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**Original Research Article**

# Evaluation of non-stress test as predictor of perinatal outcome in high risk and low risk pregnancy: a prospective study

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## ABSTRACT

**Background:** NST is simple, cheap, non-harmful, easily repeated, and cost effective with low maintenance profile. NST is a very effective method to investigating the intrauterine growth retardation (IUGR), late pregnancy, premature birth, multiple pregnancy, Rh sensitivity, diabetes, liver disease, decreased bowel movements, oligohydramnios etc. Objectives were to evaluate the efficacy and role of antenatal NST in improving perinatal outcome in high-risk pregnancies.
**Methods:** This prospective study was done among 100 pregnant women (group A: high risk pregnancy, n=50, group B: low risk pregnancy, n=50). Nonstress test was done for 20 minutes if the test was inconclusive or nonreactive. It was continued for another 20 minutes extended CTG. Fetal stimulation was also done. The NST done before onset of labour was used as reference. Interpretation if NST tracings was done according to ACOG guideline.
**Results:** Around 58% participants of high-risk group and 82% of low-risk group had 'reactive' and NST tracings respectively. Almost 36% participants of high-risk group and 16% of low-risk group were delivered baby by LSCS method. Around 24% participants of high-risk group and 10% of low-risk group had meconium-stained amniotic fluid. Around 66% babies of participants of high-risk group and 24% of low-risk group were admitted in NICU. The mean birth weight of babies of high-risk group participants was 2.52 kg and of low-risk group participants was 2.85 kg.
**Conclusions:** Present study reveals significant difference between reactive and nonreactive NST in terms of Apgar scores and NICU admissions in both the groups. Hence judicious use of NST will certainly help in timely identification of at-risk fetuses thereby avoiding unnecessary delay in intervention.

**Keywords:** Bio-physical profile, High risk pregnancy, Non-stress test (NST), Perinatal outcome

## INTRODUCTION

In present era antenatal fetal surveillance is gaining popularity and importance in order to get a successful outcome in high-risk pregnancy cases. About 8,90,000 perinatal deaths occur annually in India alone. Improvement in perinatal care in the last two decades has resulted in a dramatic decrease in perinatal mortality and morbidity. These advances include improvement in technological aspect of NICU and better fetal surveillance methods. Antepartum evaluation of the fetus at risk for damage or death in utero remains a major challenge in modern obstetrics and is an integral part of antenatal care.[1,2]

Every woman considering becoming a mother hope that by the end of her pregnancy she will produce healthy offspring that will live to their full physical and mental potential.

Fetal health assessment is done by various biophysical and biochemical methods. However, the issues with sample collection, accuracy and laboratory testing, and the need for staff to perform biochemical fetal analysis methods are no better than biophysical methods.[3]

Antenatal nonstress test is the assessment of fetal well-being in utero before the onset of labour. The risk of stillbirth increases in the last weeks of pregnancy. It facilitates early detection of fetuses at risk, so timely management can prevent further damage and thus reduce perinatal morbidity/mortality.[4] NST is considered as a good predictor of fetal health and is recommended after 32 weeks of pregnancy. Prenatal Non stress test is also a component of Biophysical profile.[5]

The stress-free test is the most widely used test to assess fetal health and demonstrate brain oxygenation. Fetal movements during testing are identified by maternal perception and are recorded. NST is based on the assumption that non-acidic, non-pulsating heart rate increases transiently with fetal movements. The fetal heart rate normally is increased or decreased by autonomic influences mediated by sympathetic or parasympathetic impulses from brain stem centres. Beat to Beat variability is under control of autonomic nervous system. Heart rate reactivity is believed to be a good indicator of normal fetal autonomic function. Consequently, pathological loss of acceleration may be seen in conjunction with significantly decreased beat to beat variability and fetal heart rate. 'NST at admission' at ≥32 weeks of gestation is one such non-invasive technique by which 20 to 40 minutes of external fetal monitoring is used as a screening test to identify the time and mode of intervention according to its reactivity.[6-8]

NST is a very effective method to investigating the intrauterine growth retardation (IUGR), late pregnancy, premature birth, multiple pregnancy, Rh sensitivity, diabetes, liver disease, decreased bowel movements, oligohydramnios etc.[9]

So, the present study was conducted with the objectives to evaluate the efficacy and role of antenatal NST in improving perinatal outcome in high-risk pregnancies.

## METHODS

This prospective study was done among 100 pregnant women registered at the obstetrics and gynecology department of Pacific Medical College and Hospital, Udaipur during January 2021-June 2022 (18 months). These 100 pregnant women divided into two groups: group A: high risk pregnancy, n=50, group B: low risk pregnancy, n=50. High risk pregnancy is identified as pregnancy in which there is a risk of adverse outcome in the mother and/or baby that is greater than the incidence of that outcome in general population. Low risk pregnancies were all pregnant women ≥37 weeks gestation without any risk factor. Data collection was done after ethical permission from institutional ethical committee and informed consent of clients. Pre-tested questionnaire was administered and details like socio-demographic information, past history of medical illness, menstrual history, obstetrical history, history of previous operation, medical illness was collected.

### *Inclusion criteria*

Inclusion criteria was high-risk pregnant women with gestational age ≥34 weeks, anaemia, maternal thyroid disorder, diabetes, renal disease, chronic hypertension, o elderly primigravida (>30 years), pre-eclampsia requiring delivery before 34 weeks' gestation, previous pre-eclampsia or gestational hypertension with delivery after 34 weeks' gestation, spontaneous premature delivery, low birth weight, previous abruption, previous placenta previa, previous LSCS, previous stillbirth/early-neonatal death, previous two miscarriage or induced abortion, history of decreased fetal movements, intrauterine growth restriction, Rh-isoimmunisation, willing to give informed written consent to participate in present study.

### *Exclusion criteria*

Exclusion criteria was pre/postnatal diagnosis of a fetal chromosomal or structural abnormality, women with multiple gestation, women with uterine malformation, women with gestational age <34 weeks.

Nonstress test was done for 20 minutes if the test was inconclusive or nonreactive. It was continued for another 20 minutes extended CTG. Fetal stimulation was also done. Sometimes NST was repeated 1-2 hours later after giving i.v. Ringer Lactate drip last. The NST done before onset of labour was used as reference. Interpretation if NST tracings was done according to ACOG guideline. A normal test is one in which two or more accelerations of 15 bpm or more above baseline each lasting 15 seconds or more and all occurring within 20 minutes of beginning of test. The non-reactive NST by definition does not meet the above criteria. The perinatal outcome was analysed by observing meconium staining of liquor. APGAR scored of neonates at 1 minute and 5 minutes and NICU admissions. Intrapartum CTG was interpreted according to FIGO 2015 consensus guidelines and perinatal outcomes were correlated with it.

The data were recorded in an Excel sheet and descriptive analysis was performed, of which data are presented in the tables. To know the association between dependent and independent variables chi-square was applied accordingly. P value less than 0.05 was considered as statistically significant.

## RESULTS

Table 1 shows that the mean age was 29 years with 4.56 SD of participants of high-risk group and 28.1 years with 4.67 SD of participants of low-risk group and 32%, 68% participants of high-risk group and 38%, 62% participants of low-risk group were primigravida and multigravida respectively. Almost 12% participants of high-risk group and 8% participants of low-risk group were unbooked cases. The mean gestational age was 37.6 weeks with 1.57 SD in high-risk group and 38.3 weeks with 1.38 SD in low-risk group.

**Table 1: Socio-clinical characteristics of study participants (N=100).**

| Variables | Group | |
|---|---|---|
| | High risk (n=50) (%) | Low risk (n=50) (%) |
| **Age (mean±SD) (in years)** | 29.0±4.56 | 28.1±4.67 |
| **Parity** | | |
| Primigravida | 16 (32) | 19 (38) |
| Multigravida | 34 (68) | 31 (62) |
| **ANC Registration** | | |
| Booked | 44 (88) | 46 (92) |
| Unbooked | 6 (12) | 4 (8) |
| **Gestation age (mean±SD) (in years)** | 37.6±1.57 | 38.3±1.38 |
| **NST** | | |
| Reactive | 29 (58) | 41 (82) |
| Non-reactive | 21 (42) | 9 (18) |
| **FIGO classification** | | |
| Normal | 29 (58) | 41 (82) |
| Suspicious | 14 (28) | 6 (12) |
| Pathological | 7 (14) | 3 (6) |
| **Mode of delivery** | | |
| LSCS | 18 (36) | 8 (16) |
| Normal | 32 (64) | 42 (84) |
| **MSAF** | 12 (24) | 5 (10) |
| **NICU admission** | 33 (66) | 12 (24) |
| **Birth weight (mean±SD) (in years)** | 2.52 ± 0.59 | 2.85 ± 0.32 |
| **APGAR score at 1 minute** | | |
| ≤6 | 15 (30) | 8 (16) |
| >6 | 35 (70) | 42 (84) |
| **APGAR score at 5 minutes** | | |
| ≤6 | 10 (20) | 5 (10) |
| >6 | 40 (80) | 45 (90) |

Around 58% participants of high-risk group and 82% of low-risk group had 'reactive' and NST tracings respectively. Almost 58%, 28%, 14% participants of high-risk group and 82%, 12%, 6% participants of low-risk group were noted with FIGO classification category 'normal', 'suspicious', 'pathological' respectively. Almost 36% participants of high-risk group and 16% of low-risk group were delivered baby by LSCS method. Around 24% participants of high-risk group and 10% of low-risk group had meconium-stained amniotic fluid. Around 66% babies of participants of high-risk group and 24% of low-risk group were admitted in NICU. The mean birth weight of babies of high-risk group participants was 2.52 kg with 0.59 SD and of low-risk group participants was 2.85 kg with 0.32 SD.

Figure 1 shows that risk factor like severe anemia, preeclampsia, GDM, oligohydramnios, Rh negative, hypothyroidism, IUGR, previous LSCS, SB/neonatal death, history of decreased fetal movement, post-dated, elderly primi were noted in 20%, 18%, 4%, 4%, 4%, 8%, 4%, 6%, 4%, 8%, 16%, 4% participants respectively.

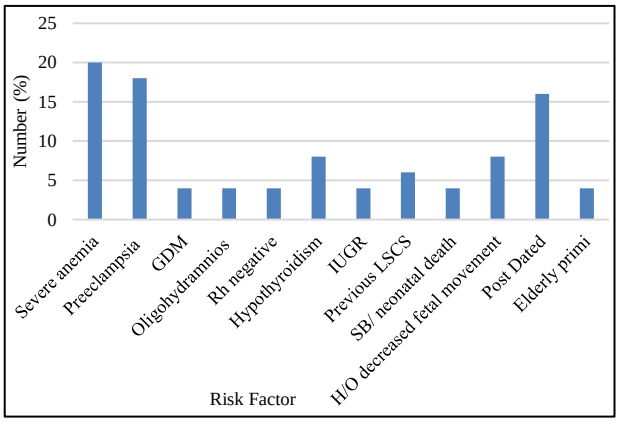


**Figure 1: Risk factor distribution among study participants (N=100).**

Table 2 shows association between category of FIGO Classification of NST and APGAR scores at 1 minute. In high-risk group Apgar scores <6 at 1 minute after birth were observed in 12% neonates in suspicious and 14% in pathological category. In low-risk group Apgar scores <6 at 1 minute were seen in 10% and 6% neonates in both categories. These scores improved at 5 minutes in low-risk group but not significantly in high-risk group.

**Table 2: Association between category of FIGO classification and APGAR score at 1 minute (N=100).**

| FIGO Classification | APGAR score | | | | | |
|---|---|---|---|---|---|---|
| | High risk group (n=50) | | | Low risk group (n=50) | | |
| | ≤6 (n=15) | >6 (n=35) | P value* | ≤6 (n=8) | >6 (n=42) | P value* |
| **Normal** | 2 (4%) | 25 (50%) | 0.001 | 0 (0.0%) | 41 (82%) | 0.001 |
| **Suspicious** | 6 (12%) | 8 (16%) | | 5 (10%) | 1 (2%) | |
| **Pathological** | 7 (14%) | 2 (4%) | | 3 (6%) | 0 (0%) | |

*Chi-square test

Table 3 shows association between category of FIGO Classification and APGAR score at 5 minutes. Among high-risk group neonates 8% neonates in suspicious FIGO Classification category and 12% in pathological category had APGAR score ≤6. Among low-risk group participants 4% neonates in suspicious category, 6% in with

pathological category had APGAR score ≤6. All the newborns in normal FIGO classification category had good Apgar scores at 5 minutes after birth in both the groups.

Table 4 shows that overall sensitivity, specificity, PPV, NPV values of NST test for predicting perinatal outcome was 94.1%, 83.5%, 48.8%, 98.7% respectively.

**Table 3: Association between category of FIGO classification and APGAR score at 5 minutes (N=100).**

| FIGO classification | APGAR score | | | | | |
|---|---|---|---|---|---|---|
| | High risk group (n=50) | | | Low risk group (n=50) | | |
| | ≤6 (n=10) | >6 (n=40) | P value* | ≤6 (n=5) | >6 (n=45) | P value* |
| Normal | 0 (0%) | 27 (54%) | 0.001 | 0 (0%) | 45 (90%) | 0.001 |
| Suspicious | 4 (8%) | 10 (20%) | | 2 (4%) | 0 (0%) | |
| Pathological | 6 (12%) | 3 (6%) | | 3 (6%) | 0 (0%) | |

*Chi-square test

**Table 4: Predictive value of NST for perinatal outcome.**

| Parameters | Predictive value (%) | | | | |
|---|---|---|---|---|---|
| | Overall | High risk group (n=50) | | Low risk group (n=50) | |
| | | nst reactive | NST non-reactive | NST Reactive | NST non-reactive |
| Sensitivity | 94.1 | 96.2 | 90.2 | 96.6 | 92.6 |
| Specificity | 83.5 | 86.7 | 81.6 | 90.2 | 84.1 |
| PPV | 48.8 | 56.9 | 46.8 | 64.5 | 54.3 |
| NPV | 98.7 | 98.8 | 91.4 | 98.7 | 95.5 |

## DISCUSSION

NST is simple, cheap, non-harmful, easily repeated, and cost effective with low maintenance profile.[2] The probability of adverse outcomes such as meconium-stained amniotic fluid, low APGAR score, and NICU admission. A reactive NST is a reliable indicator of fetal wellbeing in term fetus.[10]

Present prospective study was conducted among 100 antenatal cases divided in low and high-risk groups registered at the obstetrics and gynecology department. The aim of present study was to evaluate the efficacy and role of NST in improving the perinatal outcome in high-risk pregnancies.

Present study found that the mean age of participants was almost similar in both the study group. A study done by Singh et al noted mean age was 25.1 years in high-risk group which almost similar to present study.[11] Similar mean age was also noted in studies done by Arunkumar et al, Denny et al, Hoh et al, Verma et al, Bano et al, Lohana et al[17], Sekhavat et al.[12-18]

Present study found that participants with multipara were noted slightly more among high-risk group compare to low-risk group.

Present study found that incidence of unbooked antenatal cases (either no antenatal or <3 antenatal visits) was higher in high-risk group compare to low-risk group. Present study found that mean gestational age of high-risk group participants were slightly lower than the participants of low-risk group. In present study severe anemia (20%) was the most common risk factor observed among the study participants followed by preeclampsia (18%).

**Table 5: Comparison of incidence of non-reactive NST in high risk group in other similar study with present study.**

| Study | Incidence of non-reactive NST in high risk group |
|---|---|
| Singh et al[11] | 40% |
| Himabindu et al[2] | 30% |
| Panchal et al[1] | 45% |
| Mehta et al[19] | 45% |
| Verma et al[20] | 18% |
| Kaur et al[8] | 23.2% |
| Das et al[21] | 26.2% |
| Jamatia et al[4] | 32% |
| Lohana et al[17] | 15% |
| Phelan et al[22] | 14% |
| Present study | 42% |

Present study found that 'non-reactive NST' was statistically significantly more in high-risk groups compared to low-risk group.

Present study found that the 'pathological category' and suspicious category according to FIGO Classification was observed more among the participants of high-risk groups compared to low-risk group. Present study found that the incidence of 'MSAF' was statistically not significantly observed more among the participants of high-risk groups

(24%) compared participants of low-risk groups (10%). These findings are correlate with the study done by Himabindu et al and Lohana et al.[2,17] Present study found that the almost more than 60% high risk group cases statistically significantly required to admit in NICU and only 24% cases of low-risk group required NICU admission. Studies by Panchal et al, Kaur et al, Das et al and Himabindu et al showed that the incidence of NICU admission in 29%, 47.2%, 19.1% and 13% in high-risk group respectively.[1,2,8,21] Mean birth weight of high-risk group babies were statistically significantly lower (2.5 kg) than the low-risk group babies (2.9 kg). Miller et al also concluded that babies with birth weight <10 percentile for gestational age were increased in the non-reactive NST group and even in study done by Kaur et al noted the mean birth weight in reactive NST group was higher (2.34 versus 1.83 kg) at 34-37 weeks gestation and (1.76 versus 1.39 kg) in 32-34 weeks.[8] Present study found that women with non-reactive NST in high-risk group the incidence of LSCS was higher (36%) compared to normal vaginal delivery (16%). Edessy et al, Raouf et al, Himabindu et al, Kaur et al noted the incidence of LSCS as 39%, 42.7%, 46%, 88% respectively.[2,8,23,24]

Overall sensitivity, specificity, PPV, NPV, false positive, false negative values of NST test for predicting perinatal outcome was 94.1%, 83.5%, 48.8%, 98.7%, 51.3%, 1.4% respectively.

A study done by Himabindu et al noted the sensitivity, specificity, PPV, NPV of NST test was 82.3%, 80.7%, 46.6%, 95.7% respectively.[2] Biswas et al noted the sensitivity, specificity, PPV, NPV of NST test was 72.7%, 72.7%, 30.7%, 94.1% respectively in their study.[25] In the study by Mehta et al the sensitivity, specificity, PPV, NPV of NST test was 67.6%, 80.8%, 90.9%, 46.5% respectively.[19] Vermal et al found the sensitivity, specificity, PPV, NPV of NST test was 76%, 60%, 55.8%, 62.5% respectively.[19,20] Our results were comparable with study done by Chaudhary et al (sensitivity 50%, specificity 86.3%, PPP 38.3%, NPV 92.6%).[26]

## CONCLUSION

Present study reveals significant difference between reactive and nonreactive NST in terms of Apgar scores and NICU admissions in both the groups. Hence judicious use of NST will certainly help in timely identification of at-risk fetuses thereby avoiding unnecessary delay in intervention. In the present study NST was highly specific with high negative predictive value which means that a reactive NST is highly reassuring of a healthy fetus. So, it can be used as single best screening or admission test. The positive predictive value was low suggesting that a non-reactive NST does not reliably predict fetal hypoxia. Hence it is advisable to perform tests like biophysical profile, modified biophysical profile, Doppler ultrasound studies, contraction stress test, fetal scalp electrode monitoring and fetal blood sampling (if available) when NST results are non-reactive before planning obstetric intervention.

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