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The relationship between first trimester nuchal translucency and adverse pregnancy outcome at Usmanu Danfodiyo University Teaching Hospital, Sokoto, Nigeria

Boysungni Zaro[1], Constance E. Shehu[2], Panti AA[3], Jamila Garba[4], Abdullahi Habib[5], Jibril Abdullahi[6]

[1]*Rasheed Shekoni Federal University Teaching Hospital Dutse, Jigawa state.*
[2,3,4]*Usmanu Danfodiyo University Teaching Hospital Sokoto*
[5,6]*Rasheed Shekoni Federal University Teaching Hospital Dutse, Jigawa State*

Abstract

Context: The first trimester of pregnancy is crucial for monitoring fetal development and maternal health. One significant screening method is the measurement of nuchal translucency (NT), which assesses the fluid-filled space at the back of a fetus neck via ultrasound. This study aims to investigate the relationship between elevated first-trimester nuchal translucency and adverse pregnancy outcomes among women receiving antenatal care at Usmanu Danfodiyo University Teaching Hospital, Sokoto.
Materials and Methods: This prospective cohort study was conducted among pregnant women between 11 and 13 weeks of gestation who presented to antenatal, gynecological, and general outpatient clinics. The clients were enrolled into the study after obtaining informed consent. Nuchal translucency (NT) measurements were obtained during first-trimester ultrasound examinations, and data were analyzed using SPSS Version 20.
Results: A total of 402 pregnant women participated in the study. The mean NT value was 2.5 mm, with a median of 2.4 mm. The clients with nuchal translucency values above 3.0 mm were considered elevated which we had the prevalence of 15.8% in this study. Out of the 402 clients, 351 (87.3%) had uneventful pregnancy outcomes, 15 (4.8%) had intrauterine growth restriction (IUGR), 10 (3.2%) had prematurity, and 7 (2.2%) had birth asphyxia. Those with elevated NT in this study 4 (1.0%) cases had congenital anomaly. The elevated NT was significantly associated with congenital anomalies (100.0%) and IUGR (60.0%), as well as an increased risk of abruptio placenta($p<0.001$).
Conclusion: The study demonstrates a significant association between elevated NT levels and adverse pregnancy outcomes, particularly congenital anomalies and IUGR. The mean NT value of 2.5 mm observed in this study was lower than previously reported international values. NT measurement in the first trimester is therefore an important non-invasive screening tool for identifying pregnancies at risk, allowing for timely interventions and closer monitoring to improve maternal and fetal outcomes. Further studies are recommended to evaluate long-term outcomes in affected pregnancies.

Keyword: First trimester, Pregnancy, Nuchal translucency

1.0 Introduction

The first trimester of pregnancy is important in fetal development and maternal health observation. Several screening techniques are used by healthcare providers during this period, such as nuchal translucency (NT) via ultrasound which is an important non-invasive procedure that evaluates the presence of fluid in the lower part of the fetal neck.[1] The significance of this measurement is that it helps identify diseases of chromosomes like Down syndrome and Trisomy 18, but also congenital heart

Corresponding Author:

Boysungni Zaro
Rasheed Shekoni Federal University Teaching Hospital Dutse, Jigawa state

boysungni@gmail.com

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diseases and other abnormalities and as a result, early detection of the condition is crucial to take corrective actions for expectant mothers.[2]

The second trimester is considered the "golden period" of pregnancy, which is the period between weeks 13 and 26, and during which many women feel the symptoms of the first trimester relieved, like nausea, fatigue, etc.[3] It is the period of fetal development, but also a period of maternal well-being. During this period, the fetus develops rapidly with the formation of essential organs and systems. The fetus is usually able to survive outside the womb with medical assistance and this is why fetal health is critical and must be monitored closely during this stage.[4]

The measurement of nuchal translucency is one of the major aspects of the first-trimester screening and is done through the use of ultrasound. The NT measurement is used to show the amount of fluid that is located under the skin on the back of the fetal neck.[5] A larger NT measurement, considered to be more than 3.0 mm, has been linked to an increased risk of chromosomal abnormalities, congenital heart defects, and other severe problems. Studies have shown that NT measurement is especially useful in detecting pregnancies with Down syndrome with a detection rate of over 80% when combined with maternal age and serum markers.[6]

High levels of NT, as well as indicating the possibility of chromosomal abnormalities, are also linked to a number of undesirable pregnancy outcomes. Research has demonstrated that the higher an NT level, the higher the chances of miscarriage, stillbirth, and preterm birth become. As an example, a systematic review also revealed that women with a high NT level were at a higher risk of adverse outcomes than those with normal levels and that close monitoring and appropriate interventions could help improve birth outcomes and fetal health.[4]

NT measurements in combination with maternal serum markers, including pregnancy-associated plasma protein-A (PAPP-A) and free β-human chorionic gonadotropin (β-hCG), can be used to improve the accuracy of risk assessment of chromosomal abnormalities.[9] Studies have demonstrated that combining NT and these markers can significantly increase detection rates such as Down syndrome.[10] This combined strategy will enable medical practitioners to rank the patients according to their individual risk factor and provide targeted prenatal care. As an example, a high-risk woman can be provided with invasive diagnostic tests, including chorionic villus sampling (CVS) or amniocentesis, to confirm or exclude possible diagnoses.[11]

Besides NT measurements and serum markers, maternal factors are important in the diagnosis of pregnancy risk. The age of the mother, her weight, ethnicity, and medical history can all play a role in determining the chances of chromosomal abnormalities and complications.[1] As an illustration, high maternal age is a long-established risk factor for aneuploidy, and the population is usually provided with more comprehensive screening opportunities.[12] Moreover, pregnancies may be complicated by maternal conditions such as obesity, diabetes, and hypertension, which affect fetal development. Through maternal health status screening, health professionals will be able to create care plans and strategies that are more tailored to the needs of each patient.[13]

2.0 Materials and Method

2.1 Study Area and Research Design

The study was carried out in Usmanu Danfodiyo University Teaching Hospital, Sokoto, a large tertiary health facility in northwestern Nigeria which provides specialized antenatal care to Sokoto and other states. The hospital also provides an ideal environment for pregnancy-related research through its well-equipped antenatal, gynecology, ultrasound, and labor wards.

A prospective cohort study design was used which involved the use of baseline data on the participants at a single point in time during early pregnancy, and the systematic follow-up of the participants during gestation. The design was selected to test the relationship between first-trimester NT and the outcome of the pregnancy in real time, which would help track maternal and fetal outcomes.

2.2 Population, Inclusion and Exclusion Criteria of the Study

The population that was studied was pregnant women undergoing antenatal care and had a gestational age of about 11–13 weeks and a single pregnancy. Inclusion criteria were a confirmed gestational age based on the last menstrual period or an early ultrasound. Women who were carrying multiple pregnancies, with serious medical problems

or those who refused to take part in the study were excluded from the study. The samples were obtained through systematic random sampling giving all eligible pregnant women an equal chance of selection. This careful selection ensured that the sample would be representative of the target population and the findings would be applicable to other clinical settings.

2.3 Sample Size and Sampling Method

The Cochran formula (Cochran, 1963)[14] was used to calculate the study population with a 95% confidence level, 5% margin of error, and 50 expected prevalence rate, giving a minimum of 384 participants. A total of 402 patients were recruited to account for an expected 10% rate of attrition. Among the 402 study subjects, 314 subjects (78.1%) had full information. The rest of the participants were not included as they did not fill out all the records, lost referral documents, or delivered at home without monitoring. About 20 patients were registered per week on average in the booking clinic as well as the gynecology emergency clinic.

2.4 Procedure of Study

The participants were recruited during their routine antenatal visits upon which they had to give informed consent. A pretested, structured questionnaire was used to collect socio-demographic data as well as medical and obstetric history. The questionnaire was also pretested with 20 people at the same facility and it was reviewed by a panel of obstetricians and sonographers regarding the accuracy of the questions. Research assistants and resident doctors in the Department of Obstetrics and Gynecology conducted the data collection.

Body mass index (BMI) was calculated using the anthropometric measurements (weight and height). Each of the participants underwent general and obstetric physical examination. The ultrasound measurement of the nuchal translucency (NT) was conducted with the help of a high-resolution ultrasound machine (GE Voluson 730 PRO). It involved the use of transabdominal sonography, and fetal imaging was performed in a mid-sagittal plane with the fetal neck in a neutral position. The calipers were placed on the inner edges of the nuchal space to obtain the greatest thickness. The measurement of NT was done between 11 and 13+6 gestational weeks. Normal NT values were taken as ≤ 3.0 mm. A value above 3.0 mm was considered high NT.

Follow-up was done prospectively on the participants who were recruited during the first trimester until birth. The visitations were scheduled following the routine antenatal visits, and the outcomes of the pregnancy were recorded at birth. Among the data collected, there were both fetal outcomes (e.g., prematurity, intrauterine fetal death, congenital anomalies, IUGR) and maternal outcomes (e.g., preeclampsia, abruptio placentae, chorioamnionitis, PPH). In case of patients who did not deliver in the facility, the data were collected using structured phone interviews and referral records.

2.5 Ethical Clearance

The institutional review board of Usmanu Danfodiyo University Teaching Hospital gave the study an ethical clearance. All the participants were informed in writing about the study, its purpose, procedures, and possible risks before their participation in the study and their informed written consent was obtained. The research was conducted in the strictest confidence, and the participants were assured that their information would be utilized only for research purposes only.

2.6 Analysis of Data

Included in the analysis of the data collected by the use of questionnaires and ultrasound measurements was SPSS Version 20. Descriptive statistics were used to summarize demographic data and clinical data and inferential statistics was used to determine the association between selected variables and level of NT.

3.0 Results

3.1 Socio-demographic Characteristics

All percentage calculations were performed in terms of the total number of participants (N = 402). A summary of the socio-demographic characteristics of the study population was summarized in Table 1. Most of the respondents (54.7%) fell in the range of 20 to 29 years. The majority were Hausa/Fulani (66.7%) and had already attained tertiary education (59.2%). Few of them smoked (0.7%), and 3.0% drank alcohol, with the majority reporting no notable social history. Concerning the past medical history, the majority of the participants (91.0%) denied having any underlying medical condition.

Table 1: Socio-demographic characteristics of the participants

Socio-demographic Characteristics	Frequency (n=402)	Percent (%)
Age in years		
< 20	26	6.5
20 – 29	220	54.7
30 – 39	150	37.3
40 – 49	6	1.5
Total	402	100.0
Tribe		
Hausa/Fulani	268	66.7
Igbo	49	12.2
Yoruba	41	10.2
Others	44	10.9
Total	402	100.0
Educational status		
No formal education	27	6.7
Primary	39	9.7
Secondary	98	24.4
Tertiary	239	59.2
Total	402	100.0
Social history		
Smoking	3	0.7
Alcohol	12	3.0
None	387	96.3
Total	402	100.0
Past medical history		
Diabetes	8	2.0
Hypertension	15	3.7
Sickle cell disease	7	1.7
Asthma	6	1.5
None	366	91.0
Total	402	100.0

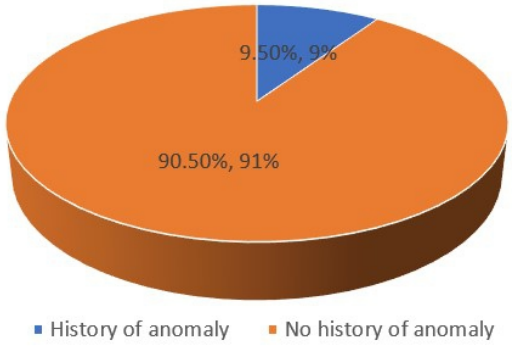

Figure 1. History of previous foetal anomaly

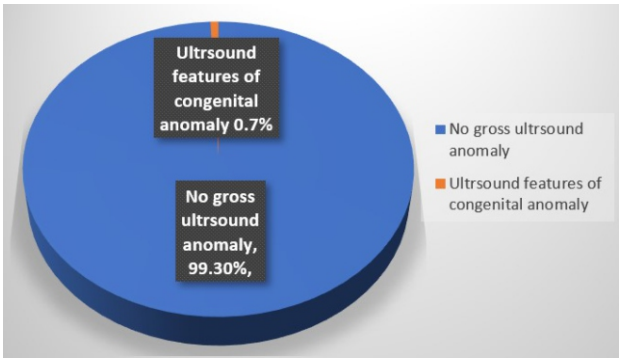

Figure 2. Anomaly ultrasound scan in index pregnancy

Table 2: Relationship between nuchal translucency and fetal, maternal, and pregnancy outcomes (N = 402)

Outcome	Normal NT (n, %)	Elevated NT (n, %)	Fisher's Exact value
Fetal Outcome			**<0.001**
Prematurity	5 (55.6)	4 (44.4)	
Birth asphyxia	3 (100.0)	0 (0.0)	
IUFD	2 (50.0)	2 (50.0)	
Congenital anomaly	0 (0.0)	4 (100.0)	
IUGR	6 (40.0)	9 (60.0)	
No complication	130 (89.7)	15 (10.3)	
Maternal Outcome			**<0.001**
Chorioamnionitis	1 (100.0)	0 (0.0)	
PPH	1 (100.0)	0 (0.0)	
Anaemia	1 (33.3)	2 (66.7)	
Abruptio placenta	0 (0.0)	2 (100.0)	
Preeclampsia	21 (67.7)	10 (32.3)	
Preterm labour	1 (100.0)	0 (0.0)	
No complication	120 (86.3)	19 (13.7)	
Pregnancy Outcome			**<0.001**
IUGR	2 (50.0)	2 (50.0)	
Placenta previa	2 (66.7)	1 (33.3)	
Abruptio placenta	0 (0.0)	4 (100.0)	
PROM	4 (66.7)	2 (33.3)	
Preterm delivery	4 (66.7)	2 (33.3)	
IUFD	0 (0.0)	1 (100.0)	
Preeclampsia	19 (76.0)	6 (24.0)	
Oligohydramnios	1 (25.0)	3 (75.0)	
Perinatal morbidity	1 (100.0)	0 (0.0)	
Congenital anomaly	0 (0.0)	2 (100.0)	
Postdatism	8 (88.9)	1 (11.1)	
Uneventful	104 (91.2)	10 (8.8)	

Key: IUFD = Intrauterine fetal death; IUGR = Intrauterine growth restriction; PROM = Premature rupture of membranes; PPH = Postpartum hemorrhage.

3.2 Nuchal Translucency

The median NT was 2.4 mm, with an average of 2.5 mm. Any NT of more than 3.0 mm was considered elevated. The frequency of high NT among the research participants was 15.8% (n = 64). Associations between elevated NT and pregnancy outcomes were checked using Chi-square tests, and statistical significance was set at a p-value of less than 0.05. It was discovered that elevated NT had a significant association with poor fetal and maternal outcomes ($p < 0.001$).

In the patients with high NT, all had congenital abnormalities, which comprised cardiac defects, neural tube defects, and abdominal wall defects. Moreover, most of them experienced intrauterine growth restriction (IUGR). Another finding was that elevated NT was also strongly associated with the risk of placental abruption. On the other hand, the

majority of patients with normal NT values (n = 120; 86.3%) experienced normal fetal development outcomes.

Another important correlation was also observed between NT and the overall pregnancy outcomes ($p < 0.001$). Most of the patients with placental abruption (n = 4; 100.0%), intrauterine fetal death (IUFD) (n = 1; 100.0%), and congenital anomalies (n = 2; 100.0%) had high NT. NT and placenta previa, premature rupture of membranes (PROM), preeclampsia, oligohydramnios, IUFD, perinatal morbidity, and postdatism showed no statistically significant associations with NT.

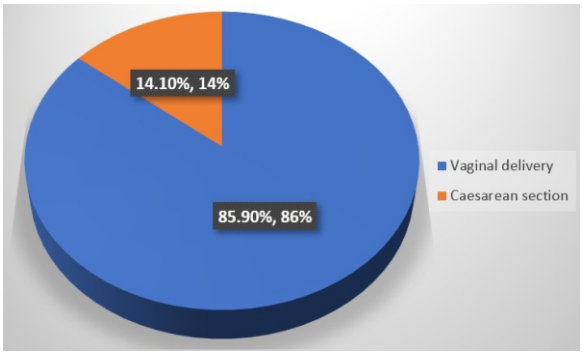

FIGURE 3: Mode of Delivery

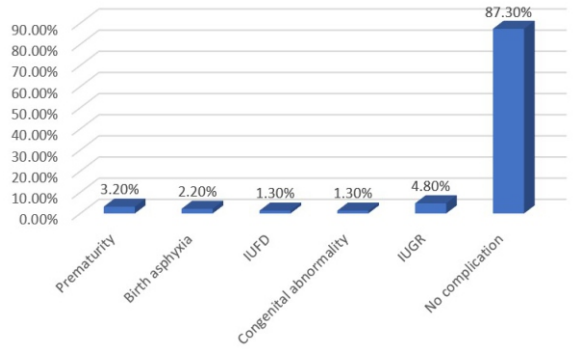

FIGURE 4: General Fetal Outcome

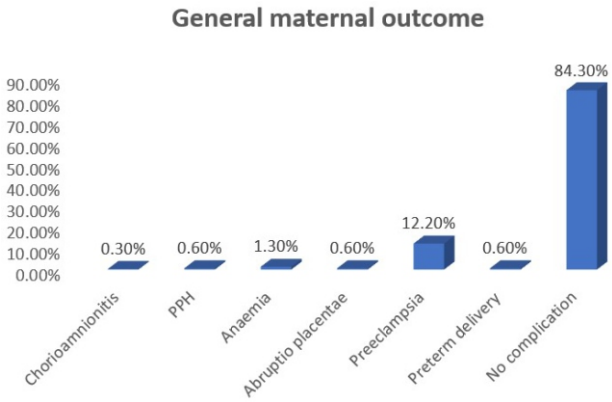

FIGURE 5: General maternal Outcome

3.3 General Outcome

4. Discussion

The mean value of the nuchal translucency (NT) in this study was 2.5 mm, which is lower than the 4.6 mm average value of NT described by Dane et al.[15] Any NT greater than 3.0 mm was deemed to be high which aligns with the 3.0 mm cutoff used in Turkey and other countries, where sensitivity to detecting chromosomal and structural abnormalities ranges from 39% to 93%.

The NT prevalence rate in the study was 15.8 which is higher than 8.3% (2.5 mm cut-off) and 3.0% (3.5 mm cut-off) in a local unpublished report. This prevalence is also higher than the 3.3% reported in a similar study in Lagos, Nigeria, using a 2.5 mm cut-off.[16] The difference can be explained by variations in population characteristics, sample size, or ultrasound measurement procedures.

In the study, the majority of fetuses who were found to have high NT were those with congenital defects (100.0%) and intrauterine growth restriction (IUGR) (60.0%). These results are comparable to a United Kingdom study that found that fetuses in the 99th percentile for NT measurements had a 17.8% risk of poor pregnancy outcomes, including miscarriage, intrauterine death, or termination due to fetal abnormality, compared to 1.5% in those with normal NT measurements. Similar results were also found by Michailidis and Economides[17], who observed a much higher rate of congenital heart defects in fetuses with high NT. Three of 11 fetuses with major cardiac abnormalities in their study had NT measurements above the 99th percentile.

On the other hand, participants with normal NT had no adverse events in 89.7% of cases, and no significant associations were found between normal NT and prematurity (55.5%) or birth asphyxia (100%).

In patients with high NT, maternal outcomes showed a higher risk of placental abruption (100.0%), but most patients overall (86.3%) had normal NT and uncomplicated outcomes. NT did not show a significant association with elevated risk of postpartum conditions such as chorioamnionitis, postpartum hemorrhage (PPH), preeclampsia, and preterm labor. The reason could be that the small sample size of patients with high NT, which could

have reduced the power to detect associations with more uncommon maternal complications.

A statistically significant relationship was found between high NT and poor pregnancy outcomes. NT was high in the majority of patients with placental abruption (100.0%), intrauterine fetal demise (IUFD) (100.0%), and congenital anomalies (100.0%). The results can be compared to global studies, which have shown a high level of correlation between high NT and poor perinatal outcomes, such as chromosomal abnormalities and structural malformations.[18]

NT levels, alpha-fetoprotein (AFP) and β-hCG were not significantly related to the mode of delivery. The majority of women (85.9%) gave birth through spontaneous vaginal delivery and 14.1% of women gave birth through cesarean due to obstetric reasons. The total fetal outcomes were positive with 87.3% of the neonates recording no incidences. Adverse outcomes included IUGR (4.8%), prematurity (3.2%), birth asphyxia (2.2%), and congenital anomalies (1.3%).

These findings are similar to a study conducted in the UK, which found more pregnancy loss and congenital heart defects in cases associated with an increase in NT, likely associated with chromosomal abnormalities.[19] The result of Roozbeh et al. found that major cardiac anomalies were more common in fetuses with increased NT than in those with other abnormalities.[20] Atrial septal defect (ASD), ventricular septal defect (VSD), and tricuspid valve insufficiency are the most frequently reported cardiac defects associated with increased NT. Our study did not identify these anomalies since no chorionic villus sampling and fetal echocardiography were performed.

All in all, the overall maternal outcome was positive, with 84.3% of pregnancies being uneventful. Preeclampsia and anemia were found in 12.2% and 1.3% of cases, respectively. Postpartum hemorrhage, placenta abruption, preterm birth, and chorioamnionitis were reported in 0.6% each, without any statistically significant differences related to NT levels.

5.0 Conclusion

The mean NT value that was found to be 2.5 mm in this study was lower than the international values. Nevertheless, its clinical importance as an early predictor of poor pregnancy outcomes is demonstrated by the prevalence of high NT of 15.8%. Elevated NT was closely related to congenital anomalies and IUGR which makes it an important prenatal screening tool.

This study reveals that the majority of pregnancies were associated with positive maternal and fetal outcomes, however, those with high NT had adverse pregnancy outcome like fetal defects and IUFD. The implementation of NT measurement as a part of routine screening during the first trimester, in conjunction with the confirmatory diagnostic test (e.g., chorionic villus sampling and fetal echocardiography), may enhance the prompt and accurate risk detection and pregnancy control in our setting.

6.0 Study Strengths and Limitations

Strengths

The researchers included the participants from the first trimester to delivery to record any outcomes of the pregnancies in real-time and reduce the chances of recall bias. The ultrasound machine and standard protocol was used to take care of all measurements of nuchal translucency, which would be accurate and consistent. The validity and reliability of the results were enhanced by the fact that the participants who were selected required confirmation of their gestational age. The scientifically calculated sample size was also taken into account and used in the study to improve the statistical power. The study was carried out in a tertiary care facility, which is a referral center; hence, the results can be generalized to other low- and middle-income countries and globally.

Limitations

A proportion of participants was lost to follow-up because of home deliveries and record loss, which could have led to some selection bias. More complex fetal tests including chorionic villus sampling, amniocentesis, and fetal echocardiography were not done and this could have underestimated the incidence of chromosomal or structural abnormalities. The research did not include longitudinal biomarker analysis (e.g., AFP, β-hCG) more than the simple measurements, making it impossible to determine combined screening performance. NT measurement is operator-dependent, even though it is standardized, and might have shown intra-observer variability.

7.0 Recommendations

1. It is suggested that healthcare providers adopt standardized procedures in the measurement of nuchal translucency, so that every pregnant woman receives relevant screening in the first trimester.
2. Women diagnosed with increased NT level should be closely monitored during pregnancy. This involves scheduling follow-up anomaly scans during the second trimester and offering in-depth counseling on the possible risks and management alternatives.
3. It is important to raise the level of awareness among pregnant women regarding the importance of screening nuchal translucency and its effects on fetus health.
4. There is a need to put in place educational programs to educate women on the screening procedure, possible outcomes, and the significance of early prenatal care so that they are empowered to make informed choices about their pregnancies.

Conflicts of Interest

The authors state that there is no conflict of interest in the research on the association between nuchal translucency in the second trimester and poor pregnancy outcomes in a tertiary care facility. The study was a purely academic and clinical one, and had no external financial aid or influence from pharmaceutical companies, medical device manufacturers, and other parties. Integrity and impartiality were applied in all the data collection, analysis, and interpretation to ascertain the validity of the findings. Peer review and ethical research guidelines were followed to minimize any possible bias.

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