**Original Research Article**

**EVALUATION OF HIGH-RISK TERM PREGNANCIES USING NON-STRESS TEST AT A TERTIARY HOSPITAL IN SOUTHEASTERN NIGERIA**

**ABSTRACT**

**INTRODUCTION** High-risk pregnancies include pregnancy with co-existing chronic illnesses like diabetes, hypertension, asthma, pre-eclampsia, eclampsia, renal disease, HIV, auto-immune diseases, etc. A high-risk pregnancy is defined as a pregnancy in which there is a significant probability of an adverse maternal or fetal outcome that is more than the incidence of that outcome in the general populace. **AIM:** To evaluate the outcome of high-risk term pregnancies using non-stress tests. **MATERIALS AND METHOD:** A prospective study of 160 subjects using non-stress tests to evaluate high-risk term pregnancies at NAUTH, Nnewi. **RESULTS**: The most frequent age group of occurrence was 25-34 years. There were more multigravida than primigravida women. The fetal outcomes were as follows; fetal distress showed absent = 91.1% while present = 8.9%, clear amniotic fluid = 91.8% while meconium-stain = 8.2%, admission into neonatal intensive care unit (NICU) = 12.0%, no stillbirths were recorded, and neonatal birth weight > 2.5kg = 94.3% while < 2.5kg = 5.7%. The association between NST and fetal outcomes showed fetal distress, admission into the NICU, amniotic fluid colour, mode of delivery, and APGARS score were not statistically significant p > 0.05. The association between fetal birth weight and NST was statistically significant p < 0.05. **CONCLUSION:** There is an association between non-stress tests and fetal birth weight.

Keywords: high-risk, pregnancy, fetal outcomes, birth weight, non-stress test.

I**NTRODUCTION**

Term pregnancy is the pregnancy between 37 and 42 weeks of gestation [1]and it has been established that there is a progressive increase in perinatal morbidity and mortality during this period.[2] A high-risk pregnancy is defined as a pregnancy in which there is a significant probability of an adverse maternal or fetal outcome that is more than the incidence of that outcome in the general population.[3,4] High-risk pregnancies include pregnancy with co-existing chronic hypertension, diabetes mellitus, asthma, cardiac disease, seizure disorder, sickle cell anaemia and other haemoglobinopathies, renal disease, rhesus alloimmunization, HIV infection, Syphilis, hepatitis B virus infection, preeclampsia*,* hypertension in pregnancy, cardiovascular accidents, hyperthyroidism, hypothyroidism, post maturity, malnutrition, thrombophilia, psychiatric illness, drug and alcohol abuse, smoking, family history of genetic disease and systemic lupus erythematosus.[4,5]In a bid to prevent such occurrences, clinicianshave developed several methods of assessing both antepartum and intrapartum fetal conditions. These methods include: fetal movement counting (fetal kick counting), fetal breathing, non-stress test, contraction stress test, acoustic stimulation tests, amniotic fluid volume, the biophysical profile, the modified biophysical profile, rapid biophysical profile, and Doppler velocimetry.[6]

The non-stress test (NST) is a cardiotocographic parameter. The cardiotocograph (CTG) is a continuous record of the heart rate of the fetus by an ultrasound transducer placed on the maternal abdomen, with a second transducer placed over the uterine fundus to record uterine activity simultaneously. When the CTG is used in isolation, it is called a non-stress test, but when the CTG is used after oxytocin injection, it is referred to as a contraction stress test (CST).[7] The NST and CST were two primary methods available for fetal surveillance but were noted to be poor predictors of asphyxiated infants.[7] Acoustic stimulation tests use loud external sounds from acoustic stimulators to startle the fetus and provoke heart rate acceleration.[6]

There are new emerging methods in the literature and these include fetal physiology assessment which involves the use of fetal physiological and behavioral parameters such as motor activity, heart rate patterns, and sleep-wake cycle as well as the fetal magnetoencephalography which directly assesses the fetal cortical and brain stem functions.[8,9]

The ideal methods of antepartum fetal monitoring should be simple, safe, reproducible, and reliable, This study is expected to contribute towards the timely identification of the compromised fetus which will form an evidence base for prompt intervention and possible delivery to present a live baby to a happy mother thereby averting permanent damage/death and ultimately reducing the perinatal mortality rate and maternal mortality ratio. The NST is non-invasive, accurate, and produces results that are immediately available with minimal expense and inconvenience to the fetus and its mother.[10]The non-stress test however requires 40 minutes for full observation to be done.[10]This study aimed to evaluate the non-stress test in the determination of fetal outcomes in high-risk term Pregnancy in NAUTH, Nnewi.

**MATERIALS AND METHODS**

**STUDY DESIGN**

This was a prospective cross-sectional study. The study comprised high-risk singleton pregnant women of 37 to 42 weeks of gestation, recruited from the antenatal clinics, antenatal wards, labour ward, and postnatal wards, who had ultrasound scans done in the Radiology department. The convenience sampling technique[11]was used in recruiting the 160 subjects who were used for the study in NAUTH, Nnewi.

Written consent was obtained without coercion from the respondents after an explanation of the objectives and expected outcomes of this study. The respondents were assured of full confidentiality and there was freedom to withdraw from the study at any stage without any form of penalty. Ethical approval was received from the institution of study with reference number NAUTH/CS/66/VOL.11/118/2018/58.

**STUDY POPULATION**

The inclusion criteria were high-risk pregnant women at 37 to 42 completed weeks, single fetus, and fetuses with no detected structural malformations. While the exclusion criteria were twin gestation or other higher multiples, intrauterine fetal congenital anomalies, pregnant women with antepartum haemorrhage, acute severe oligohydramnios secondary to membrane rupture, pregnant subjects <37weeks of gestational age, and maternal intake of CNS depressants, sedatives or other drugs.

**SAMPLE SIZE DETERMINATION**

The minimum sample size was obtained using the formula[11,12] for calculating sample proportion in a cross-sectional study.

n0 = Z2pq

e2

Where n0 is the sample size, Z2 is 95% = 1.96, P is 10% = 0.1, q is = 1- p = 0.9, e is 0.005

n0 = (1.96)2 x (0.1) x (0.9) = 3.8416 x 0.1x 0.9

(0.005)2  0.000025

= 138.30 approximately 138

Anticipating an attrition rate of 10%, therefore ns = n0/1-f

Given f = 10% = 0.1, then

n = 138/0.9 = 153

The expected minimum sample size was 153. A sample size of 160 was used for this study.

**STUDY TECHNIQUE**

Each participant was placed in a recumbent left lateral position on the examination couch in the ultrasound suite of the department.[13]The subjects were asked to lie on the side because having the subject supine may cause compression of the inferior vena cava and a feeling of dizziness. The abdomen was exposed from the xiphisternum to just below the suprapubic area. Acoustic gel was applied to the abdomen for lubrication and to obliterate the air interface between the probe and the skin surface. A general survey of the fetus was done with the fetal gestational age determined using the biparietal diameter, abdominal circumference, and femur length.

Following the application of acoustic gel over the cardiotocograph (ctg) transducers, one of the transducers was placed over the uterine fundus while the second transducer was placed over the fetal back. Acoustic gel reduces acoustic impedance and reflection thereby producing clearer images. Both of the transducers were securely strapped over the maternal abdomen. The ctg was switched on and a recording of the fetal cardiac activity was recorded on the paper feed of the ctg machine. The woman was asked to specify when she notes fetal movement. A normal fetus responds to fetal movement by an increase in Fetal Heart Rate (FHR). A reactive (normal) result is when at least two or more accelerations (15 beats per minute above a baseline) occur in 30 minutes. When the results of the NST were negative they were recorded as reactive while non-reactive results were recorded as positive. A positive NST result meant there have been fewer than 2 accelerations of FHR in 40 minutes.

**STATISTICAL ANALYSIS**

Data entry and analysis were carried out with the aid of the statistical package for the social sciences( SPSS) Version 23 Armonk, NY, U.S.A, 2015. Descriptive statistics was used to summarize the respondent’s socio-demographic profiles. Frequency distributions of all relevant variables were developed. Relevant means and proportions were calculated while associations between the non-stress test results and the fetal outcome were analyzed using a Chi-square test. A p-value of ≤ 0.05 was considered statistically significant

**RESULTS**

The most frequent age group of occurrencewas 25-34 years while the least frequent was the > 45 years age group with a mean age of 31.5 years. Most of the participants were married 157 (98.1%). More subjects were multigravida 98 (61.3%) than primigravida 36 (22.5%). **Table 1**

There were 120 (75.0%) reactive to the non-stress test and 40 (25.0%) non-reactive to the non-stress test. **Table 2**

The commonest high-risk factor among the participants was HIV infection (22.5%) and this was followed by hypertension in pregnancy (15.6%). The other high-risk factors in descending order of occurrence were Post-date (13.8%), Diabetes Mellitus (11.3%), Chronic Hypertension (7.5%), Hepatitis B (5.6%), decreased fetal movement (5.0%), Asthma, Hyperthyroidism, and Rhesus Iso-immunization each had values of 4.4%, Gestational diabetes (2.5%), Malnutrition, Liver Diseases, and Protein in urine had the least values with 0.6%. **FIGURE 1**

The outcomes of the pregnancies were as follows: fetal distress was present in 14 (8.9%) and absent in 144 (91.1%), there were no stillbirths recorded in the study, admission into the NICU was only seen in 19 (12.0%) of the babies while 139 (88.0%) did not require admission, amniotic fluid was clear in 145 (91.8%) while meconium-stain was seen in 13 (8.2%) of the babies, and neonatal birth weight was recorded as > 2.5kg seen in149 (94.3%) babies while <2.5kg was noted in 9 (5.7%). **Table 3**

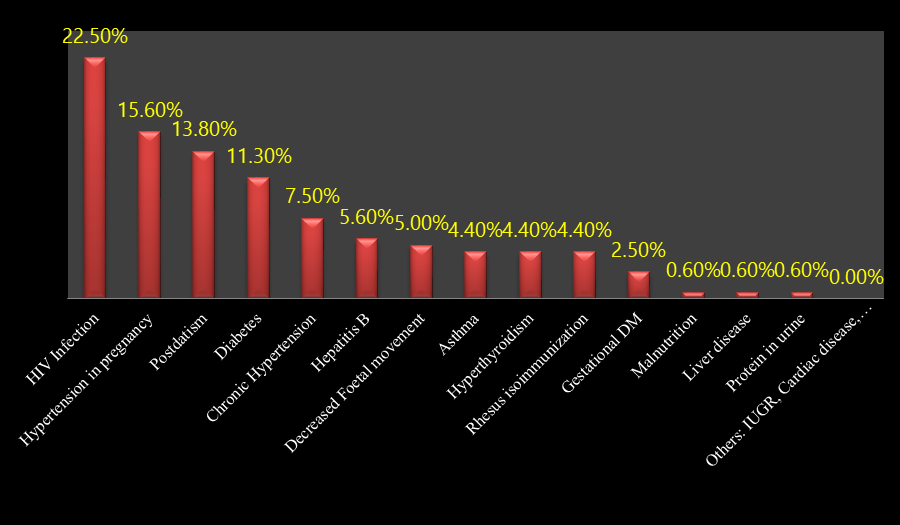
The association between the non-stress test and the fetal outcome showed that only the fetal birth weight showed statistical significance with a p-value of 0.037. All the other fetal outcome parametres such as mode of delivery, fetal distress in labour, admission into the NICU, amniotic fluid colour, and APGAR score at 1 minute and 5 minutes were all not statistically significant p-value> 0.05. The APGAR score at 1 minute and the colour of the amniotic fluid had the highest values with p values of > 0.999. **Table 4**

**Table 1:** Socio-demographic characteristics of the participants

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | | Frequency (N = 160) | Percentage (%) |
| Age category in years | 15 – 24 | 19 | 11.9 |
| 25 – 34 | 90 | 56.3 |
| 35 – 44 | 48 | 30.0 |
| ≥ 45 | 3 | 1.9 |
| Age (mean ± Standard deviation) | | 31.5 ± 5.1 | |
|  | | | |
| Marital status | Married | 157 | 98.1 |
| Divorced | 1 | 0.6 |
| Widowed | 2 | 1.3 |
|  | | | |
| Pregnancy order | Primigravida | 36 | 22.5 |
| Multigravida | 98 | 61.3 |
| Grand multipara | 26 | 16.3 |

**Table 2:** Distribution of respondents using Non-stress test

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  |  |
| Non-stress test | Zero (non-reactive) | 40 | 25.0 |
| Two (reactive) | 120 | 75.0 |

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**Figure 1: Shows a histogram of the distribution of high-risk factors among the study population**

**Table 3:** Outcome at Delivery and Post-delivery

|  |  |  |  |
| --- | --- | --- | --- |
| Variable | | Frequency | Percentage (%) |
| Fetal distress | Present | 14 | 8.9 |
| Absent | 144 | 91.1 |
|  |  |  |  |
| Stillbirth delivery | YES | 0 | 0.0 |
| NO | 158 | 100.0 |
|  |  |  |  |
| Admission into ICU | YES | 19 | 12.0 |
| NO | 139 | 88.0 |
|  |  |  |  |
| Colour of amniotic fluid | Clear | 145 | 91.8 |
| Meconium-stained | 13 | 8.2 |
|  |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| Neonatal birth weight | < 2.5Kg | 9 | 5.7 |
| >2.5 Kg | 149 | 94.3 |
|  |  |  |  |

**Table 4:** Association between non-stress test and fetal outcome

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Fetal outcome parameters | Zero  (%) | Two  (%) | Total  (%) | Test value | P-value |
| Mode of delivery: |  |  |  |  |  |
| Vaginal | 23(57.5) | 61(51.3) | 84(52.8) | 0.636 | 0.760 |
| LSCS-elective | 8(20.0) | 31(26.1) | 39(24.5) |  |  |
| LSCS-emergency | 9(22.5) | 27(22.7) | 36(22.6) |  |  |
| Fetal distress in labour: | |  |  |  |  |
| Present | 5(13.20) | 9(7.5) | 14(8.9) | 1.144 | 0.327 |
| Absent | 33(86.8) | 111(92.5) | 144(91.1) |  |  |
| Admission into NICU: |  |  |  |  |  |
| Yes | 6(15.8) | 13(10.8) | 19(12.0) | 0.670 | 0.402 |
| No | 32(84.2) | 107(89.2) | 120(100.0) |  |  |
| Colour of amniotic fluid: | |  |  |  |  |
| Clear | 35(92.1) | 110(91.8) | 145(91.8) | 0.007 | >0.999 |
| Meconium-stained | 3(7.9) | 10(8.3) | 13(8.2) |  |  |
| Neonatal birth weight: | |  |  |  |  |
| <2.5kg | 5(13.2) | 4(3.3) | 9(5.7) | 5.186 | 0.037 |
| ≥2.5kg | 33(86.8) | 116(96.7) | 149(94.3) |  |  |
| APGAR score in 1 minute: | |  |  |  |  |
| <7 | 2(5.3) | 6(5.0) | 8(5.1) | 0.004 | **>**0.999 |
| ≥7 | 36(94.7) | 114(95.0) | 150(94.9) |  |  |
| APGAR score in 5 minutes: | |  |  |  |  |
| <7 | 2(5.3) | 3(2.5) | 5(3.2) | 0.719 | 0.594 |
| ≥7 | 36(94.7) | 117(97.5) | 153(96.8) |  |  |

**DISCUSSION**

The commonest high-risk factor among the participants in this study was HIV infection followed by hypertension in pregnancy. The studies by Manzoor et al,[14] Maurya et al,[15], and Prabhu et al[16]demonstrated that hypertension in pregnancy was the most common high-risk factor with values close to that reported in this study. The mild difference in the values recorded in this study may be because it was done in a tertiary center that receives referrals from its surrounding environs and HIV-positive pregnant women attending antenatal care elsewhere are referred here for adequate multidisciplinary attention.

This study showed that vaginal delivery was more for the feti with non-reactive NST than for those with reactive NST. Studies by Rahman et al[17]and Maurya et al[15]reported similar results. Whereas, Yogitha et al[18] revealed that a greater proportion of participants with both reactive and non-reactive non-stress tests ended up delivering through a caesarean section. Our study showed that there is no statistical significance between the mode of delivery and NST. The findings show that a non-reactive NST in a pregnant woman does not always result in vaginal delivery and suggest that NST is a poor indicator of the mode of delivery in high-risk subjects.

Our study established a relationship between NST and fetal distress in labour and agrees with that reported by Lohanaet al [2] and Maurya et al[15]who also demonstrated that a non-reactive NST is associated with fetal distress. This suggests that a non-reactive NST may therefore suggest the possibility of fetal distress during labour. Fetal movement patterns are determined by the neurologic development of the fetus as well as the metabolic state of the fetus.[19]

We noted a relationship between non-reactive NST and admission into the NICU and it is collaborated with studies reported by Raouf et al[20]and Maurya et al[15]who also showed that a greater proportion of babies with a non-reactive NST were admitted into the NICU in comparison with the proportion of women with reactive NST. This association was however not statistically significant in our study.

In establishing the relationship between the non-stress test and meconium staining of the amniotic fluid, our study showed a higher percentage of the babies with a reactive NST had meconium staining at delivery and it is in agreement with that reported by Maurya et al[15]and Lohana et al[2]. Conversely, Himabindu et al[21] and Shrestha et al[22]showed that the proportion of those with meconium-stained amniotic fluid was higher in the non-reactive group than in the reactive group. This finding suggests that NST does not predict which fetuses will have meconium staining of the amniotic fluid.

The percentage of low birth weight babies from the non-reactive group is higher than the percentage in the reactive group in our study. This is similar to that in the studies by Raouf et al[20]and Bano et al[23]who also discovered that a greater proportion of neonates with low birth weight belonged to the non-reactive group in comparison to the reactive group. The association between the birth weight and the non-stress test is statistically significant and indicates that a non-reactive NST may be a pointer for a baby with low birth weight.

A greater proportion of babies with poor APGARS scores showed a non-reactive NST which was collaborated by the studies of Maurya et al[15]and Bano et al[23]. The similarity in the findings may be due to similarity in the methodology. It is important to note that there was no statistical significance between the APGARS score and NST. It is important to note that non-stress test interpretation relies only on one variable, which is the acceleration of fetal heart rate associated with movement. On a lot of occasions, the fetus is asleep during the testing, and considerable time is spent waiting for sufficient acceleration to occur to correctly interpret the results.

**CONCLUSION**

The association between non-reactive non-stress test and birth weight was statistically significant. Non-stress test alone is insufficient to predict neonatal outcomes but combining a non-stress test and an acoustic stimulation test can better predict perinatal outcomes. This will help to reduce false non-reactive non-stress tests.

**RECOMMENDATION**

Health institutions involved in obstetrics and delivery services should develop policies that incorporate the Non-stress test in their patient management protocol and this should be routinely carried out for all pregnant women with any of the high-risk factors at term.

Data: Anonymized data could be made available upon request by the corresponding author.

Ethical approval: This was received from the institution of the study with a reference number NAUTH/CS/66/VOL 11/118/2018/058. This study was conducted under the ethical principles of the Declaration of Helsinki.

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