11.96	*5.541*	*0.019**	*7.22*	*0.008 **
Number of accelerations	1.83± 0.68	2.18± 0.52	2.06± 0.58	*31.487*	*0.000**	*25.820*	*0.000**
Number of foetal movements	1.93±0.75	2.21±0.52	2.10±0.68	*32.084*	*0.000**	*6.543*	*0.012 **

F repeated measures ANOVA test * *significant at P<0.05*

Table 3: Comparisons of fetal CTG variability and reactivity during different maternal position (n= 118)

CTG variability and reactivity	Supine No (%)	Left lateral No (%)	Semi-fowler No (%)	*Mc Nemar*	*P*
FHR variability					
Absent	2 (1.7)	1 (0.8)	2 (1.7)		
Minimal	17 (14.4)	10 (8.5)	12 (10.2)	*4.103*	*0.663*
Moderate	93 (78.8)	104 (88.1)	100 (84.7)		
Marked	6 (5.1)	3 (2.5)	4 (3.4)		
NST Reactivity					
Reactive	110 (93.2)	115 (97.5)	114 (96.6)	*2.924*	*0.232*
Non-reactive	8 (6.8)	3 (2.5)	4 (3.4)		

McNemar's test

Table 4: Comparisons of maternal hemodynamic parameters and satisfaction during different position (n= 118)

Maternal hemodynamic parameters and satisfaction	Supine (Mean ±SD)	Left lateral (Mean ±SD)	Semi-fowler (Mean ±SD)	*F within subject effect*	*P*	*F within subject contrast*	*p*
Heart rate	87.16± 5.73	84.76± 6.26	83.33± 5.67	*14.411*	*0.001**	*12.197*	*0.001**
Systolic BP	113.89± 5.66	117.69± 6.99	114.55± 5.84	*22.773*	*0.000**	*1.525*	*0.219*
Diastolic BP	74.27±5.79	77.91±4.74	75.37±5.542	*23.889*	*0.000**	*5.982*	*0.015**
Respiratory rate	20.59± 1.14	20.14± 1.51	20.28± 1.38	*1.663*	*0.258*	*1.228*	*0.316*
Satisfaction scale	3.051±0.503	3.966±0.318	3.118±0.693	*97.987*	*0.000**	*0.693*	*0.406*

F repeated measures ANOVA test * *significant at P<0.05* supply to the fetus and may result in fetal distress. Therefore, different positions such as left lateral, semi-fowler, or sitting positions may be useful and more comfortable for both mother and fetus.

The present study results displayed statistically significant differences in the mean baseline FHR, number of accelerations, and fetal movement throughout the repeated measures. These results indicated a higher FHR, increased accelerations, and fetal movement in the left lateral position followed by semi-fowler position compared to the supine position. These findings may be attributed to changes in pregnant woman' positions and may provoke a response in the FHR. In the supine position, the inferior vena cava and pelvic veins compressed by the enlarged uterus lead to a decrease venous return, reduced uteroplacental perfusion, and a lower FHR. The result of the current study was in line with Essa and Hafez, who investigated the impact of different maternal positions on CTG patterns. They stated that almost all the study participants in semi-fowler and left lateral positions had a normal baseline FHR compared to 83.3% of the supine position group[11]. The differences between groups in their study were statistically significant. Bradycardia was recorded among 16.7% of the supine position group compared to non among semi-fowler and left lateral positions. They further added statistically significant differences between semi-fowler and left lateral positions compared to the supine position concerning FHR and number of fetal accelerations. Moreover, Stone *et al.* reported that although FHR increased in the supine position compared to the lateral position, it remains within the normal range. They further added that FHR variability significantly increased in the left lateral position compared to the supine and sitting positions. They further added that FHR variability did not differ from the left and right lateral position[18]. Also, EL Sayed and Mohamady conducted a quasi-experimental study to assess the effect of maternal positions during NST on maternal and fetal physiologic parameters. They reported a significant variance in the FHR baseline in semi-fowler and left lateral positions compared to the supine position. The mean FHR slightly increased in semi-fowler and left lateral positions than the supine position, although all positions were normal values[19]. In addition, Warland *et al.* conducted an experimental study on modifying maternal sleep position during the last trimester of pregnancy on the maternal and fetus hemodynamic parameters. The FHR monitored using CTG, and the mother's physiologic parameter was observed by digitalized high technological cameras. They concluded that maternal oxygen saturation significantly improved in the left lateral position compared to the supine position. They further added that the left lateral position was associated with lower oxygen desaturation and FHR deceleration[20]. On the contrary, Lucchini *et al*. reported that sleeping on a supine position does not affect FHR and pattern[21].

The current study results revealed that although there were no statistically significant differences between the three positions regarding FHR variability and NST reactivity, the moderate FHR variability was higher in the left lateral position followed by semi-fowler compared to the supine position. In this regard, Kiratli *et al.* conducted an experimental study on 243 pregnant women to examine the effects of different maternal positions on the NST reactivity and maternal vital signs. They found no statistically significant differences between the different maternal positions regarding FHR variability and NST reactivity[22]. Furthermore, no significant difference was observed in the NST reactivity between left-lateral position and sitting position by Kaur and Saha when they conducted a comparative study to evaluate the influence of different maternal positions on NST reactivity[23].

On the other hand, the previously mentioned Essa and Hafez study reported that one-third of the supine position group, compared to a small proportion of the semi-fowler and left lateral position groups had a lack of FHR variability. They also reported that variability of CTG was nearly the same among the semi-fowler and left lateral group but different from supine position groups[11]. The difference between the current study result and Essa and Hafez results may be attributed to the study design's differences. They conducted a true experimental design on three different groups, while the current study conducted a quasi-experimental design in only one group that examined in the three positions.

The present study's results indicated statistically significant differences in maternal physiological parameters in terms of maternal systolic and diastolic BP and heart rate in the three intergroup positions during the NST. The respiratory rate was only not found to be statistically different among the intergroup positions. The blood pressure and heart rate in the left lateral and the semi-Fowler positions were more favorable, although all three positions values were within the normal range. In fact, in late pregnancy, the large uterus can compress the inferior vena cava when a woman assumes the supine position, which leads to low blood pressure. So, placing a pregnant woman in the left lateral or semi-fowler positions during NST can relieve aortocaval compression symptoms, enhance blood circulation and heart rate within average values.

At least three other researchers supported the findings mentioned above. First, EL Sayed and Mohamady found statistically significant differences in maternal BP and heart rate in the supine, left lateral and semi-fowler positions during the NST. They also concluded that the left lateral and semi-fowler positions during NST in the third trimester of pregnancy have a favorable maternal physiological parameter than the supine position[19]. Second, Esin had investigated the factors that increase NST reactivity. She 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[24]. Third, Humphries *et al.* investigated the impact of supine position during the late pregnancy on maternal hemodynamic parameters. They elaborated that maternal venous and arterial blood flow were significantly altered in the supine position compared to the left lateral position. They explained their results with a Doppler investigation where inferior vena cava was significantly compressed in the supine position with an 85% reduction in renal veins' blood flow. The cardiac output was reduced by 16.4% and stroke volume by 23.9% compared to the left lateral position. Also, the aortic blood flow significantly decreased by 32.3% in the supine position[25]. These hemodynamic changes may justify the low blood pressure and high heartbeats in the present study participants during the supine position.

Lucchini *et al.* investigated the impact of different maternal positions during sleep on maternal heart rate and fetal ECG pattern. They studied 42 women in the 34 to 36 weeks of gestation. They reported that left-side sleeping was associated with lower maternal heart rate comparing to the supine position. They further added other significantly higher systolic and diastolic blood pressure when sleeping on the left lateral position than the supine position[21].

Maternal satisfaction and comfort during different obstetrical procedures is a fundamental issue for maternity nurses. Besides, maternal comfort and cooperation during NST may affect the accuracy of NST results. The present study results indicated that the left lateral position was the most comfortable during NST, followed by semi-fowler position compared to the supine position. The previously mentioned Essa and Hafez reported that semi-fowler and left lateral positions were associated with lower levels of discomfort than the supine position[11]. EL Sayed and Mohamady also pointed out that nearly two-thirds of their studied participants felt uncomfortable in the supine position compared to the semi-fowler and left lateral positions[19]. Moreover, Kaur and Saha demonstrated that around two-thirds of their participants reported that they were comfortable in the left lateral position during NST. Only one-quarter of them preferred a sitting position[23]. The results of the current study and the supported study group seem logical and congruent with pregnancy's physiological changes. Sleeping on left lateral or semi-fowler positions reduces the incidence and severity of supine hypotension and its associated symptoms. Consequently, pregnant women are more comfortable in the left lateral and semi-fowler positions than the supine.

Limitation

This was a quasi-experimental study because we take only one group to be rotated on the three maternal positions. It was better to be done as a randomized controlled clinical trial.

Ethical Consideration

An official permission was obtained from the deanship of scientific research, Najran University. Another formal letter was sent from the nursing college to the health affairs administration at Najran to get permission to carry out the study. An institutional review board log number 2020-29 E. Oral informed consent was taken from each woman before data collection. Women had the right to refuse participation or withdraw from the study at any time. Furthermore, all data was confidential and used for the research purpose only.

Conclusion

Left lateral and semi-fowler positions were associated with higher baseline FHR, number of accelerations, and fetal movement throughout the repeated measures without significant differences in FHR variability and NST reactivity. The two positions were also associated with lower maternal heart rate and higher systolic BP, diastolic BP, and maternal satisfaction compared to the supine position.

Recommendation and Clinical Implication

Left lateral and semi-fowler positions during NST should be standardized to reduce practical variations among health care providers. A simple protocol for NST application may be tailored to be followed by health care providers. Further researches about the effect of different NST positions is recommended, and its results need to be disseminated to health teams. The availability of such data may help to reduce inaccurate results of NST, which, in turn, may lead to needless, expensive, and even hazardous interventions.

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Consent for Publication

The authors have read and approved the publication of the manuscript in its current form.

Competing Interests

The authors declare they have no conflict of interest.

Contribution of Authors

Ibrahim conceived the initial idea, wrote the initial stage of the manuscript, and discussed findings. *Elgzar* collected data, and wrote the initial draft. *Saied* participated in statistical analysis and contributed to the scientific background. All authors agree on the current version of the manuscript.

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