International Journal of Reproduction, Contraception, Obstetrics and Gynecology
Garg S et al. Int J Reprod Contracept Obstet Gynecol. 2016 Nov;5(11):3993-4000
www.ijrcog.org

pISSN 2320-1770 | eISSN 2320-1789

DOI: http://dx.doi.org/10.18203/2320-1770.ijrcog20163877

Original Research Article

Non-stress test as an admission test to assess the outcome in high-risk pregnancy

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Received: 12 September 2016
Revised: 14 September 2016
Accepted: 07 October 2016

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ABSTRACT

Background: Perinatal deaths are still a significant problem in India. Therefore, there is a need for effective fetal surveillance, in order to improve the outcomes of pregnancy.
Methods: This was a prospective study including fifty one females with high-risk pregnancy and 50 with low risk pregnancy. The included participants were subjected to NST done using a cardiotocograph with ultrasound transducer placed on maternal abdomen for duration of 20 min. The NST results were classified into reactive and non-reactive. Subjects were then followed up for mode of delivery and different variables of perinatal outcome.
Results: Majority of study subjects were in the age group of 26-30 years (n=74; 73.3%). The period of gestation in 74 (73.3%) subjects was 37-38 weeks. Gestational diabetes mellitus was the most common risk factor in the high-risk group (n=22; 43.1%).The NST was non-reactive in 6 and 4 subjects in the high-risk and low-risk groups respectively (p=0.741). Only 3 subjects in the high-risk group had a vaginal delivery, while 33 in low-risk group did.
Conclusions: We did not find any significant difference in the results of the NST between women with high and low-risk pregnancy. But this test is a promising basic screening tool in pregnancy to assess fetal well-being.

Keywords: NST, High risk group, Low risk group

INTRODUCTION

Recently, there has been a significant decrease in maternal mortality in developing countries.[1] However, in India alone, about 8,90,000 perinatal deaths occur annually.[2] Previously, the fetus was considered only as an outcome of pregnancy and since, the fetus cannot be "seen" or "examined", obstetricians considered fetal wellbeing to be a by-product of maternal health and welfare.[1,3] However, the fetus is no longer considered a transient maternal organ, and is treated as a second patient who faces greater risks of serious morbidity and mortality.[1,3]

Additionally, a better understanding of the fetal physiology and advancement in technology have changed this attitude towards the fetus.[3] Therefore, the need for fetal surveillance requires emphasis. Currently, intrapartum assessment of fetal wellbeing is one of the primary tasks of modern obstetric practice.[1]

Normally, term pregnancy is between 37 and 42 weeks of gestation and the perinatal mortality and morbidity rates increases progressively during this period. In clinical practice, it is important and also very difficult to decide an "ideal" time after which medical intervention (induction of labor) is more beneficial than risky in terms of pregnancy outcomes**.** Both preterm (defined as delivery <37 week of gestation) and post term (delivery at or beyond 42 week of gestation) births are associated with increased neonatal morbidity and mortality.[3]

Although the need for fetal surveillance is well-acknowledged now, antepartum evaluation of the fetus at

risk for damage or death in utero continues to be a major challenge in modern obstetrics.[2] Traditionally, obstetricians classify pregnant women as "low" and "high" risk. Surprisingly, approximately 50% of antepartum fetal deaths occur in women with low risk pregnancies. Therefore, there is a need for a test, which can be used to screen all pregnancies.[1,3]

The fact that the main purpose of the various antepartum surveillance techniques is to detect fetal distress in order to prevent fetal death need not be overemphasised.[4] It is reassuring that the fetus is safe, when the fetal heart rate patterns are normal and the fetus is in a good position.[3]

In developing countries, continuous electronic monitoring throughout labor is difficult because of lack of adequate trained manpower and resources.[1] Though there are many antepartum biophysical methods like contraction stress test (CST), non-stress test (NST), fetal biophysical profile (BPP), vibroacoustic fetal stimulation test, amniotic fluid volume assessment and Doppler velocimetry for high risk pregnancies, there is no single test which is ideal for all high risk fetuses.[5]

Non-stress test is an easy test to perform and normal value will predict good fetal wellbeing for the next few hours in labor.[1] This test is most commonly used for antepartum evaluation of the fetal status. It is non-invasive, easily performed and interpreted, and readily accepted by patients. The test looks for the presence of temporary accelerations of the fetal heart rate (FHR) associated with fetal movement.[6] Therefore, admission NST will help to detect high risk fetus and further course of action is decided based on the test result.

The current study was conducted to analyse the predictive value of NST as an admission test in evaluating perinatal outcome in high risk pregnancy.

METHODS

Women with high risk pregnancy above 32 weeks of gestation attending the antenatal clinic in Little Flower Hospital, Angamaly, Kerala from June 2013 to June 2014 were included in the study. Informed consent was obtained from all the patients. Ethical clearance was obtained from the Institutional Ethics Committee.

Inclusion criteria

- Females with high risk singleton pregnancies ≥32 week's period of gestation.
- Females with low risk singleton pregnancies ≥32 week's period of gestation.
- Only NST performed 7 days prior to delivery were considered for the fetal outcome.
- Women were divided into low as well as high risk groups based on age, height, parity, blood pressure, haemoglobin, period of gestation, rupture of membranes or any other risk factor.
- Women were divided into low as well as high risk groups based on age, height, parity, blood pressure, haemoglobin, period of gestation, premature rupture of membranes(PROM), Preterm Premature rupture of membranes(PPROM), Primary infertility with GDM, IUGR, Preeclampsia, Hypertension, Gestational diabetes mellitus, previous fetal demise, Decreased fetal movements, Anemia, third trimester bleeding, post-dated pregnancy, Rh negative pregnancy, Antiphospholipid antibody syndrome, seizure disorder(epilepsy), Oligohydramnios, Previous LSCS, Polyhydramnios, Preterm labour and advanced maternal age.

Exclusion criteria

- Pregnancies less than 32 weeks period of gestation.
- Females with multiple pregnancies.
- Major congenital anomaly of fetus detected on routine ultrasound scanning.

Methodology

This was a prospective, observational study carried out between June 2013 and June 2014. Fifty one females with high-risk pregnancy and 50 with low risk pregnancy were included in the study. Data was collected on a prestructured proforma. The included participants were subjected to NST. NST was done using a Cardiotocograph with ultrasound transducer placed on maternal abdomen for duration of 20 min.

The NST results were classified into two groups: Reactive and Nonreactive.

Subjects were then followed up for mode of delivery and different variables of perinatal outcome including perinatal mortality, fetal distress during labor, 5 min Apgar score, meconium stained amniotic fluid.

Statistical analysis

Dichotomous data are summarized as percentages. Continuous data are reported as mean and standard deviation.

To test the difference in proportion between the high- and low-risk groups, we used Fisher exact test (chi-square test).

RESULTS

A total of 51 females with high risk pregnancy and 50 with low risk pregnancy were included in the study. Table 1 show the age-wise distribution of the subjects. Maximum subjects in both groups were in the age group of 26-30 years (n=47; 46.5%), followed by 21-25 years (n=32; 31.7%).

Table 1: Age-wise distribution of study subjects.

Age	Risk		Total
	High risk	Low risk	
18-20 yrs	2	1	3
	3.90%	2.00%	3.00%
21- 25 yrs	11	21	32
	21.60%	42.00%	31.70%
26-30 yrs	24	23	47
	47.10%	46.00%	46.50%
31-35 yrs	10	3	13
	19.60%	6.00%	12.90%
>36 yrs	4	2	6
	7.80%	4.00%	5.90%
Total	51	50	101
	100.00%	100.00%	100.00%

Table 2 show the number of booked cases in both the high-risk and low-risk groups. Of the 101 subjects, 74 (73.3%) were booked and 27 (26.7%) were unbooked cases.

Table 2: Booked and unbooked cases.

Booked	Risk		Total
	High risk	Low risk	
No	13	14	27
	25.50%	28.00%	26.70%
Yes	38	36	74
	74.50%	72.00%	73.30%
Total	51	50	101
	100.00%	100.00%	100.00%

The period of gestation was between 37-38 weeks in 74 (73.3%) subjects, 34-36 weeks in 18 (17.80%), 39-40 weeks in 6 (5.9%) and 32-34 weeks in 3 (3%; Table 3).

Table 3: Gestational age of subjects at the time of inclusion in the study.

Gestational age	Risk		Total
	High risk	Low risk	
32-34 wks	3	0	3
	5.90%	0.00%	3.00%
34-36 wks	12	6	18
	23.50%	12.00%	17.80%
37-38 wks	36	38	74
	70.60%	76.00%	73.30%
39-40 wks	0	6	6
	0.00%	12.00%	5.90%
total	51	50	101
	100.00%	100.00%	100.00%

Majority of the subjects were primigravida (n=59; 58.4%), followed by Gravida 2 (n=25; 24.80%). Thirteen (12.9%) were Gravida 3 and two each (2%) were Gravida 4 and 5 (Table 4).

Table 4: Number of gravida of subjects.

Gravida	Risk		Total
	High risk	Low risk	
1	26	33	59
	51.00%	66.00%	58.40%
2	12	13	25
	23.50%	26.00%	24.80%
3	10	3	13
	19.60%	6.00%	12.90%
4	1	1	2
	2.00%	2.00%	2.00%
5	2	0	2
	3.90%	0.00%	2.00%
Total	51	50	101
	100.00%	100.00%	100.00%

Of all the subjects, 63 (62.4%) were nullipara**,** 28 (27.7%) were Para 1 and 10 (9.9%) were Para 2 (Table 5).

Table 5: Number of para of the subjects.

Para	Risk		Total
	High risk	Low risk	
0	29	34	63
	56.90%	68.00%	62.40%
1	16	12	28
	31.40%	24.00%	27.70%
2	6	4	10
	11.80%	8.00%	9.90%
Total	51	50	101
	100.00%	100.00%	100.00%

Of the subjects, 26 (25.7%) had one living child, and 8 (7.9%) had two living children (Table 6).

Table 6: Number of living children.

Living	Risk		Total
	High risk	Low risk	
0	31	36	67
	60.80%	72.00%	66.30%
1	15	11	26
	29.40%	22.00%	25.70%
2	5	3	8
	9.80%	6.00%	7.90%
Total	51	50	101
	100.00%	100.00%	100.00%

A total of 24% of subjects in the high-risk group had had at least one abortion while only 10% had this in the low-risk group (Table 7).

Of the various risk factors observed in the pregnancy, which were used to categorise the latter as high-risk, gestational diabetes mellitus was present in 22 (43.1%), pregnancy-induced hypertension in 5 (9.8%) and anemia

was present in 1 (2%; Table 8). Other risk factors observed are shown in Table 9.

Table 7: Previous abortions in the study subjects.

Number of abortions	Risk		Total
	High risk	Low risk	
0	39	45	84
	76%	90%	83%
1	8	5	13
	16%	10%	13%
2	2	0	2
	4%	0%	2%
3	2	0	2
	4%	0%	2%
Total	51	50	101
	100%	100%	100%

When an NST was done in the study subjects, 6 in the high-risk group and 4 in the low-risk group had a non-reactive NST. There was no significant difference between the two groups (p=0.741; Table 10).

Table 8: Gestational diabetes mellitus, hypertension and anemia in the subjects in the high-risk group.

	Gestational DM	Hypertension	Anemia
No	29	46	50
	56.90%	90.20%	98.00%
Yes	22	5	1
	43.10%	9.80%	2.00%

With respect to pharmacotherapy during pregnancy, 19 subjects in the high-risk group were either being treated for diabetes, or hypertension or both. A total of 16 subjects were on insulin, and 5 received methyldopa of whom, 1 received only methyldopa, 1 along with a beta-blocker, 1 along with nifedipine and 2 with insulin. None in the low-risk group were on any pharmacotherapy (Table 11).

Doppler study was performed in 7 subjects in the high-risk group, of whom, it was abnormal in 4, while none in the low-risk group underwent this study (p=0.013; Table 12).

In the high-risk group, of the 51 subjects, only 3 (5.9%) had vaginal delivery, while 20 (39.2%) underwent elective LSCS and 28 (54.9%) emergency LSCS. In the low-risk group, 33 (66%) had vaginal delivery, 8 (16%) underwent elective LSCS and 9 (18%) emergency LSCS (Table 13 and Figure 8). The difference in the mode of delivery was significant in both the study groups (p=0.000).

When the Apgar score was calculated, 15 (29.4%) and 9 (18%) in the high-risk and low-risk groups respectively had a score ≤7. Thirty six (70.6%) and 41 (82%) in the high-risk and low-risk groups respectively had a score >7 (Table 14). There was no significant difference between the two study groups (p=0.243).

Table 9: Other risk factors in the subjects to classify them as high-risk.

Other risk factors	Number and percentage of subjects
Antiphospholipid antibody syndrome	1
	2.00%
Epilepsy with GDM	**1**
	2.00%
IUGR with GDM	**2**
	3.90%
IUGR with oligohydramnios	2
	4.00%
Oligohydramnios	4
	7.80%
Oligohydramnios with PROM	**1**
	2.00%
Oligohydramnios with PPROM	**`2**
	4%
Oligohydramnios with previous LSCS	2
	4.00%
Polyhydramnios	1
	2.00%
Preterm labor	1
	2.00%
Preterm labor with IUGR	1
	2.00%
Previous LSCS	**8**
	16.00%
Previous LSCS with GDM	**4**
	8%
Primary infertility with GDM	**1**
	2.00%
PROM	3
	5.90%
PPROM with IUGR	**1**
	2.00%
Rh negative with GDM	**2**
	3.90%
PPROM	**1**
	2.00%
Short primi	1
	2.00%

Neonates born to 11 and 8 subjects in the high-risk and low-risk groups respectively were admitted to the NICU (Table 15). There was no significant difference (p=0.323). One neonate born to a subject in the high-risk group required ventilatory support.

The various indications for LSCS in the study subjects are enumerated in Table 16.

Table 10: NST results in the study subjects.

NST test results	Risk		Total
	High risk	Low risk	
Non-reactive	6	4	10
	11.80%	8.00%	9.90%
Reactive	45	46	91
	88.20%	92.00%	90.10%
Total	51	50	101
	100.00%	100.00%	100.00%

Of the neonates born to the subjects in the high-risk and low-risk groups, 1 (2%) and 5 (10%) respectively had hypothermia, and 6 (11.8%) and 3 (6%) respectively had respiratory distress syndrome (RDS). Four neonates born to subjects in the high-risk group had IUGR. The remaining were normal (40 [78.4%] and 42 [84%] born to the subjects in the high-risk and low-risk groups; Table 17).

Table 11: Summary of pharmacotherapy of study subjects.

Drugs	Risk	
	High risk	Low risk
Methyldopa and beta-blocker	1	0
	2.00%	0.00%
Methyldopa and Nifedipine	1	0
	2.00%	0.00%
Methyldopa	1	0
	2.00%	0.00%
Insulin	14	0
	27.50%	0.00%
Insulin and methyldopa	2	0
	3.90%	0.00%
No drugs	32	50
	62.70%	100.00%
Total	51	50
	100.00%	100.00%

DISCUSSION

In our study, we found that NST if an effective screening test to assess fetal well-being in women who are over 32 weeks pregnant. We included 51 females with high risk pregnancy and 50 with low risk pregnancy. Till date, only Biswas et al compared the use of NST in women with high-risk vs. low-risk pregnancy.[2] However, the ratio of high-risk: low-risk was 8:2. In our study, we made a comparison in a ratio of 1:1.

Recent studies have been conducted either in high-risk groups or low-risk groups.[1-3,7] However, none of them have compared the two populations.

In our study, about 46.5% of subjects were in the age group of 26-30 years, followed by 21-25 years (31.7%). However, in the study by Himabindu et al 50% of subjects were in the age group of 21-25 years, followed by 26-30 years and 18-20 years (23% each).[2] In the study by Lohana et al 83% of subjects were in the age group of 21-30 years, and 15% were between 18-20 years old.[3]

Table 12: Doppler study findings in the study subjects.

Doppler study	Risk	
	High risk	Low risk
Abnormal	4	0
	7.80%	0.00%
Not done	44	50
	86.30%	100.00%
Normal	3	0
	5.90%	0.00%
Total	51	50
	100.00%	100.00%

Table 13: Mode of delivery in the high-risk vs. low-risk groups.

Delivery	Risk	
	High risk	Low risk
Elective LSCS	20	8
	39.20%	16.00%
Emergency LSCS	28	9
	54.90%	18.00%
Vaginal delivery	3	33
	5.90%	66.00%
Total	51	50
	100.00%	100.00%

Table 14: Mode of delivery in the high-risk vs. low-risk groups.

APGAR	Risk	
	High risk	Low risk
≤7	15	9
	29.40%	18.00%
>7	36	41
	70.60%	82.00%

Table 15: Admission to NICU in the neonates born to subjects in the high-risk vs. low-risk groups.

Admission to NICU	Risk	
	High risk	Low risk
No	40	42
Yes	11	8

The numbers of booked cases were similar in the two groups (74.5% in the high-risk group vs. 72% in the low-risk group). However, in the study by Himabindu et al they opine that most high-risk cases were referred as unbooked cases to their hospital, which is a tertiary referral center.[2]

Table 16: Indications for LSCS in the high risk vs. low risk groups.

Indication for LSCS	Risk	
	High risk	Low risk
Antiphospholipid antibody syndrome (APLAS) with GDM with unfavourable cervix	1	0
	2.00%	0.00%
Breech presentation	0	1
	0.00%	2.00%
Primigravida with breech presentation	0	1
	0.00%	2.00%
IUGR with breech presentation	1	0
	2.00%	0.00%
Cervical dystocia with meconium stained liquor	1	0
	2.00%	0.00%
CPD	6	5
	11.80%	10.00%
CPD with GDM	1	0
	2.00%	0.00%
Deep transverse arrest	1	0
	2.00%	0.00%
Failed induction	1	3
	2.00%	6.00%
Failed progress	0	1
	0.00%	2.00%
Fetal distress	0	4
	0.00%	8.00%
GDM on insulin with PIH with CPD	1	0
	2.00%	0.00%
GDM on insulin with two loops of cord on ultrasonography	1	0
	2.00%	0.00%
PIH with non-reactive NST	1	0
	2.00%	0.00%
GDM with primary infertility	1	0
	2.00%	0.00%
IUGR	1	0
	2.00%	0.00%
IUGR with unfavourable cervix	1	0
	2.00%	0.00%
Meconium stained liquor	1	0
	2.00%	0.00%
Non-reactive NST	0	1
	0.00%	2.00%
Non-reactive NST with IUGR with previous LSCS	1	0
	2.00%	0.00%
Oligohydramnios with IUGR	1	0
	2.00%	0.00%
Oligohydramnios with unfavourable cervix	1	0
	2.00%	0.00%
Oligohydramnios	3	0
	5.90%	0.00%
Oligohydramnios with uteroplacental insufficiency	1	0
	2.00%	0.00%
PIH with previous LSCS	1	0
	2.00%	0.00%
Preterm labor	1	0
	2.00%	0.00%
Previous 2 LSCS in labor	1	0
	2.00%	0.00%
Previous LSCS	6	1
	11.80%	2.00%
Previous LSCS with epilepsy	1	0
	2.00%	0.00%
Previous LSCS with GDM and on insulin	2	0
	3.90%	0.00%
Previous LSCS with GDM and on insulin with breech	1	0
	2.00%	0.00%
Previous LSCS with oligohydramnios	1	0
	2.00%	0.00%
PROM with failed progress	2	0
	4.00%	0.00%
PROM with IUGR with unfavourable cervix	1	0
	2.00%	0.00%
PROM with meconium stained liquor	1	0
	2.00%	0.00%
PROM with oligohydramnios	1	0
	2.00%	0.00%
Severe polyhydramnios	1	0
	2.00%	0.00%
Severe preeclampsia with unfavourable cervix	1	0
	2.00%	0.00%
Unfavourable cervix	1	0
	2.00%	0.00%

Table 17: Diagnosis of the neonates born to the study subjects.

Diagnosis	Risk	
	High risk	Low risk
Hypothermia	1	5
	2.00%	10.00%
IUGR	4	0
	7.80%	0.00%
RDS	6	3
	11.80%	6.00%
Normal	40	42
	78.40%	84.00%
Total	51	50
	100.00%	100.00%

We included women >32 weeks of gestation. Biswas et al evaluated women with >28 weeks of gestation, Himabindu et al included women with >30 weeks of gestation, and Lohana et al and Patel et al included

women with >37 weeks of gestation.[1-3,7] In our study, the period of gestation was between 37-38 weeks in 73.3% subjects (70.6% in the high-risk group and 76% in low-risk group) followed by 34-36 weeks in 17.80% (23.5% in high-risk group and 12% in the low-risk group).

Majority of the subjects were primigravida (58.4%), followed by gravida 2 (24.80%), gravida 3 in 12.9% and gravida 4 and 5 in 2% each. These findings are similar to the study by Himabindu et al where 55% were primigravida, followed by 29, 12 and 4 with gravida 2, 3 and 4 respectively.[2]

We additionally also collected information on the para, living and abortion status of the study subjects. About 62.4% were Nullipara, 27.7% were Para 1 and 9.9% were Para 2. A total of 25.7% had one living child, and 7.9% had two living children. A total of 24% of subjects in the high-risk group had had at least one abortion while only 10% had this in the low-risk group.

Gestational diabetes mellitus was the most common risk factor, present in 43.1% of cases, followed by oligohydramnios in 21.8% and pregnancy-induced hypertension in 9.8%. Since GDM was the commonest morbidity observed in our study, the obvious observation was that 16 subjects were being treated with insulin. Other commonly used drug was methyldopa for PIH.

With respect to the NST results, we found the number of non-reactive cases in the high-risk group to be lesser compared to that in the study by Himabindu et al (7/51 vs. 30/100 respectively).[2] In the low-risk group, there were 4/50 cases who had a non-reactive NST. Lohana et al showed that at 37 weeks of gestation, 1 of 100, at 38 weeks, 2/90, at 39 weeks 2/59, at 40 weeks 6/18 and at 41 weeks 4/10 subjects had a non-reactive NST.[3] In the study by Patel et al.[1] 18/350 low-risk pregnant women had a non-reactive NST. Based on findings from other reports as well as our study, we can imply that the incidence of non-reactive NST was less in both high- and low-risk groups in our study.

We performed umbilical artery Doppler study in 7 subjects in the high-risk group, of whom, it was abnormal in 4, while none in the low-risk group underwent this study (p=0.013). El-Edessy et al in a recent study, report that umbilical artery Doppler is a promising screening test in high risk pregnancies and is associated with better maternal and neonatal outcomes.[8]

In the high-risk group, of the 51 subjects, only 3 (5.9%) had vaginal delivery, while 20 (39.2%) underwent elective LSCS and 28 (54.9%) emergency LSCS. The rate of LSCS was higher in our study compared to that by Himabindu et al (54% women underwent LSCS).[2] In the low-risk group, 33 (66%) had vaginal delivery, 8 (16%) underwent elective LSCS and 9 (18%) emergency LSCS. In the study by Patel et al[1] 14.84% with reactive NST and 66.66% with non-reactive NST underwent LSCS.[1]

The Apgar score ≤7 was lesser in neonates of subjects in the low-risk group (18%) vs. of those in the high-risk group (29.4%), although this difference was not statistically significant (p=0.243). Among those with a non-reactive NST, 3 (50%) neonates of subjects in the high-risk group and 1 (25%) of those in the low-risk group had an APGAR score of ≤7. Similar findings were observed in the study by Himabindu et al, where the neonates of 14/16 high-risk subjects with non-reactive NST had an APGAR score of ≤7.[2] In the study by Patel et al, 61.1% of neonates of low-risk pregnant women with non-reactive NST had an APGAR score of ≤7, which is in contrast to our study, where only 25% had a score ≤7.[1]

Neonates born to 11 and 8 subjects in the high-risk and low-risk groups respectively were admitted to the NICU. There was no significant difference (p=0.323). One neonate born to a subject in the high-risk group required ventilatory support. Of the neonates born to the 10 non-reactive NST cases in our study, 5 (50%) required admission to NICU, while in the study by Himabindu et al, the mothers of all 13 neonates admitted to NICU had a non-reactive NST.[2] Similar to our study, Patel et al demonstrated that 44.1% of neonates of mothers with a non-reactive NST required NICU admission.[1]

The most frequently encountered indication for LSCS in our study was a previous LSCS (12 in high-risk group and 1 in the low-risk group), followed by CPD (7 in high-risk group and 5 in low-risk group), oligohydramnios (8 in high-risk group) and PROM (5 in high-risk group). In the study by Himabindu et al, the most common indications were failed induction, failure of progress of labor and fetal distress.[2] In the study by Patel et al fetal distress, failure of progress of labor and CPD.[1]

Of the neonates born to the subjects in the high-risk and low-risk groups, 1 (2%) and 5 (10%) respectively had hypothermia, and 6 (11.8%) and 3 (6%) respectively had respiratory distress syndrome (RDS). Four neonates born to subjects in the high-risk group had IUGR.

ACKNOWLEDGEMENTS

I express my sincere thanks to Rev. Fr. Dr. Paul V. Madan, Director, Little Flower hospital and Research Centre for permitting me to conduct this study. I am thankful to Dr. Jayashree for all the help and advice in framing the study and for guidance throughout the study period. I am indebted to her keen interest and untiring efforts to correct me at every step in my endeavor. I am thankful to Dr. Marykutty Illickal, Head of the Department, for all the help and encouragement she had given me during this period of study. I am thankful to my husband Dr. Ashish Gupta for his efforts to correct me at every step and for all the encouragement. I thank Dr Elizabeth Jacob for her valuable suggestions. I thank Dr Urmila Soman for her valuable suggestions and timely help in later stages of study. I thank Dr. Cherian Joseph, HOD, Department of Paediatrics for their guidance and

suggestions. I also wish thanks to all my colleagues. I acknowledge my parents, in-laws and my brother for their love, support and understanding.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Garg S, Gupt A, Madhavan J. Non-stress test as an admission test to assess the outcome in high-risk pregnancy. Int J Reprod Contracept Obstet Gynecol 2016;5:3993-4000.