

# The ultrasound identification of fetal gender at the gestational age of 11–12 weeks

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## ABSTRACT

**Introduction:** The early prenatal identification of fetal gender is of great importance. Accurate prenatal identification is currently only possible through invasive procedures. The present study was conducted to determine the accuracy and sensitivity of ultrasound fetal gender identification. **Materials and Methods:** The present cross-sectional study was conducted on 150 women in their 11<sup>th</sup> and 12<sup>th</sup> weeks of pregnancy in Hamadan in 2014. Ultrasound imaging performed in the 11<sup>th</sup> and 12<sup>th</sup> weeks of pregnancy for fetal gender identification identified the fetus either as a girl, a boy, or as a “gender not assigned.” Frequency, sensitivity, specificity, positive and negative predictive values, and accuracy of the gender identification was assessed using SPSS version 20. The significant level was 0.05 in all analyses. **Results:** Of the total of 150 women, the gender was identified as female in 32 (21.3%), as male in 65 (43.3%), and not assigned in 53 (35.3%); overall, gender identification was made in 64.6% of the cases. A total of 57 male fetuses were correctly identified as boys, and 8 female fetuses were wrongly identified as boys. As for the female fetuses, 31 were correctly identified as girls, and 1 was wrongly identified as a boy. The positive predictive value for the ultrasound imaging gender identification was 87.6% for the male fetuses and 96.8% for the female fetuses. **Conclusion:** The present study had a much higher gender identification accuracy compared to other studies. The final success of fetal gender identification was about 91% in the 11<sup>th</sup> and 12<sup>th</sup> weeks of pregnancy.

**Keywords:** Fetal gender, pregnancy, ultrasound

## Introduction

The early prenatal identification of fetal gender is of great importance in the management of pregnancy in families at risk for certain inherited diseases. Accurate prenatal identification is currently only possible through invasive procedures and chorionic villus sampling (CVS).<sup>[1-3]</sup> Occasionally, CVS is difficult to perform, posing a 1%–5% threat of pregnancy loss.<sup>[2]</sup> The fetal gender can be identified even in the first trimester of pregnancy from the 11<sup>th</sup>-week onward through observing the direction of the genital tubercle and sagittal sign. A downward tubercle indicates a female fetus and an upward tubercle a male fetus.<sup>[3,4]</sup> If the examination of the midline sagittal view of the genital area shows a caudal notch, the fetus is female, and if it shows a cranial notch, then the fetus is male.<sup>[5]</sup> In the second and third trimesters

of pregnancy, ultrasound imaging scans the genital anatomy of the fetus to identify its gender. In the early studies conducted on the use of ultrasound results for identifying the fetal gender, a male fetus was demonstrated by the presence of a scrotum and a penis, and a female fetus by the absence of these organs.<sup>[6]</sup>

With technological advances, seeing the vulva, clitoris, and labia are taken to indicate a female fetus, whereas seeing the scrotum, penis, testicles, and raphe indicate a male fetus. Seeing the internal pelvic structure of the fetus, including the uterus and ovary, is also used to help identify the fetal gender.

There is a substantial chance of getting a false-negative diagnosis if the ultrasound imaging for fetal gender identification has been performed in the first trimester of pregnancy.<sup>[3,7]</sup> However, research suggests a better sensitivity of ultrasound imaging for fetal gender identification performed in the second trimester of pregnancy.<sup>[8]</sup>

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The sensitivity of gender identification measures depends on the operator, machine, and habitus involved, and it increases with the radiologist's experience and if ultrasound imaging is performed using the high-resolution machine.<sup>[3]</sup> A false fetal gender identification has adverse psychological effects on the family.<sup>[3]</sup> Specialists are therefore constantly seeking to make accurate fetal gender identification in the first trimester of pregnancy. The present study was conducted to determine the accuracy and sensitivity of ultrasound fetal gender identification in Hamadan.

## Materials and Methods

The present cross-sectional study was conducted progressively on 150 women in their 11<sup>th</sup> and 12<sup>th</sup> weeks of pregnancy visiting private clinics in Hamadan for ultrasound fetal gender identification in 2014. Ultrasound imaging performed in the 11<sup>th</sup> and 12<sup>th</sup> weeks of pregnancy for fetal gender identification identified the fetus either as a girl, a boy, or as a "gender not assigned."

Some patients visited during their second or third trimesters of pregnancy to confirm their fetal gender and register the ultimate fetal gender identified. In patients who did not visit during their second or third trimesters of pregnancy, the ultimate fetal gender identification was confirmed over the phone.

The ultrasound imaging device used was GE Voluson E6. Ultrasound imaging was performed by a radiologist; the genital region was examined in a mid-sagittal plane, and the fetal gender was assigned as male if the angle of the genital tubercle to a horizontal line through the lumbosacral skin surface was  $>30^\circ$  and female when the genital tubercle was parallel or convergent ( $<30^\circ$ ) to the horizontal line.

The data obtained were analyzed in SPSS 20 (SPSS, Chicago, IL, USA). The descriptive analysis of the data was conducted through assessing the frequency, sensitivity, specificity, positive and negative predictive values, and accuracy of the gender identified. The researchers used Chi-square test, Fisher's exact test, and *t*-test with a significance level of 0.05 to identify any significant differences between the data.

## Results

Ultrasound imaging was performed in 150 pregnant women, 51 (34%) of whom were in their 11<sup>th</sup> week of pregnancy and 99 (66%) in their 12<sup>th</sup> week. The youngest female fetus whose gender was correctly identified was 11-week-old, and the youngest male fetus whose gender was correctly identified was 11 weeks and 1 day old. The correct identification of gender was not related to the fetal gender (Fisher's exact test,  $P = 0.264$ ).

Gestational age was significantly higher in cases where fetal gender identification could be made compared to in cases where the gender was not assigned ( $85.9 \pm 3.3$  days vs.  $83.7 \pm 3.9$  days and  $P = 0.001$ ). Of the total of 150 women who underwent

ultrasound imaging in the 11<sup>th</sup> and 12<sup>th</sup> weeks of pregnancy, the gender was identified as female in 32 (21.3%), as male in 65 (43.3%), and not assigned in 53 (35.3%); overall, gender identification was made in 64.6% of the cases. As presented in Table 1, in the 11<sup>th</sup> week of pregnancy, gender identification was made in 23 (45.1%) cases, and in the 12<sup>th</sup> week, in 74 (74.7%) cases. In the 11<sup>th</sup> and 12<sup>th</sup> weeks of pregnancy, a correct fetal gender identification was made in 31.32 (96.9%) of the baby girls and in 57.65 (87.7%) of the baby boys.

A total of 57 male fetuses were correctly identified as boys and 8 female fetuses were wrongly identified as boys. As for the female fetuses, 31 were correctly identified as girls, and 1 was wrongly identified as a boy [Table 2].

The positive predictive value for the ultrasound imaging gender identification was 87.6% for the male fetuses and 96.8% for the female fetuses. That is to say, reporting a male gender in the ultrasound imaging performed in the 11<sup>th</sup> or 12<sup>th</sup> weeks of pregnancy is likely to be 87.6% correct and reporting a female gender is likely to be 96.8% correct. Overall, ultrasound gender identification showed a high sensitivity, specificity, and accuracy [Table 3].

## Discussion and Conclusion

The final success of fetal gender identification was about 91% in the 11<sup>th</sup> and 12<sup>th</sup> weeks of pregnancy. When gestational age

**Table 1: Fetal gender identification in relation to gestational age**

	11 weeks, n (%)	12 weeks, n (%)
Gender not assigned	28/51 (54.9)	25/99 (25.3)
Correct male	12/14 (85.7)	45/51 (88.2)
Incorrect male	2/14 (14.3)	6/51 (11.8)
Correct female	9/9 (100)	22/23 (95.7)
Incorrect female	0/9 (0)	1/23 (4.3)
Total correct when attempted	21/33 (91.3)	67/74 (90.5)
Overall correct (percentage of total fetus)	21/51 (45.1)	67/99 (67.7)
Total cases studied	51	99

**Table 2: Binary classification tests for the ultrasound identification of male and female genders**

USS sex	Sex at birth		Total
	Female	Male	
Female	31 (96.9)	1 (3.1)	32 (100)
Male	8 (12.3)	57 (87.7)	65 (100)
Total	39 (40.2)	58 (59.8)	97 (100)

USS: Ultrasonography Sex (sex identified by sonography)

**Table 3: Binary classification tests for ultrasonic detection of male and female sexes, respectively**

	Sensitivity	Specificity	PPV	NPV	Accuracy
Males	98.2	79.4	87.6	96.8	90.7
Females	79.4	98.2	96.8	87.6	

PPV: Positive predictive value; NPV: Negative predictive value

increases, the possibility of gender identification becomes larger in percentage. Operator's skills had no significant effects on gender identification in either the baby girls or boys. The results of the present study were consistent with the results of other studies in terms of the effectiveness of an increased gestational age and the ineffectiveness of gender in the correct identification of fetal gender.<sup>[9]</sup>

The present study had a much higher gender identification accuracy compared to Whitlow's study (66%), which might be attributed to the new devices' better resolutions or the operators' skills. A study conducted by Hsiao *et al.*<sup>[10]</sup> between the 11<sup>th</sup> week of pregnancy and the 13<sup>th</sup> week plus 6 days reported an overall ultrasound accuracy of 91.8%, which is almost consistent with the results of the present study. Since, in the present study, ultrasound imaging was performed in the 11<sup>th</sup> and 12<sup>th</sup> weeks of pregnancy, the overall accuracy obtained was very favorable (90.7%). Ultrasound accuracy was 91.3% in the 11<sup>th</sup> week of pregnancy and 90.5% in the 12<sup>th</sup> week, compared to the 71.9% and 91.9% accuracy levels obtained for Hsiao's study. Compared to Hsiao's study, the ultrasound identification accuracy obtained in the present study was significantly higher in the 11<sup>th</sup> week of pregnancy.

In 2009, Whitlow and Efrat published the very first articles about fetal gender identification in the first trimester of pregnancy.<sup>[9]</sup> Whitlow used a combination of transverse and sagittal view planes, whereas Efrat used a mid-sagittal plane to measure the genital tubercle angle with a horizontal line drawn on the lumbosacral surface. The results obtained by Whitlow *et al.*, Efrat, and Hsiao (who used transverse and mid-sagittal planes in 2008) showed an ultrasound fetal gender identification accuracy of 78% (35/46), 70.3% (26/37), and 71.9% (41/57) in the 11<sup>th</sup> week of pregnancy, respectively, if taking into account only cases, in which the gender has been assigned.<sup>[9]</sup> The accuracies obtained were significantly lower than the accuracy obtained for the present study, which was 21/23 (91.3%). If all the women who underwent ultrasound imaging are taken into account regardless of the assigning or nonassigning of their fetal gender, the accuracies obtained for the cited studies will be 46% (35/76), 65% (26/40), and 42.7% (41/96), respectively, which is then comparable to the overall ultrasound accuracy obtained in the present study, that is, 45.1% (21/51).

The accuracy obtained on the 12<sup>th</sup> week of pregnancy was 90.5% (67/74) in the present study if counting only the cases where the gender has been assigned; however, if also taking into account the cases, in which the fetal gender has not been assigned, the accuracy is 67.7% (67/99), which is comparable to the accuracies obtained for other studies: 86% (123/143), 92.8% (77/83), and 92% (195/212).<sup>[11,12]</sup> Compared to the previous studies, the present study found no significant increase in fetal gender identification accuracy in the 12<sup>th</sup> week compared to in the 11<sup>th</sup> week.

Overall, various factors can affect the correct identification of fetal gender in the first trimester of pregnancy. First, the operator's skills, which depends on his or her training; second, the ultrasound imaging device's resolution (a transvaginal ultrasound provides a better resolution than a transabdominal ultrasound); third, certain maternal factors can affect the results, such as bowel gas induced shadowing of the fetus or maternal obesity; and fourth, the fetal position in the womb, which can be in different forms, including the fetal legs being crossed, umbilical cord being between the fetus' legs, fetal hyperactivity, and an unfavorable fetal position.<sup>[12]</sup>

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### Conflicts of interest

There are no conflicts of interest.

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