Original Article

# Comparison of vibro-acoustic stimulation and acupressure effects in nonstress test results and its parameters in pregnant women

*Mahboubeh Valiani, Masoumeh Pirhadi[1], Zahra Shahshahan[2]*

## Abstract

**Background:** The primary goal of antenatal testing is to identify fetuses at risk of intrauterine neurologic injury or death so that these adverse outcomes can be prevented. We want to assess nonstress test (NST) results and some parameters before and after vibro-acoustic stimulation and acupressure. We did a randomized controlled clinical trial in Shahid-Beheshti Hospital in Isfahan in 2011.

**Materials and Methods:** A total of 64 pregnant women (32-36 weeks) in prenatal care unit were selected for vibro-acoustic stimulation ($n$ = 32) and acupressure ($n$ = 32) during the second NST. The statistical processing was performed by descriptive, paired $t$-test, analysis of variance (ANOVA), chi-square, and McNemar test through SPSS version 20.

**Results:** The mean baseline fetal heart rate (FHR) in vibro-acoustic and acupressure groups before and after stimulations did not differ significantly. The mean time of first acceleration in vibro-acoustic group was decreased after stimulations significantly, but in the acupressure group it did not differ statistically. The numbers of accelerations in both groups did not differ significantly before and after stimulation. The mean time of second acceleration in the vibro-acoustic group was 6.7 min before stimulation and 3.9 min after stimulation. This decrease was significant. The mean time of second acceleration after stimulation was lower than before significantly in the acupressure group. The frequency of reactive NST was same in both groups, before and after stimulation.

**Conclusion:** Vibro-acoustic stimulation and acupressure of acupoint BL67 did not change FHR parameters but they could decrease the time of reactive result of NST.

**Key words:** Acoustic stimulation, Acupressure, fetal monitoring, Iran

## Introduction

One of the valuable blessings of God to humans is the physical and mental health. Every mother wishes to have a healthy child. Physical and mental health are guaranteed based an obedience of health principles and receiving the needed prepartum and intrapartum care.[1] The first goal of prenatal assessment of fetal health is detection of the fetuses, predisposed to fetal neuronal defects, and fetal death, although these miserable outcomes can be prevented to some extends.[2] Based on some researches, electronic fetal monitoring may not lead to a significant reduction in risk of prenatal death compared with periodical cardiotocography.[3] Meanwhile, Chen *et al.* concluded that early neonatal mortality was significantly less in deliveries of electronic fetal monitoring group compared with the group with no electronic fetal monitoring.[4]

As a rule, fetal heart rate (FHR) and movements are among primary techniques of prenatal assessment of fetal health. Therefore, one of the primary tests used for FHR and movements, or in other words, fetal health is nonstress test (NST), which assesses the amount of fetal movements as well as FHR pattern. Most of the time, normal report or reactive test result is significantly reliable. This result means that fetal death may rarely occur within a week after normal report of this test.[5] Freeman *et al.* in a study on 1542 women who underwent NST weekly, reported its false negative reports as 109 out of 1000. In contrast, reported false positive rate of the NST vary widely, with an average rate of 50% of the cases. Currently, NST is the most applied primary method of prenatal health assessment. It is usually used as a screening test, and if its result is nonreactive (abnormal), other complementary tests such as contraction

Midwifery Department, Nursing and midwifery care research center, School of Nursing and Midwifery, Isfahan University of Medical Sciences, Isfahan, [1]School of Nursing and Midwifery, Isfahan University of Medical Sciences, Isfahan, [2]Obstetrics and Gynecology Department, Medical School, Isfahan University of Medical Sciences, Isfahan, Iran.

**Address for correspondence:** Dr. Valiani Mahboubeh, Department of Midwifery, Faculty Member, School of Nursing and Midwifery, Isfahan University of Medical Sciences, Isfahan, Iran.
E-mail: valiani@nm.mui.ac.ir

stress test or biophysical profile test are conducted.[6]

As NST is a convenient noninvasive method, less costly than other tests, and does not need uterine contraction,[7] it is often used as the first choice for fetal health and survival assessment.[8] Since mothers' referrals for other tests and interventions is based on NST results, achieving methods for possible increase of its diagnostic power concerning reactive (normal) reports, and the chance to lower its needed time seems appropriate and essential. Various methods have been suggested to lower its false positive results including fetus shaking, making the test time longer, fetal acoustic stimulation before the test and mothers' positioning during the test.[9] Annunziata *et al.* reported that vibro-acoustic stimulations increased FHR responses, but had no effect on fetal basic heart rate.[10] Another study showed that vibro-acoustic stimulation leads to shorter NST time and reduced the time of the first FHR response.[11] Cardini showed that stimulation of acupoint BL67 with moxibustion led to increased fetal movements.[12] Neri in another study showed that stimulation of acupoint BL67 throng acupuncture led to a reduction in fetal basic heart rate while it increased the number of accelerations of FHR.[13] Based on this important finding, FHR responses to external stimulation has the same value of spontaneous predictive responses.[14]

Therefore, usage of vibro-acoustic external stimulation and acupressure to speed up and facilitate the obtained results of NST and possible reduction of human resources working time seems logical. This study aimed to compare two nonmedicational methods of vibro-acoustic stimulation and acupressure to assess cost effective and less time consuming methods compared with conventional NST in order to obtain better results.

## Materials and Methods

This is a two group, two-step clinical trial. The research environment was Shahid Beheshti gynecology center in Isfahan, Iran. The subjects were selected through convenient random allocation sampling during September 2011 to June 2012 in the clinic of Shahid Beheshti Hospital. The researcher invited pregnant women, referring to the clinic and meeting inclusion criteria, to attend the study. She explained about the goals and methods of the study, the reason for the selection of interventional method, as well as a complete details of these methods to the volunteers, and if yet, they decided to attend the study, an informed written consent together with their personal information were obtained from them by the researcher in the form of a questionnaire. The subjects were then randomly divided into two groups of vibro-acoustic stimulation and acupressure. The data of the present study were qualitative (nominal, ordinal) and quantitative (discrete and continuous variables) and were collected by a two-section questionnaire whose first section included demographic characteristics, and the second contained a specific questionnaire comprising 10 questions on existing data of fetus's electrocardiogram (ECG). Sixty-four pregnant mothers attended the present study. Inclusion criteria were age between 18 and 35 years, being primipara, 32-36 weeks of gestational age, single tone pregnancy, no history of infertility, not using assisted conception techniques, history of regular referrals to health care centers or private clinics to receive maternal care, no involvement in any diseases or maternal disorders, not smoking cigarette, cigar and/or taking any medications, having a meal 2-4 h before conducting NST and having at least 50 min free time. In order to assign the subjects randomly to two groups, envelop number method was used so that the mothers were asked to select a closed envelope containing the number of the interventional group. Number one was assigned to vibro-acoustic group and number two was assigned to acupressure group. The researcher conducted NST on the subjects after they were randomly assigned to two groups. Before the test started, the researcher made sure that all subjects had voided their bladders so not to leave the bed during test. Before conducting any intervention, NST was taken and recorded from all subjects for 20 min in left lateral position. After taking primary NST, the mothers were asked to sit on the bed for 5 min and drink a glass of cold water if they liked. After a short test, they were asked to lie on their left side, and the researcher detected fetal head position by Leopold maneuver in all mothers (to have an identical abdomen skin stimulation effect in all mothers). Then, after putting the prob of the device on mothers' abdomen and detection of correct fetal heart location, concurrent with start of fetal monitoring device recording, the intervention was conducted. The intervention in vibro-acoustic stimulation group was conducted in the way that the researcher put a diapason (128 c) directly on mothers' abdomen skin on the central line, under the umbilicus and vibrated that for 3 s by a diapason hammer. The response to this stimulation was counted as a normal response when acceleration of FHR by at least 15 pulses/min, lasting at least for 15 s occurring within 15 s poststimulation accompanied with significant fetal movements. In case of no response within the first 15 s after stimulation, the researcher repeated stimulation for up to three times (each time for 3 s). NST in the vibroacoustic stimulation group, lasted for a total of 20 min. In the acupressure group, the researcher asked the mothers to sit on the bed in their resting time after the first NST and while leaning back to avoid their waist tiredness, they were asked to stretch out their legs in front of the researcher. The researcher sat on a chair in front of the mothers' legs and with mothers' toes in complete access, stimulation acupoint

BL67 in external surface of the third knuckle of mothers' little toes in both feet (nail root). The researcher pressured this point for at least 2 min so that the third anterior knuckle of the researcher's thumb went pale. After 5 min, the researcher stimulated the same point by pressure for 2 min. The researcher, in a pilot study on 10 pregnant mothers to assess the length of time and number of repetitions of BL67 acupoint stimulation, found out that stimulation of this point should be conducted twice, each for 2 min, with a 5-min interval. Just after the end of stimulation, the researcher conducted the second NST on the mothers and recorded the result. Then, 20 min after the second NST, the researcher dispatched the prob of the device from the mother. In case of any sudden disturbance in fetal or mother's health, or in case of recording any doubtful interpretation of the results or components of NST, or lack of subjects' interest to keep on cooperation, the subjects were excluded from the study. The researcher analyzed the obtained data of NST, recorded in the questionnaire including basic FHR, numbers of FHR accelerations, the time of the first acceleration, reactivity o fetal NST, and the time passed until the second FHR acceleration. The subjects' personal information were analyzed by descriptive (mean and SD) and analytical statistical tests (one-way analysis of variance [ANOVA], chi-square, paired *t*-test, and McNnemar test) through SPSS version 20 (IBM manufactured).

*P*-value < 0.05 was considered significant for all statistical tests results.

## Results

Mothers' age in vibro-acoustic and acupressure groups ranged 21-32 and 20-30 years, respectively. Mean (SD) age of the subjects in vibro-acoustic and acupressure groups were 25.5 (2.6) years and 24.7 (2.8), respectively. In the vibro-acoustic group, 28.1% of the mothers had middle school education, 46.9% high school education, and 25% higher education. In the acupressure group, 6.2% of the mothers had primary school education, 28.1% middle school education, 46.9% high school education, and 18.8% higher education. Based on the findings, presented in Table 1, mean fetal basic heart rate in vibro-acoustic and acupressure groups had no significant difference before intervention, which shows almost similar fetal basic heart rate in both groups.

**Table 1: Mean basic fetal heart rate in both groups before and after intervention**

| Basic fetal heart rate group | Before intervention | | After intervention | | Paired *t*-test | |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | *T* | *P* |
| Vibro-acoustic stimulation | 140.3 | 6.3 | 140.1 | 6.1 | 0.01 | 0.98 |
| Acupressure | 142.2 | 7.1 | 142.5 | 6.7 | 0.21 | 0.83 |
| ANOVA | *F*=0.46 | | *F*=1.62 | | | |
| | *P*-value =0.63 | | *P*-value=0.2 | | | |

After intervention, comparison of fetal basic heart rates in both groups through ANOVA test showed no difference. The findings showed that mean (SD) time of the first increase in FHR before intervention in the vibro-acoustic group was 4.01 (3.8) min. Based on the obtained results, the shortest and the longest time to the first acceleration in FHR were 0.3 and 15.2 min, respectively. In addition, mean (SD) time of the first acceleration in FHR in the acupressure group was 4.9 (5.6) min before intervention. The shortest and the longest time to the first acceleration in FHR were 0.4 and 10.6 min, respectively. In the vibro-acoustic group, mean (SD) time to the first acceleration in FHR was 1.5 (1.2) min after intervention. The shortest and the longest time to the first acceleration in FHR were 0.2 and 5.0 min, respectively. In the acupressure group, mean (SD) time to the first acceleration was 3.1 (5.5) min after intervention. In addition, the shortest and the longest time to the first acceleration were 0.3 and 19.8 min, respectively.

Paired *t*-test showed a significant difference in mean time to the first acceleration in FHR before and after intervention ($P = 0.00$), which means that vibro-acoustic stimulation leads to an earlier and faster acceleration in FHR compared with the subjects with no stimulation. Nevertheless, in the acupressure group, there was no significant difference in mean time to the acceleration before and after intervention ($P = 0.14$), which showed that stimulation of acupoint BL-67 had no effect on the time of the first acceleration in FHR.

The findings showed no significant difference in mean time to the first acceleration in both groups before intervention ($P = 0.75$).

One-way ANOVA showed no significant difference in mean time interval to the first acceleration in both vibro-acoustic and acupressure groups after intervention ($P = 0.24$). The findings showed that mean (SD) of FHR acceleration number before intervention in the vibro-acoustic group was 6.4 (2.7) with the lowest and the highest recorded numbers of 2-11.

In the acupressure group, mean (SD) of FHR acceleration number was 5.3 (2.9) with the lowest and the highest numbers of 0-11.

After intervention, in the vibro-acoustic group, mean (SD) number of accelerations in FHR was 7 (2.8) with the lowest and highest numbers of 3-13. Mean (SD) number of

**Table 2: Frequency distribution of fetal nonstress test reactive result in both groups before and after intervention**

| Group | Before intervention | | | | After intervention | | | | McNemar test *P*-value |
|---|---|---|---|---|---|---|---|---|---|
| | Reactive | | Nonreactive | | Reactive | | Nonreactive | | |
| | *N* | % | *N* | % | *N* | % | *N* | % | |
| Vibro-acoustic stimulation | 32 | 100 | 0 | 0.0 | 32 | 100 | 0 | 0.0 | 1 |
| Acupressure | 30 | 93.8 | 2 | 6.2 | 29 | 90.6 | 3 | 9.4 | 0.92 |
| Chi-square | *P*-value=0.054 Chi-square =5.8 | | | | *P*-value=0.16 Chi-square =3.6 | | | | |

**Table 3: Mean time of onset of the second acceleration in fetal heart rate in both groups before and after intervention**

| Onset of the second acceleration group | Before intervention | | After intervention | | Paired *t*-test | |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | *T* | *P* |
| Vibro-acoustic stimulation | 6.7 | 4.5 | 3.9 | 1.7 | 3.1 | 0.004 |
| Acupressure | 8.5 | 5.5 | 5.8 | 5.9 | 2.05 | 0.048 |
| ANOVA | *F*=1.1 | | *F*=1.5 | | | |
| | *P*-value =0.33 | | *P*-value=0.22 | | | |

accelerations in FHR after intervention was 6.2 (3.3) in the acupressure group with the lowest and the highest numbers of 0-15. Paired *t*-test showed no significant difference in mean number of accelerations in FHR before and after intervention in vibro-acoustic group ($P = 0.32$). This test showed no significant difference in mean number of accelerations in FHR before and after intervention ($P = 0.2$). One-way ANOVA showed no significant difference in mean number of accelerations in FHR in both the vibro-acoustic stimulation and acupressure groups before intervention ($P = 0.33$). After intervention, mean number of accelerations in FHR in both the groups showed no significant difference ($P = 0.58$). Based on the obtained results, in Table 2, there was no significant difference in percentages of reactivation of NST in both the groups before intervention. There was also no significant difference in percentages of reactivation of NST in the vibro-acoustic and acupressure groups after intervention.

Based on the findings, presented in Table 3, one-way ANOVA showed no significant difference in mean spent time to the second accelerations in FHR in both the groups before and also after intervention ($P = 0.33$). Comparison of mean spent time to the second acceleration in FHR in both the vibro-acoustic stimulation and acupressure groups showed no significant difference ($P = 0.22$).

## Discussion

Some researchers concluded that there was a significant association and correlation between FHR and fetal behavioral states.[15] Some other went further and hypothesized that the difference in fetus gender (female or male) can affect its heart rate responses to vibro-acoustic stimulation.[16] The obtained results of the present study showed no significant difference in mean basic FHR after interventions of vibro-acoustic stimulation and/or acupressure. Annunziata *et al.* claimed that basic FHR remained unchanged after vibro-acoustic stimulation.[10] Jeong *et al.* reported that mean basic FHR in NST significantly decreased by increase of gestational age while it remained steady with no significant difference by vibro-acoustic stimulation before and after intervention.[14] Hofmeyr *et al.* showed that mean basic FHR was 137.14 before vibro-acoustic stimulation and was calculated as 137.33 with no change after vibro-acoustic stimulation by tapping on a metal box,[17] which is consistent with the findings of the present study. Neri *et al.*[18] through a paired *t*-test, concluded that acupuncture stimulation accompanied with moxibustion (burning herbals for warming up and stimulation of acupoint) could diminish basic FHR while each of these alone had no effect on basic FHR. Meanwhile, Neri *et al.*[13] observed a significant reduction in basic FHR during stimulating acupoint BL67. Guittier *et al.* concluded that mothers' blood pressure (BP) investigation and analysis of fetuses' ECGs taken 10 min before stimulation, 20 min during intervention, and 10 min after stimulation showed that all items in the ECGs were normal and no unexpected complication accrued in the mother and her fetus during moxibustion.[19] Based on this finding, the researcher believes that according to the results of various researches on the effect of BL67 acupoint stimulation on fetal cardiac and psychomotor parameters and the safety of this stimulation, an investigation on this method to obtain better results seems helpful. It seems that due to the vast range of basic FHR in the acupressure group and due to calculation of standard deviation of mean difference of basic FHR before and after intervention as 8.2, paired *t*-test logically could not yield significant differences. In the present study, the results showed that intervention in both the groups did not lead to significant changes in the number of FHR accelerations. Jyn Hoh argues that vibro-acoustic stimulation for 1 second, evidence-based, lead to acceleration of FHR and potentially result in a reduction of total test time.[14] D'Eliaa *et al.* reported that vibro-acoustic stimulation significantly increased

fetal health assessment parameters including number of FHR accelerations to more than 10-15 pulses/min.[20] Cardini *et al*. concluded that mean number of fetal movements was more in acupoint BL67 stimulation group compared with control group.[12]

The researchers reported that the interventions, conducted on acupoint BL67, had no effect on the number of accelerations of FHR.[18] In contrast, Neri and Fazzio observed a significant increase in the number of FHR accelerations during acupuncture with stimulation of BL67 acupoint.[13] Bartnicki and Dudenhausen reported that vibro-acoustic stimulation in fetuses with reduction of heart rate changeability pattern significantly enhanced the number of FHR accelerations and resulted in short-term and long-term increases.[21] With regard to conducting this study on healthy mothers of normal fetuses with a normal growth pattern and relatively high and close numbers of FHR accelerations before and after intervention, no significant difference was seen between acceleration numbers means. Indeed, conducting such a study on mothers of fetuses with reduction of FHR changeability or any other complications yields different results before and after intervention. The researcher found no significant difference concerning the percentage of reactivity of NST before and after intervention in both the vibro-acoustic stimulation and acupressure groups.

All subjects in the vibro-acoustic stimulation group and over 90% of the subjects in the acupressure group had a reactive test response before and after intervention. Hence, McNemar test revealed no difference before and after intervention. The researcher believes that reactive response in almost all NST results before intervention led to inability to reveal the possible effect of intervention. XiQ *et al*. could increase the level of reactive test results from 29.5% to 92.3% through acoustic stimulation (clapping hands over fetus head) and concluded that NST with acoustic stimulation is a reliable, quick, safe, and efficient method to detect false nonreactive results of the test, and this method could increase specification of NST.[22]

Park *et al*.[23] observed three cases of false reactive test results after vibro-acoustic stimulation.

In other words, the number of a false reactive test result (false negative result) in study group of vibro-acoustic stimulation and control group was 3/16 and 1/16, respectively, but the difference was not statistically significant. It seems that in cases of sever fetal neural disorders, application of vibro-acoustic stimulation can be accompanied with false negative NST results. Batcha and Goonewardene concluded that conducting a NST with acoustic stimulation has less sensibility ($P = 0.00$) and more specificity ($P = 0.00$) compared with the test without stimulation.[24] The positive predictability value of the result in a NST with acoustic stimulation was higher compared with the test without stimulation ($P = 0.02$) and test accuracy increased with help of acoustic stimulation ($P = 0.03$). With regard to negative predictability value, both methods have been similar ($P > 0.05$). These researches also concluded that fetal acoustic stimulation significantly reduced false nonreactive results and had an acceptable positive predictability. Piyamongkol *et al*. concluded that manual fetal stimulation during the test in 270 subjects in study group led to more reactive results of NST compared with a standard NST (with no stimulation). In other words, mean (SD) of the least time of conducting test in stimulation group was 7.94 (6.27) min compared with 13.91 (9.58) min in control group ($P < 0.001$).[25] The researcher believes that with regard to the fact that manual stimulation on mother's abdomen can lead to fetal stimulation and its encouragement for a cardiovascular and psychomotor response, intervention with more direct effects on the fetus may also reduce the test time and lead to a reactive test result.

Bolnik *et al*. stated that in vibro-acoustic stimulation group, mean time of the first acceleration (2.6 min) was reduced compared with control group ($P < 0.01$). They also reported that the mean spent time up to reactive result of NST (onset of the second acceleration) got 2.4 min shorter due to vibro-acoustic stimulation compared with before stimulation[11] ($P < 0.05$). In the present study, although intervention in the vibro-acoustic stimulation group led to the reduced time of the first acceleration in FHR compared with before stimulation, Comparison of these two methods showed that there was no significant difference in mean time of the first acceleration in FHR after intervention. As discussed earlier, although conducting the intervention in both the groups led to a significant shorter test time, comparison of these methods with each other showed no preferability concerning their application.

## Conclusion

Although fetal NST with vibro-acoustic stimulation and/or acupressure showed no change in most of the parameters studied, it has been effective on achieving the goal of reducing the total NST time and attaining at least two accelerations in FHR in a shorter time. With regard to the low number of studies conducted in this regard, the researcher hopes that a documented study may be conducted on this issue in the future, and suggests conducting these interventions or similar actions in high risk pregnancies as well as those with abnormal growth in order to evaluate and compare the effects of these interventions in abnormal cases also.

## References


1. Sarafraz N, Montazeri S, Saadati N, Latifi M. Effect of Glucose in NST parameters. Iran J Obstet Gynecol 1389;21:13-25.
2. Signore C. Spong Catherine. Overview of fetal assessment. c2010. Available from: http://www.uptodate.com/contents/overview-of-fetal-assessment/2010.[Last accessed on 2013 Feb 14].
3. Alfirevic Z, Devane D, Gyte GM. Continuous cardiotocography (CTG) as a form of electronic fetal monitoring (EFM) for fetal assessment during labour. c2006. Available from: http://www.uptodate.com/contents.[Last accessed on 2013 Feb 14].
4. Chen HY, Chauhan SP, Ananth CV. Electronic fetal heart rate monitoring and its relationship to neonatal and infant mortality in the United States. Am J Obstet Gynecol 2011;204:491.e1-10.
5. Cunningham FG, Leveno KJ, Bloom SL, Hauth JC, Rouse DJ, Spong CY. Antepartum Assessment. Williams Obstetrics. 23th ed. New York City: Mc Graw Hill; 2010. p. 334-48.
6. Spong CY. Assessment of fetal Well-being. In: Gibbs R, Karlan B, editors. Danforths Obstetrics and Gynecology. 10th ed. Philadelphia: Lippincott Williams and Wilkins; 2008. p. 160-1.
7. Pillitteri A. Maternal and child health nursing: Care of the childbearing and childrearing family. 5th ed. Philladelphia: Lippincott Williams and Wilkins; 2007. p. 203-4.
8. Farley D, Dudley DJ. Fetal assessment during pregnancy. Pediatr Clin North Am 2009;56:489-504.
9. Murray SS, Mc Kinney ES. Foundations of maternal-newborne nursing. 4th ed. St Louis: Saunders; 2006. p. 213-5.
10. Annunziata ML, Scala M, Giuliano N, Tagliaferri S, Imperato OC, Esposito FG, *et al*. Fetal vibroacoustic stimulation in computerized cardiotocographic analysis: The role of short-term variability and approximate entropy. J Pregnancy 2012;2012:7.
11. Bolnick JM, Garcia G, Fletcher BG, Rayburn WF. Cross-over trial of fetal heart rate response to halogen light and vibroacoustic stimulation. J Matern Fetal Neonatal Med 2006;19:215-9.
12. Cardini F, Weixin H. Moxibustion for Correction of Breech Presentation. JAMA 1998;280:1580-4.
13. Neri I, Fazzio M, Menghini S, Volpe A, Facchinetti F. Non-stress test changes during acupuncture plus moxibustion on BL67 point in breech presentation. J Soc Gynecol lnvest 2002;9:158-62.
14. Hoh JK, Park YS, Cha KJ, Park MI. Fetal heart rate after vibroacoustic stimulation. Int J Gynaecol Obstet 2009;106:14-8.
15. Gonçalves H, Bernardes J, Rocha AP, Ayres-de-Campos D. Linear and nonlinear analysis of heart rate patterns associated with fetal behavioral states in the antepartum period. Early Hum Dev 2007;83:585-91.
16. Bernardes J, Gonçalves H, Ayres-de-Campos D, Rocha AP. Linear and complex heart rate dynamics vary with sex in relation to fetal behavioural states. Early Hum Dev 2008;84:433-9.
17. Hofmeyr GJ, Lawrie TA, de Jager M, da Ponte A. Fetal vibro-acoustic stimulation with a can-a clinical study. Afr Med J 1998;88:199-203.
18. Neri I, De Pace V, Venturini P, Facchinetti F. Effects of three different stimulations (acupuncture, moxibustion, acupuncture plus moxibustion) of BL.67 acupoint at small toe on fetal behavior of breech presentation. Am J Chin Med 2007;35:27-33.
19. Guittier MJ, Klein TJ, Dong H, Andreoli N, Irion O, Boulvain M. Side-effects of moxibustion for cephalic version of breech presentation. J Altern Complement Med 2008;14:1231-3.
20. D'Eliaa A. Vibroacoustic stimulation in normal term human pregnancy. Early Hum Dev 2005;81:449-53.
21. Bartnicki J, Dudenhausen JW. Antepartum vibroacoustic stimulation in patients with low fetal heart rate variability. Int J Gynaecol Obstet 1995;48:173-7.
22. Xi Q, Du J, Liu X, Shao L. Clinical study on detecting false non-reactive of non-stress test by improved acoustic stimulation. Arch Gynecol Obstet 2011;284:271-4.
23. Park YJ, Park SH, Kim YJ, Hoh JK, Park YS, Park MI. Computerized fetal heart rate monitoring after vibroacoustic stimulation in the anencephalic fetus. Early Hum Dev 2010;86:569-72.
24. Piyamongkol W, Trungtawatchai S, Chanprapaph P, Tongsong T. Comparison of the manual stimulation test and the nonstress test: A randomized controlled trial. J Med Assoc Thai 2006;89:1999-2002.
25. Batcha TM, Goonewardene IM. The fetal acoustic stimulation test: A reliable and cost effective method of antepartum fetal monitoring. Ceylon Med J 2005;50:156-9.


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