

## Research Paper

# Investigating the Relationship Between Congenital Heart Disease in Fetal Echocardiography and High Nuchal Translucency Size in Fetal Ultrasound



Mohammad Hossein Arjmandnia<sup>1</sup>, Mostafa Vahedian<sup>1</sup>, Maryam Yousefi<sup>3\*</sup>, Sajjad Rezvan<sup>4</sup>, Sima Habibi<sup>5</sup>, Seyed Mehrdad Motiei Langroudi<sup>6</sup>, Enayatollah Noori<sup>1</sup>, Meysam Feizollahjani<sup>1</sup>, Mohammad Hossein Assi<sup>1</sup>

1. Department of Pediatrics, School of Medicine, Hazrat-e Fatemeh Masoumeh Hospital, Qom University of Medical Sciences, Qom, Iran.

2. Department of Family and Community Medicine, School of Medicine, Qom University of Medical Sciences, Qom, Iran.

3. Department of Obstetrics and Gynecology, School of Medicine, Qom University of Medical Sciences, Qom, Iran.

4. Department of Radiology, Ali Ebn-e Abitaleb Hospital, Faculty of Medicine, Rafsanjan University of Medical Sciences, Rafsanjan, Iran.

5. Department of Obstetrics and Gynecology, Shahid Beheshti University of Medical Sciences, Taleghani Hospital, Tehran, Iran.

6. School of Medicine, Tehran University of Medical Sciences, Tehran, Iran.



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## ABSTRACT

**Background and Aim:** This study aimed to investigate the relationship between congenital heart disease found in fetal echocardiography with high nuchal translucency (NT) size found in fetal ultrasound in mothers referring to Hazrat Masoumeh Hospital, Qom City, Iran, in 2019.

**Materials and Methods:** In this analytical study, information on all pregnant women who underwent ultrasound screening in the first trimester of pregnancy and their NT size was determined. Also, information obtained from fetal echocardiographic results, which were then subjected to fetal echocardiography, was extracted from the files. Then, the relationship between cardiovascular abnormalities with NT size and variables such as birth, weight, gestational age, and gender in these mothers were entered into a checklist and examined. Finally, the relationship between congenital heart disease and NT size was investigated using the t-test.

**Results:** The Mean±SD NT size of 152 neonates without cardiovascular disease was 1.67±0.3 mm, and the Mean±SD size was 1.86±0.5 mm in 40 neonates with cardiovascular disease. Also, a statistically significant relationship was found between NT size and cardiovascular disease in neonates (P=0.00). There was also a statistically significant relationship was not found between neonatal gender (P=0.71), maternal age (P=0.88), as well as between number of pregnancies (P=0.26), NT size (P=0.76), type of pregnancy (P=0.63), gestational age (P=0.4), and NT size on ultrasound.

**Conclusion:** Fetal echocardiography is a non-invasive method suitable for the early diagnosis of congenital heart disease in high-and low-risk pregnancies. Increased NT size is also associated with cardiovascular disease in infants.

### \* Corresponding Author:

Maryam Yousefi, Assistant Professor.

Address: Department of Obstetrics and Gynecology, School of Medicine, Qom University of Medical Sciences, Qom, Iran.

Phone: +98 (21) 02531333

E-mail: [enoori@muq.ac.ir](mailto:enoori@muq.ac.ir)

## 1. Introduction

**H**eart abnormalities are the most common congenital anomalies, estimated to be 4 to 13 per 1000 live births [1-3]. Congenital heart defects are one of the major causes of infant mortality [4]. Prenatal diagnosis of congenital heart defects is essential in improving fetal treatment outcomes [5]. Advances in prenatal ultrasound have facilitated the diagnosis of prenatal heart disease and the care of neonates with congenital heart disease (CHD) [6]. Prenatal diagnosis of CHD plays a vital role in improving fetal CHD outcomes by providing useful information to parents and assisting in the optimal management of the prenatal system [5]. Since the 1980s, fetal echocardiography has become the most important technique in the prenatal diagnosis of CHD [7]. On the other hand, fetal ultrasound screening, including “basic” and “extended” organ screening, has significantly improved the prenatal diagnosis of CHD [8, 9]. In addition, several studies have reported the association of increased nuchal translucency (NT) with major heart defects, other structural defects, and rare genetic syndrome [10, 11]. NT measurement in 10-14 weeks of pregnancy has been developed as a sensitive, accurate, and effective method for screening chromosomal abnormalities [12]. In a screening study involving 96127 singleton pregnancies, the incidence of chromosomal defects increased with thicker fetal NT [12]. Another study of 693 normal chromosomal pregnancies with a fetal NT of at least 3.5 mm, representing the 99<sup>th</sup> percentile of the normal range, reported the prevalence of adverse outcomes, including significant structural abnormalities and genetic syndrome [11]. The American College of Obstetricians and Gynecologists, the Institute of Ultrasound in Medicine (AIUM), and the International Society of Obstetrics and Gynecology Ultrasound recommended that women with known risk factors for CHD perform two ultrasound screening tests and one fetal echocardiogram [13-15]. The application of fetal echocardiography in the diagnosis of CHD after normal cardiac imaging, with the diagnosis of anatomical dissection, has been questioned in previous work [16, 17]. However, the recommendations have not changed.

Given the high prevalence of CHD and the importance of its early diagnosis, especially in the prenatal stage, we should take appropriate measures at the right time to reduce morbidity and mortality. However, no study has been conducted in Iran on this topic. We, therefore, intended to re-evaluate the rate of abnormal fetal echocardiography after an accurate anatomical ultrasound. Also, we examined the incidence of CHD in NT-size ul-

trasound fetal echocardiography in pregnant women to use the project results for timely and appropriate referral.

## 2. Materials and Methods

The present research is an analytical cross-sectional study. The study population comprised all pregnant women referred to the Fetal Echocardiography Department of Hazrat Masoumeh Hospital, Qom City, Iran, in 2019. According to the following sample volume formula and taking into account the type I error of 5%,  $P=42.8\%$ , and  $d=7\%$  based on the results of similar studies [18], the minimum number of required samples is 192. This number was included in the study. The sample was chosen by available sampling. After approving the plan by the Research Council of the Medical School and obtaining the code of ethics from Qom University of Medical Sciences, the researcher began to study. In this study, we extracted information from all pregnant women who underwent pregnancy ultrasound, and their NT size was determined, as well as information from fetal echocardiographic results that were later subjected to fetal echocardiography. Then fetuses with CHD and NT size and variables such as birth, weight, gestational age, and gender in these mothers were checked and examined. Finally, the relationship between CHD and NT size was examined. The inclusion criterion included complete information in the file, and the exclusion criteria included the use of cardiac drugs by mothers, presence of heart disease in mothers, multiple pregnancies, and non-viable fetuses in the echocardiographic examination. In this study, all echoes were examined by a pediatric cardiologist, and a gynecologist performed all ultrasounds. All data were entered into SPSS software, version 22. After estimating the descriptive results, such as Mean $\pm$ SD for quantitative variables and frequency for the frequency of qualitative variables, the study hypotheses were analyzed using the t-test at a significance level of 0.05%.

## 3. Results

A total of 104 infants (54.2%) were girls, and 88 (45.8%) were boys. The Mean $\pm$ SD NT size was  $1.60\pm 0.28$  mm for girls and  $1.62\pm 0.35$  mm for boys, and no statistically significant relationship was found between neonatal gender and NT size on ultrasound ( $P=0.71$ ). The Mean $\pm$ SD age of mothers was  $32.16\pm 10.73$  years. There was no significant relationship between NT size and mothers' age ( $P=0.88$ ).

The Mean $\pm$ SD number of pregnancies in the studied mothers was  $2.13\pm 1.19$ , and no statistically significant relationship was found between the number of pregnan-

cies and NT size ( $P=0.26$ ). The Mean $\pm$ SD gestational age of pregnant women was  $39.44\pm 1.7$  weeks. No statistically significant relationship was found between gestational age and NT size ( $P=0.4$ ).

The Mean $\pm$ SD NT size in mothers who normally became pregnant was  $1.61\pm 0.32$  mm, and this value was  $0.3\pm 1.59$  mm in mothers who were induced pregnant, and no statistically significant relationship was found between the type of pregnancy and NT size ( $P=0.63$ ). The Mean $\pm$ SD NT size was  $1.62\pm 0.33$  mm in mothers without metabolic disease and  $1.55\pm 0.22$  mm in mothers with metabolic disease. There was no statistically significant relationship between NT size and metabolic diseases in mothers ( $P=0.23$ ). In 152 infants without cardiovascular disease, the Mean $\pm$ SD NT size was  $1.55\pm 0.24$ , and in 40 infants with cardiovascular disease, it was  $1.83\pm 0.46$  mm. Also, a statistically significant relationship was found between NT size and cardiovascular disease in neonates ( $P=0.001$ ) (Table 1).

#### 4. Discussion

Based on our study findings, in 152 infants without cardiovascular disease, the Mean $\pm$ SD NT size was  $1.67\pm 0.3$  mm, and in 40 infants with cardiovascular disease, it was  $1.86\pm 0.5$  mm. Also, a statistically significant relationship was found between NT size and cardiovascular disease in infants ( $P=0.005$ ). Besides, no statistically significant relationship was found between infant gender, maternal age, number of pregnancies, NT size, type of pregnancy, gestational age, and NT size on ultrasound. Souka et al. conducted a study to evaluate the results of normal chromosomal pregnancies with an increase in NT on scan at 10-14 weeks of gestation [18]. This retrospective study examined 1320 normal chromosomal singleton pregnancies with NT above 3.5 mm. In addition to fetal karyotyping, these patients were examined by ultrasound at

weeks 14 to 16 and 20-20-20, special fetal echocardiography, and infection screening and genetic testing in selected cases. The findings of this study were that in 1320 pregnancies, 68 cases (5.15%) of spontaneous abortion or intrauterine death, 18 cases (1.36%) of neonatal deaths, and 154 cases (11.67%) of pregnancies occurred. Of 1080 survivors (81.82%), 60 (5.56%) had abnormalities that required medical or surgical treatment or resulted in a mental disability. The probability of a flawless delivery in the group with NT of 4.4 to 4.4 mm was 86%, for people with NT of 4.4 to 5.4 mm, it was 77%, for those with NT 4.4-5.5 mm, 67%, and for people with NT, of 6.5 mm was  $\geq 31\%$ . Increased fetal NT was associated with chromosomal abnormalities and many fetal defects and genetic syndromes [18]. The study findings, in line with our results, showed that increasing the size of NT will be effective in the development of CHD of cardiovascular disease. So in most cases, a series of prenatal research, including fetal karyotyping, accurate scanning, fetal echocardiography, as well as genetic testing, and infection screening (which can be completed up to 20 weeks of gestation), can distinguish between complicated and safe pregnancies. In another study, Rosemary et al. conducted a retrospective study of women who underwent fetal anatomy ultrasound and echocardiography during 16 and 26 weeks of gestation [19]. Their primary outcome was an abnormal fetal echocardiogram, defined as a structural abnormality of the heart. A total of 1000 women (1052 fetuses) were admitted. The most common sign of echocardiography was a family history of CHD. Five fetuses were abnormally echoed (0.5%, 95% confidence interval: 1-1/1%), of which only one case changed. The other four were suspected of having ventricular septal defects. Of these, postnatal cardiac imaging was not observed in three cases. This study showed that the fetus's abnormal echocardiogram is low after a detailed anatomical ultrasound, which obstetricians and fetuses interpret. Fetal echocardiography as a second

**Table 1.** Relationship between nt size and cardiovascular abnormalities and patients' risk factors

Variables		NT size (mm)	P
Metabolic disease	No	$1.62\pm 0.33$	0.23
	Yes	$1.55\pm 0.22$	
Type of pregnancy	Normal	$1.61\pm 0.32$	0.63
	Induction	$1.59\pm 0.3$	
Cardiovascular abnormalities	No	$1.55\pm 0.24$	0.00
	Yes	$1.83\pm 0.46$	

screening test is of little clinical use and is unlikely to be cost-effective in this setting [19]. Like our study, Chen et al. conducted a study to evaluate the performance of accurate fetal echocardiography by a gynecologist-obstetrician sonographer in diagnosing CHD in a Chinese population [3]. The study included a prospective mountaineering team of 10259 pregnant women who attended 10 third regional hospitals in China.

The inclusion criteria included singleton pregnancy and pregnancy 18≤28, 18 years. Women with multiple pregnancies were excluded. Accurate fetal echocardiography was performed by trained physicians with at least three years of experience. Final outcome measures included sensitivity, specificity, and positive and negative predictive value of fetal echocardiographic probability in the prenatal diagnosis of CHD. The results showed that the sensitivity and specificity of fetal echocardiography in the diagnosis of any CHD disease in the high-risk population were 33.9% and 99.8%, respectively, and in the high-risk population were 68.8% and 99.4%, respectively. For the diagnosis of major CHDs, fetal echocardiography has high sensitivity and specificity and satisfactory positive and negative ratios in both low-risk (88.2%, 100%, 6947.7, and 0.1111, respectively) and high-risk populations (100%, 99.9%) (833.3 and <0.0001, respectively).

The sensitivity and probability ratios for detecting minor CHDs were significantly lower in both populations. This study showed that complete fetal echocardiography performed by skilled physicians reveals a high chance of CHD diagnosis in low-risk and high-risk populations. However, this chance was limited for the detection of partial CHD. Combining fetal echocardiography with multiple cardiac views in routine ultrasound screening may improve the rapid diagnosis of major fetal CHD and facilitate appropriate parental counseling [20]. One of the limitations of this study is the incomplete results in the studied files.

## 5. Conclusion

Our study showed that the size of the NT in the screening ultrasound of the first trimester of pregnancy somewhat predicted the results of fetal echocardiography, and the high NT size is associated with cardiovascular abnormalities in the fetal echo. We recommend that fetal echocardiography be performed routinely for all pregnant women. Finally, it is suggested that the present study be performed in a longer period and with larger sample size, and also that the result of echocardiography is compared with the result after delivery. It is rec-

ommended that the echocardiography results in a large number of pregnant women with gestational and non-gestational diabetes and pregnant women with abnormal NT size be evaluated. Also, we suggest that the accuracy of NT measurement in screening ultrasound of pregnant women be evaluated.

## Ethical Considerations

### Compliance with ethical guidelines

The Ethics Committee of Qom University of Medical Sciences approved this study (IR.MUQ.REC.1399.227). Written informed consent was obtained from all patients to access their medical file records.

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### Authors' contributions

All authors equally contributed to preparing this article

### Conflict of interest

The authors declared no conflict of interest.

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