International Journal of Reproduction, Contraception, Obstetrics and Gynecology
Rita D et al. Int J Reprod Contracept Obstet Gynecol. 2025 Oct;14(10):3301-3306
www.ijrcog.org
pISSN 2320-1770 | eISSN 2320-1789

DOI: https://dx.doi.org/10.18203/2320-1770.ijrcog20252929

Original Research Article

Non-stress test as an admission test to assess the outcome in all pregnant women attending tertiary care center

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Received: 25 August 2025
Revised: 09 September 2025
Accepted: 10 September 2025

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ABSTRACT

Background: Perinatal mortality remains high in developing countries, including India, where it is approximately 32 per 1000 live births. The non-stress test (NST) is a non-invasive, simple, and widely used method to assess fetal well-being after 30 weeks of gestation. A reactive NST usually indicates adequate fetal oxygenation, while a non-reactive result may suggest hypoxia or neurological depression.
Methods: This prospective study included 100 pregnant women (>30 weeks gestation) with singleton pregnancies admitted to the labour ward of Navodaya medical college, Raichur. NST was performed in the semi-recumbent or left lateral position for 20 minutes (extended to 40 minutes if non-reactive). Outcomes assessed included mode of delivery, birth weight, Apgar scores at 1 and 5 minutes, NICU admissions, maternal complications, and hospital stay duration.
Results: Reactive NST was recorded in 78% of participants, non-reactive in 16%, and suspicious in 6%. Non-reactive and suspicious NSTs were significantly associated with higher emergency caesarean section rates (50% vs 17.9%), increased NICU admissions (37.5% and 33.3% vs 5.1%), lower Apgar scores, and greater incidence of meconium-stained liquor and intrapartum fetal distress ($p<0.05$).
Conclusions: Admission NST is a reliable predictor of perinatal outcome. Reactive NSTs are associated with favorable outcomes, whereas non-reactive/suspicious results indicate higher perinatal risk, necessitating timely intervention.

Keywords: Non-stress test, Fetal surveillance, NICU admission, Apgar score, Maternal complications

INTRODUCTION

Perinatal mortality remains a major global health challenge, particularly in low-resource settings, with rates as high as 50 per 1000 live births compared to approximately 10 per 1000 in developed countries. In India, the perinatal mortality rate was reported at 32 per 1000 live births in 2019.[1]

Globally, an estimated 2.6 million stillbirths occur annually, most of which are potentially preventable with timely identification and management of fetal compromise. The NST is one of the most widely used antepartum fetal surveillance methods, especially for high-risk pregnancies.[2] NST, introduced by Freeman and Lee, is a graphic recording of fetal heart rate (FHR) accelerations in response to fetal movements, widely used after 30 weeks for non-invasive assessment of fetal well-being, as a healthy, well-oxygenated fetus shows accelerations, while a compromised fetus due to hypoxia or neurological depression may not.

A reactive NST is defined as two or more accelerations of ≥15 beats per minute above baseline, lasting ≥15 seconds within a 20-minute period; for fetuses under 32 weeks, the criterion is 10 bpm for 10 seconds to account for neurological immaturity.[3]Testing is performed using a cardiotocograph with an external Doppler transducer for FHR and a tocodynamometer for uterine activity. The mother is positioned semi-recumbent or in a left lateral tilt

to optimize placental blood flow.[4] If non-reactive at 20 minutes, the test is extended to 40 minutes to account for fetal sleep cycles. Optional vibroacoustic stimulation may be used to elicit accelerations.[5]

A reactive NST has a low false-negative rate (about 1.9-3.2 per 1000 within one week of testing), while non-reactive patterns are less specific and may result from fetal sleep, maternal medication, or non-hypoxic causes.[6] This high false-positive rate (up to 75-90%) necessitates confirmatory testing with the biophysical profile (BPP) or contraction stress test (CST).[3]

Studies in high-risk pregnancies-including those complicated by preeclampsia, intrauterine growth restriction (IUGR), and oligohydramnios-show that abnormal NSTs are significantly associated with increased rates of operative delivery, NICU admission, low Apgar scores, and perinatal morbidity.[2] When used as an admission test in labor wards, the NST is valuable for early detection of latent fetal distress, guiding timely obstetric intervention, and improving perinatal outcomes, particularly in resource-limited settings where it remains cost-effective, reproducible, and non-invasive.[2]

Aim

Aim of the study was to evaluate the effectiveness of the NST, as an admission test for predicting maternal and fetal outcomes in pregnancies beyond 30 weeks.

Objectives

Objectives were to assess correlation between NST findings at admission and maternal outcomes and to evaluate association between NST findings and fetal outcomes.

METHODS

Study design and setting

This prospective study was conducted in the department of obstetrics and gynaecology, Navodaya medical college, hospital and research centre, Raichur, Karnataka, India over a period of one year (May-2024 to April-2025).

Study population

A total of 100 pregnant women with gestational age greater than 30 weeks and singleton pregnancies were included. Participants were admitted to the labour ward for various obstetric indications and were included after obtaining written informed consent.

Inclusion criteria

Singleton pregnant women with gestational age >30 weeks admitted to the labour ward for any indication prior to the onset of active labour or presence of maternal complications such as-anemia, bad obstetric history, gestational diabetes mellitus (GDM), hypertensive disorders, eclampsia, fetal growth restriction (FGR), premature rupture of membranes (PROM), IUGR, oligohydramnios, threatened preterm labour, heart disease, previous lower segment caesarean section (LSCS), post-dated pregnancy and patients willing to participate in the study were included.

Exclusion criteria

Women with gestational age <30 weeks, women already in active labour at admission, malpresentations, major congenital anomalies detected on anomaly scan, intrauterine fetal demise (IUFD), multiple gestation and patients not willing to participate in the study were excluded.

Procedure

For each participant, detailed antenatal history-including age, parity, gestational age, obstetric, menstrual and medical history-was recorded, followed by general, systemic and obstetric examination. Relevant investigations were reviewed. The NST was performed in a quiet, comfortable environment to minimize maternal anxiety and movement artifacts. The participant was positioned in a semi-recumbent or left lateral tilt to prevent supine hypotension and optimize uteroplacental blood flow.

External FHR and uterine activity were monitored using a cardiotocograph (CTG) machine equipped with: Doppler ultrasonic transducer (placed over the fetal back) for continuous FHR monitoring Tocodynamometer (placed over the uterine fundus) for the uterine contraction recording.

NST recording paper

The NST paper was 150 mm in width, with a vertical axis representing FHR (in beats per minute) and uterine activity (in mmHg), and a horizontal axis representing time. Standard recording speed was 1 cm/min or 3 cm/min depending on the manufacturer's settings. The paper was calibrated so that each small square represented 10 seconds, and each large square represented 1 minute.

Testing protocol

FHR was recorded for 20 minutes initially. If the NST was non-reactive, monitoring was extended up to 40 minutes to account for fetal sleep cycles, which generally last 20-40 minutes. Maternal perception of fetal movements was encouraged, and each perceived movement was correlated with accelerations on the tracing.

In cases where accelerations were absent after 20 minutes, vibroacoustic stimulation could be used to elicit fetal response (if necessary).

Interpretation criteria

Reactive NST: Baseline FHR between 110-160 bpm, with ≥2 accelerations (≥15 bpm above baseline, lasting ≥15 seconds) in 20 minutes; for <32 weeks, ≥10 bpm for ≥10 seconds. Variability should be 5-25 bpm and no decelerations present.

Non-reactive NST: Fewer than two qualifying accelerations during a 40-minute period.

Suspicious/equivocal NST: Borderline features not meeting full reactivity criteria or presence of atypical variable decelerations.

If the NST result was non-reactive or suspicious, further evaluation was carried out as per institutional protocol, which could include a BPP, CST, or expedited delivery depending on the clinical situation.

Outcome measures measured are maternal and perinatal outcomes which include: Mode of delivery, birth weight, Apgar scores at 1 and 5 minutes, NICU admissions, maternal complications (e. g., meconium-stained liquor, intrapartum fetal distress, prolonged labour and duration of hospital stay and day of discharge.

Statistical analysis

Data were entered into Microsoft excel and analysed using SPSS software version 26.0 (IBM Corp., Armonk, NY, USA). Categorical variables were compared using the Chi-square test or Fisher's exact test as appropriate. Continuous variables were analysed using the student's t-test or Mann-Whitney U test depending on normality of distribution. A $p<0.05$ was considered statistically significant.

Ethical clearance

Ethical clearance was obtained from the institutional ethics committee at Navodaya medical college before the commencement of the study. Participation was voluntary and informed consent was obtained from all respondents. Confidentiality was maintained throughout the study.

RESULTS

Demographic characteristics

Figure 1 shows distribution of participants by age. The present study included 100 pregnant women with gestational age >30 weeks. The majority of participants (67%) were between 20 and 29 years of age, indicating that most study subjects were in their early reproductive years.

Table 1 shows obstetric history of study population. More than half of the participants were primigravida (58%), followed by multigravida (34%) and grand multi para (8%).

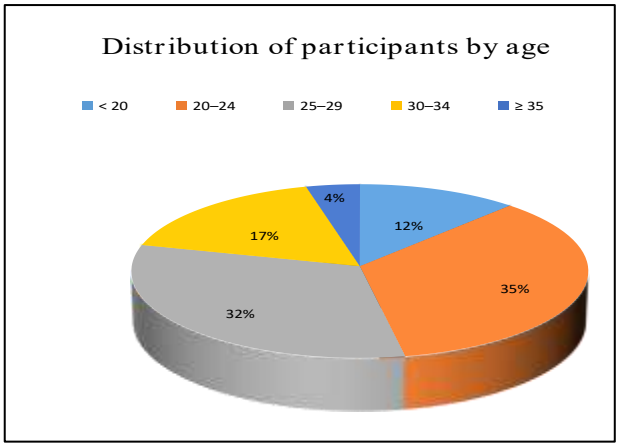

Figure 1: Distribution of participants by age, (n=100).

Table 1: Obstetric history of study population, (n=100).

Gravida/para	N
Primi (G1P0)	58
Multi (G2P1)	34
Grand multi (≥4)	8
Total	100

Table 2 shows gestational age at admission. Most women (40%) were admitted during early term gestation (37-38^{+6} weeks), followed by late preterm and post-term pregnancies. This suggests a higher concentration of patients being admitted near term, possibly for planning delivery or complications arising close to expected term.

Table 2: Gestational age at admission, (n=100).

Gestational age (weeks)	N
30-34	15
35-36+6	27
37-38+6	40
≥39	18
Total	100

Table 3 shows A large majority (78%) of participants had reactive NST, suggesting reassuring fetal status in most cases. 22% had either non-reactive or suspicious results, which may indicate a need for closer surveillance or intervention.

Table 3: NST results, (n=100).

NST category	Criteria	N
Reactive	≥2 accelerations in 20 min	78
Non-reactive	<2 accelerations in 40 min	16
Suspicious/ equivocal	Borderline criteria, does not fully meet reactivity	6
Total		100

Table 4 shows 14 women with reactive NST underwent emergency LSCS due to complications like oligohydramnios, preeclampsia, PROM. NST results showed a significant association with mode of delivery, with non-reactive tests leading more often to emergency cesarean sections. A statistically significant association was observed between abnormal NST patterns and increased rates of emergency LSCS.

Women with non-reactive NSTs underwent emergency caesarean delivery in 50% of cases compared to 17.9% in the reactive group (p<0.004).

Table 5 shows neonatal outcome by NST result. Neonates with non-reactive or suspicious NSTs had statistically significant lower birth weights, worse Apgar scores, and higher NICU admission rates, indicating a strong association between abnormal NST and poor neonatal outcomes (p<0.05). Table 6 shows maternal complications and interventions maternal complications such as meconium-stained liquor, intrapartum fetal distress, and prolonged labor were statistically significant more common in the non-reactive and suspicious NST groups, reinforcing the predictive value of NST in anticipating labor-related risks (p<0.009).

Table 4: Comparison of NST results with mode of delivery, (n=100).

Mode of delivery	Reactive, (n=78)	Non-reactive, (n=16)	Suspicious, (n=6)
Spontaneous vaginal	56	5	3
Assisted vaginal (Vacuum/forceps)	4	2	1
Emergency cesarean section	14	8	2
Elective cesarean section (previous LSCS)	4	1	0
Overall p value=0.004			

Table 5: Neonatal outcome by NST result, (n=100).

Neonatal parameters	Reactive, (n=78)	Non-reactive, (n=16)	Suspicious, (n=6)	P value
Mean birth weight	2850±350	2480±300	2650±320	0.001 ANOVA test
Apgar score <7 at 1 min	6 (7.7%)	5 (31.3%)	2 (33.3%)	<0.0001 Chi square test
Apgar score <7 at 5 min	2 (2.6%)	4 (25.0%)	2 (33.3%)	<0.0001 Chi square test
NICU admission	4 (5.1%)	6 (37.5%)	2 (33.3%)	

Table 6: Maternal complications and interventions, (n=100).

Complication/intervention	Reactive, (n=78)	Non-reactive, (n=16)	Suspicious, (n=6)
Meconium-stained liquor	3 (3.8%)	4 (25.0%)	1 (16.7%)
Hypertensive disorders	8 (10.3%)	3 (18.8%)	1 (16.7%)
Intrapartum fetal distress (leading to emergency C-section)	0	8 (50.0%)	2 (33,3%)
Prolonged labour	6 (7.7%)	3 (18.8%)	1 (16.7%)

DISCUSSION

The admission NST serves not only as a screening tool but also as an early predictor of perinatal outcomes in laboring women. Its utility lies in its ability to stratify risk at the time of admission, allowing timely intervention in cases with potential fetal compromise. By correlating NST patterns with maternal, fetal, and neonatal outcomes, the present study provides insight into the predictive accuracy of NST in routine obstetric practice. Importantly, this discussion evaluates the study findings in light of existing literature, emphasizing where differences were statistically significant and how they translate into clinical relevance.

Demographic characteristics

In the present study, the majority of participants (67%) were aged 20-29 years and 58% were primigravida. Most women were admitted at term gestation (37-38^{+6} weeks). Similar trends were reported by Sharma et al., who found that admission NST was more frequently performed among younger women, predominantly primigravida, and this association was statistically significant (p<0.05).[6]

Raghuwanshi and Sarda also documented that primigravidae constituted the majority of their study group (p<0.05).[4]

Medha et al observed that NST was most often employed at term gestation, reinforcing that intrapartum fetal surveillance is most critical in this period.[2]

NST results and mode of delivery

In the present study, 78% of NSTs were reactive, 16% non-reactive, and 6% suspicious. Emergency LSCS was

significantly more frequent in the non-reactive group (50%) compared to the reactive group (17.9%), with statistical significance (p=0.004).

Amin et al. also demonstrated a significantly higher rate of caesarean section in non-reactive cases (36% vs 16%, p<0.05).[5]

Garg et al observed a significant correlation between abnormal NSTs and increased operative deliveries (p<0.05).[8]

Impey et al in a randomized controlled trial, reported that the use of admission CTG including NST was associated with an increased rate of the operative deliveries (p<0.01).[11]

Taken together, these findings suggest that an abnormal NST is strongly predictive of the need for operative intervention.

Neonatal outcomes

In the present study, adverse neonatal outcomes were significantly higher in the non-reactive and suspicious groups. NICU admissions were required in 37.5% of non-reactive and 33.3% of suspicious cases, compared to only 5.1% in the reactive group (p<0.05). Low Apgar scores at 1 and 5 minutes were also significantly associated with abnormal NST results (p<0.05).

Raouf and Garg documented similar findings, with non-reactive NSTs predicting higher NICU admissions and low Apgar scores, both statistically significant (p<0.05).[7,8]

Sharma et al demonstrated that NICU admission rates were significantly higher in non-reactive (40.38%) and suspicious (32.69%) groups compared to reactive cases (26.96%, p<0.05).[6]

Geleta et al from Ethiopia also confirmed that non-reactive NSTs significantly predicted poor neonatal outcomes (p<0.05).[10]

Medha et al reported that a non-reactive NST increased the odds of fetal distress and adverse neonatal outcomes more than eightfold (p<0.001).[2]

Thus, abnormal NSTs consistently emerge as a statistically significant predictor of neonatal compromise.

Maternal complications

In the present study, maternal complications such as meconium-stained liquor, intrapartum fetal distress, and prolonged labor were significantly more frequent in the non-reactive and suspicious groups (25% vs 3.8%, p=0.009). These findings indicate that abnormal NST results are not only predictive of fetal compromise but also closely linked with maternal morbidity through their impact on intrapartum management. Non-reactive NSTs were associated with a higher incidence of emergency caesarean section (50% vs 17.9%, p=0.004), which directly translates to increased maternal surgical risk, longer recovery, and higher rates of operative morbidity. Similarly, prolonged labor observed in abnormal NST cases predisposes women to complications such as maternal exhaustion, postpartum hemorrhage, and infectious morbidity.

Garg et al also reported a significantly higher frequency of meconium-stained liquor in non-reactive NST cases compared to reactive ones (11.3% vs 5.7%, p<0.05).[8]

Nayak et al documented a strong statistical correlation between abnormal intrapartum monitoring (including NST) and maternal complications in hypertensive pregnancies (p<0.05).[12]

These consistent findings across studies establish that an abnormal NST, though primarily a fetal surveillance tool, carries indirect but important predictive value for maternal outcomes by signaling a greater likelihood of obstetric complications and operative delivery.

Clinical implications

The findings of the present study, supported by consistent evidence from comparative studies, indicate that the admission NST is a statistically significant predictor of both maternal and neonatal outcomes. A reactive test is reassuring, while non-reactive or suspicious tracings are strongly associated with higher rates of caesarean delivery, NICU admission, low Apgar scores, and intrapartum complications. Although NST should not be used in isolation for decision-making, its high predictive value in identifying at-risk fetuses underscores its role as a valuable screening tool in routine obstetric practice. Timely interpretation of abnormal NSTs can guide appropriate interventions, thereby reduce perinatal morbidity and improve overall maternal-fetal outcomes.

CONCLUSION

The admission NST remains a widely accepted, non-invasive, and cost-effective tool for the assessment of fetal well-being during pregnancy and at the time of admission in labour. By providing an early indication of fetal oxygenation and neurological status, it enables timely differentiation between reassuring and non-reassuring patterns. A reactive tracing generally predicts favorable perinatal outcomes, while non-reactive or suspicious results highlight the risk of intrapartum complications such as fetal distress, operative delivery, or the need for neonatal intensive care. In such situations, additional investigations, particularly fetal Doppler studies, are valuable in confirming abnormal findings, improving the accuracy of risk prediction, and thereby reducing unnecessary operative interventions and preventable perinatal mortality.

Despite its limitations, including a relatively high false-positive rate, the NST retains its importance as a simple and reproducible screening tool, especially in resource-limited settings where advanced techniques may not always be accessible. When interpreted within the broader clinical context and supplemented with other surveillance modalities, it continues to be a cornerstone of intrapartum monitoring, contributing significantly to the reduction of adverse perinatal outcomes.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee NMC RCR/IHEC/2025-26/117.

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Cite this article as: Rita D, Sirisha B. Non-stress test as an admission test to assess the outcome in all pregnant women attending tertiary care center. Int J Reprod Contracept Obstet Gynecol 2025;14:3301-6.