PERINATAL JOURNAL

Research Article

Perinatal Journal 2014;22(2):74-78

# Accuracy rate of sex determination in the first trimester ultrasonography

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## Abstract

**Objective:** Our aim was to compare the fetal sex determined in the ultrasonographic examination carried out at weeks between $11^{0/7}$ and $13^{6/7}$ in singleton pregnancies with the sex determination at 22 weeks of gestation, and to calculate accuracy rates.

**Methods:** Spontaneous singleton pregnant women who had first trimester screening between 2008 and 2010 and had no structural anomaly were evaluated. Fetuses on which sex determination was done between weeks $11^{0/7}$ and $13^{6/7}$, of which sex verification data were received in the ultrasonography carried out at 22 weeks of gestation, and which were evaluated by a single clinician were included to the study. A total of 395 fetuses complying with inclusion criteria were analyzed. The distribution of rates by years was reviewed.

**Results:** Mean maternal age was found as 30.5±3.3 years, and mean week of gestation was 12.6±0.5. It was found in the verification ultrasonography made at 22 weeks of gestation that the accuracy of fetuses who were made sex determination between weeks $11^{0/7}$ and $13^{6/7}$ increased by years and reached a high rate as 89.9%. In previous years, the possibility to determine sex as female but to change the determination as male in the verification made at 22 weeks of gestation was found significantly ($p<0.001$) higher (about two times) than the possibility to determine sex as male but to change the determination as female in the verification made at 22 weeks of gestation, and this difference disappeared when determination percentage increased.

**Conclusion:** The sex determination in ultrasonographic examinations between weeks $11^{0/7}$ and $13^{6/7}$ during pregnancy has an increasing accuracy rate as clinician's experience increases.

**Keywords:** First trimester, fetus, sex, ultrasonography, screening.

## *Özet:* Birinci trimester ultrasonografisinde cinsiyet tayini doğruluk yüzdesi

**Amaç:** Tekil gebeliklerde $11^{0/7}$–$13^{6/7}$ haftalar arasında yapılan ultrasonografik değerlendirmede saptanan fetal cinsiyetin 22. hafta ultrasonografisindeki cinsiyet tayini ile karşılaştırılarak doğruluk yüzdelerinin hesaplanması amaçlandı.

**Yöntem:** 2008 - 2010 yılları arasında birinci trimester taraması yapılmış olan, yapısal anomalisi bulunmayan spontan tekil gebeler değerlendirildi. $11^{0/7}$–$13^{6/7}$ haftalar arasında cinsiyet tayini yapılıp 22. hafta ultrasonografisinde cinsiyet doğrulama verilerine ulaşılan, tek uygulayıcının değerlendirdiği fetüsler incelemeye dâhil edildi. Dâhil etme ölçütlerine uygun 395 fetüs değerlendirmeye alındı. Oranların yıllara göre dağılımı incelendi.

**Bulgular:** Ortalama anne yaşı 30.5±3.3 yıl olarak saptandı. Ortalama gebelik haftası 12.6±0.5 idi. $11^{0/7}$-$13^{6/7}$ hafta taramasında cinsiyet tayini yapılan fetüslerin 22. hafta doğrulamasında uyum oranının yıllar içerisinde arttığı ve %89.9 gibi yüksek bir yüzdeye ulaştığı saptandı. Önceki yıllarda kız olarak belirtilip 22. hafta doğrulamasında erkek saptanma olasılığı, erkek olarak belirtilip 22. hafta doğrulamasında kız saptanma olasılığından anlamlı ($p<0.001$) olarak (yaklaşık 2 kat) fazla görülürken, bu fark saptama yüzdesinin artması ile ortadan kalkmıştır.

**Sonuç:** Gebelikte $11^{0/7}$–$13^{6/7}$ hafta ultrasonografik incelemelerinde cinsiyet tayini, uygulayıcı deneyimi ile artan yüksek doğruluk oranına sahiptir.

**Anahtar sözcükler:** Birinci trimester, fetüs, cinsiyet, ultrasonografi, tarama.

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**Received:** September 12, 2013; **Accepted:** November 25, 2013

Available online at:
www.perinataljournal.com/20140222003
doi:10.2399/prn.14.0222003
QR (Quick Response) Code:

## Introduction

Fetal sex determination has an importance for detecting gender-specific genetic diseases and determining to practice proper invasive test according to the possibility. While sex determination can be easily done by ultrasonography at and after second trimester,[1-6] it is a late period for invasive procedure and causes stressful gestational follow-up. Today, with the help of advanced genetic technology, fetal sex determination can be done through maternal blood in genetic diseases such as hemophilia from maternal blood; however, this method is very expensive for now and ultrasonography is recommended in developing countries in terms of costs.[7,8] In this respect, sex determination at the earliest possible period by fetal ultrasonography is very significant for detecting gender-specific genetic diseases.

In our study, we aimed to compare the fetal sex determined in the ultrasonographic examination carried out at weeks between $11^{0/7}$ and $13^{6/7}$ in singleton pregnancies with the sex determination by ultrasonography at 22 weeks of gestation, and to calculate the accuracy rates.

## Methods

In our study, medical files of pregnant women who had sex determination at first trimester during routine gestational follow-up between 2008 and 2010 and who were confirmed for sex determinations at second trimester (22 weeks of gestation) were evaluated retrospectively. Spontaneous singleton pregnancies who had first and second trimester screenings and sex determination, had no structural anomaly and evaluated by a single clinician were included to the study. Fetal ultrasonography screenings were carried out transabdominally by a single clinician by Voluson 730 Expert (GE Healthcare, Milwaukee, WI, USA) ultrasonography device with 4-7 MHz convex transducer in accordance with the criteria defined in the literature of sex determination.[1-6,9-13] Angle measuring method was used for sex determination by early period fetal ultrasonography. The evaluation was done in supine position where fetal genital area is in midsagittal plane, fetus reaches to probe in parallel and legs and spine is not on extension. The angle of genital tubercle to a horizontal line drawn through the lumbosacral skin surface was measured and the cases with angle at and above 45 degrees were determined as male (**Fig. 1**), and those with genital tubercle parallel or convergent to the horizontal line (<10 degrees) were determined as female (**Fig. 2**). In cases with an angle between 10 and 45, sex determination was not done. In the sex determinations by fetal ultrasonography at 22 weeks of gestation, 3 lines and presence of vulva was interpreted as female while presence of phallus was interpreted as male.

The cases without any sex change in sex determination evaluations between first and second trimesters constituted "No change" group; the cases who were determined as male in the first trimester but then defined as female in the second trimester constituted "male-female" group, and the cases who were determined as male in the first trimester but then defined as female in the second trimester constituted "male-female" group. By calculating accuracy rates of sex determination, the distribution of accuracy rates by years was evaluated in order to show any difference in accuracy rates depending

**Fig. 1.** Ultrasonography example of a male fetus.

**Fig. 2.** Ultrasonography example of a female fetus.

on the experience of clinician. Fetal measurement values of accuracy groups in sex determination were compared among groups for each week of gestation.

Statistical evaluations were done by using SPSS version 17.0 (SPSS Inc., Chicago, IL, USA). Chi-square test and one-way ANOVE tests were used, respectively, in order to compare distribution rates and mean measurement values among groups. Statistical significance level of p value was determined as <0.05.

## Results

A total of 395 pregnant women who complied with inclusion criteria were included to the study. Mean maternal age was found as 30.5±3.3 years, and mean week of gestation was 12.6±0.5. Accuracy rates for sex determination of fetuses evaluated and the distribution according to weeks of gestation are shown in the **Table 1**. Generally, the accuracy rate of sex determination in the first trimester for weeks $11^{0/7}$-$13^{6/7}$ was found as 82.3%. Accurate determination rates and changes by years depending on the experience of clinician for ultrasonography are shown in the **Table 2**. The compatibility rate of fetuses, which had sex determination at weeks $11^{0/7}$-$13^{6/7}$, with the verification in 22 weeks of gestation was found as low as 77.2% in the beginning; however, it increased as the experience of clinician increased by years, and reached a high rate as 89.9%. In previous years, the possibility to determine sex as female but to change the determination as male in the verification made at 22 weeks of gestation was found significantly (p<0.001) higher (about two times) than the possibility to determine sex as male but to change the determination as female in the verification made at 22 weeks of gestation, and this difference disappeared when determination percentage, in other words the experience, increased. The fetal measurement values of each group for each week regarding the fetuses, which had sex determination at weeks $11^{0/7}$-$13^{6/7}$, are shown in **Table 3** com-

**Table 1.** Accuracy rates of fetal sex determination.

| | Male→Female change | No change | Female→Male change |
|---|---|---|---|
| 11 weeks of gestation | 5.4% | **81.1%** | 13.5% |
| 12 weeks of gestation | 7.2% | **80.4%** | 12.3% |
| 13 weeks of gestation | 3.6% | **89.2%** | 7.2% |
| Total | 6.3% | **82.3%** | 11.4% |

**Table 2.** Change by years of accuracy rates in sex determination of fetuses evaluated.*

| Year | Gender change | N | Percentage (%) |
|---|---|---|---|
| 2008 | No change | 44 | 77.2 |
| | Female→Male change | 9 | 15.8 |
| | Male→Female change | 4 | 7.0 |
| 2009 | No change | 147 | 77.8 |
| | Female→Male change | 29 | 15.3 |
| | Male→Female change | 13 | 6.9 |
| 2010 | No change | 134 | 89.9 |
| | Female→Male change | 7 | 4.7 |
| | Male→Female change | 8 | 5.4 |
| Total | No change | 325 | 82.3 |
| | Female→Male change | 45 | 11.4 |
| | Male→Female change | 25 | 6.3 |

* Distribution was analyzed by chi-square test.

**Table 3.** Sex determination groups and fetal biometry according to the weeks of gestation.*

| | | CRL | Biparietal diameter | Head circumference | Abdominal circumference | Femur length |
|---|---|---|---|---|---|---|
| 11 weeks of gestation | Male→Female change (n=2) | 49.5±2.1 | 16.5±0.7 | 65.0±4.2 | 48.5±0.7 | 3.8±0.4 |
| | No change (n=30) | 50.6±2.5 | 17.0±1.3 | 66.7±5.3 | 53.4±4.8 | 5.2±0.8 |
| | Female→Male change (n=5) | 49.4±3.1 | 16.4±0.9 | 63.2±2.9 | 52.2±4.1 | 4.7±0.8 |
| 12 weeks of gestation | Male→Female change (n=20) | 58.2±3.8 | 19.3±1.5 | 74.4±5.8 | 58.8±5.4 | 6.2±1.1 |
| | No change (n=221) | 60.4±3.8 | 20.2±1.6 | 77.0±5.5 | 61.3±4.9 | 6.8±1.2 |
| | Female→Male change (n=34) | 59.7±3.8 | 19.9±1.6 | 76.1±5.4 | 60.9±4.5 | 6.6±1.1 |
| 13 weeks of gestation | Male→Female change (n=3) | 69.0±1.7 | 22.7±1.2 | 85.3±4.7 | 71.0±1.7 | 7.7±0.4 |
| | No change (n=74) | 70.7±4.8 | 22.9±1.8 | 86.8±5.7 | 70.5±5.6 | 9.1±1.5 |
| | Female→Male change (n=6) | 68.7±1.9 | 21.8±1.8 | 82.7±5.6 | 67.8±4.0 | 9.1±1.7 |

*Mean measurement values for each week were compared among the groups by ANOVA test.

paratively. Even though the fetal measurement values of the "No change" group for each week were found to be higher, there was statistically no significant difference compared to other groups.

## Discussion

Fetal sex determination has an importance for detecting gender-specific genetic diseases and determining to practice proper invasive test according to the possibility. High success rates of sex determination were reported for fetal ultrasonography generally between 12 and 40 weeks of gestation.[5] In the early periods of clinical application of fetal ultrasonography, accuracy rates for sex determination in late period screening series were reported as successful varying between 64% at 25 weeks of gestation and 95.6% at 30 weeks of gestation.[1,2] While sex determination by fetal ultrasonography can be done more easily when anatomy becomes more clear at and after second trimester,[1,2] it is a late period for invasive procedure and causes stressful gestational follow-up for pregnant woman.

In previous research series on sex determination at earlier weeks of gestation, the accuracy rate was reported as low varying between 47 and 69% between 10 and 25 weeks of gestation,[3,4] while recent studies reported success by ultrasonography in the rates as 92.3%.[6] Also, it was seen that the margin of error in sex determination has decreased as experience increases, which was also shown in our study.[6]

Especially, in a wide case series where sex determinations between 11 and 14 weeks of gestation were evaluated, fetal sex determination for each week was reported as 46%, 75%, 79% and 90%, respectively.[9] In our study, the general rates for 12 and 13 weeks of gestation are similar to that study. Again, in another similar study where sex determination rates for 11-14 weeks of gestation were evaluated, the rate was found as 70.3% for 11 weeks of gestation and as 100% for 13 weeks of gestation.[10] In that study, 56% of the determinations at 11 weeks of gestation especially for male fetuses were wrong and determined as female, while only 5% of the female fetuses were determined incorrectly as male. In our study, false sex determination of male fetuses were made similarly higher; however, while similar rates were observed for all weeks, in that study carried out previously, false determination rate for both sexes at 13 weeks of gestation was found as 0%.[10] Certainly, the accurate sex determination of male fetuses is significant when it comes to gender-specific genetic diseases. In another study carried out in Turkey, accuracy rate of sex determination was similarly found as 83.6%, and in that study, success rate for male fetuses was 77.2% while it was 91.1% for female fetuses.[11]

In a study where the relationship between CRL and increase of accuracy rate for ultrasonographic sex determination, it was emphasized that CRL could be misleading for female fetuses when CRL is below 62.6 mm even though accuracy rate was found high.[12] In our study, fetal CRL values of the "No Change" group for each week were found high; however, this difference was not statistically significant. In the study of Pedreira et al., accuracy rate of sex determination was found as 93.9% and 6 of 11 female fetuses were identified as male later.[14] They observed that the angle between spine and phallus varied at transverse and sagittal profiles depending on the phallus erection, and proposed that false determination of these male fetuses as female fetuses might depend on phallus erection.

## Conclusion

The sex determination in ultrasonographic examinations between weeks $11^{0/7}$ and $13^{6/7}$ during pregnancy has an increasing accuracy rate as clinician's experience increases.

**Conflicts of Interest:** No conflicts declared.

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