

Correlation of Estrogen, Progesteron, and Blood Sugar with Actual Gender in First Trimester of Pregnancy

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Abstract

Background: Some biochemical variables are widely used to predict fetal sex in the first trimester of pregnancy. However, their association with the expected Doppler results for fetal sex is unclear. **Objective:** The current study aimed to evaluate the degree of agreement between several biochemical variables (estrogen, progesterone, blood sugar) in the first trimester of pregnancy and the expected Doppler. **Materials and methods:** blood samples were collected from 96 Iraqi pregnancies in the first to eleventh weeks of pregnancy. **Results:** The results of the current study showed no significant differences ($P > 0.05$) in estrogen and progesterone levels between weeks. However, the level of estrogen concentration was reached in the seventh week of pregnancy (253.42 ± 92.98 , 2.76 ± 3.55) pg/ml, and its level in first week (157.73 ± 119.15 pg/ml, 3.18 ± 2.25 ng/ml) pg/ml. The results showed a significant increase ($p < 0.05$) in blood sugar levels among pregnant women in the eleventh week compared to the rest of the weeks, as its level reached (250 ± 35.93) mg/dL. The findings of the present investigation indicated a notable elevation in estrogen levels among pregnant women carrying male fetuses in comparison to those with female fetuses. The findings of the present investigation indicated no significant changes in progesterone and blood glucose levels between pregnant women carrying male fetuses and those carrying female fetuses. **Conclusion:** The current investigation found no significant variations in estrogen and progesterone levels across the weeks. Blood glucose levels increase in pregnant women during the eleventh week. The findings of the present investigation indicated a notable elevation in estrogen levels among pregnant women carrying male fetuses in comparison to those with female fetuses. The findings of the present investigation indicated no significant changes in progesterone and blood glucose levels between pregnant women carrying male fetuses and those carrying female fetuses.

Keywords: Estrogen, progesterone, blood sugar

1. Introduction

Pregnancy is a physiological process including bodily changes to facilitate the development of an embryo and subsequently a fetus. It typically endures for 39 to 40 weeks, commencing from the first day of the woman's last menstrual cycle and is segmented into three trimesters, each spanning three months. Each trimester possesses distinct developmental milestones and importance [1]. At the beginning of pregnancy, most of the hormones secreted by the placenta are the pregnancy hormone, which stimulates the corpus luteum to produce the hormone progesterone [2]. Progesterone is a steroid hormone that plays an important role in every step of pregnancy. Progesterone is produced early in pregnancy by the corpus luteum and is a key hormone in the

reproductive process, stimulating secretory changes in the endometrium and essential for successful embryo implantation. In addition, progesterone and estrogen regulate the uterine lining [3, 4]. Estrogen is a steroid hormone found largely in the ovaries and testes. Estrogen primarily functions via cytosolic estrogen receptors (ERs) located in tissues. Women possess three primary forms of estrogen: E1, E2, and E3. Estradiol (E2) is the most potent estrogen and, in conjunction with progesterone, serves as a principal regulator of the physiological alterations that transpire during the menstrual cycle in females. Estriol (E3) emerges as the predominant estrogen in the later stages of pregnancy [5, 6]. There are connections between fetal gender and maternal serum endocrine factors. Similar to oestrogens, progesterone levels exhibited an inverse correlation with overall gestation duration, further suggesting that pregnancy hormones may influence the timing of delivery[7].

Fasting glucose levels are consistently reduced during pregnancy. While the fundamental processes of this process remain incompletely elucidated, it is hypothesized that heightened glucose use by the fetus and placenta may be a contributing factor [8, 9]. During the first trimester of pregnancy, diminished fasting blood glucose corresponds with heightened insulin sensitivity, facilitating the absorption and storage of substantial glucose quantities as the principal energy source during gestation [10]. During pregnancy, maternal insulin sensitivity diminishes, resulting in a 50% increase in insulin levels, alongside a progressive elevation in postprandial glucose levels and extended peak glucose concentrations [11]. The local and placental synthesis of hormones, including estrogen, progesterone, leptin, cortisol, and placental growth hormone, contributes to this process [12]. Enhanced insulin resistance in pregnant women results in elevated maternal blood glucose levels, hence promoting glucose transfer across the placenta, which aids in accelerated fetal development [13]. The proposed mechanism by which fetal sex influences maternal glucose metabolism during pregnancy involves fetal-derived signals that modify maternal metabolism, potentially varying between male and female fetuses. The placenta is a fetal organ that profoundly affects endocrine function, with several biomolecules, including hormones, cytokines, and growth factors, regulating maternal metabolism during pregnancy. Consequently, fetal sex differences and their impact on the placental secretion of these biomolecules may account for variations in glucose metabolism across pregnant women[14].

2. MATERIALS AND METHODS

2.1 Subject

96 blood samples were collected from pregnant women who were confirmed to be pregnant based on laboratory tests in the first trimester of pregnancy (between the first and eleventh week) based on ultrasound examinations and blood was separated into gel tubes and used in the biochemical study.

2.2 Assessment biochemical test

Progesterone and estrogen concentrations were measured using a commercially available kit (DRG/Chinese) using an ELISA device. Wavelengths were read using an ELISA reader at a wavelength of 450 nm. Blood glucose concentration was measured with a commercially available measuring kit (LINEAR/Spain) using a spectrophotometer.

3. Results

The results of the current study showed no significant differences ($P>0.05$) in estrogen levels between the eleven weeks, as shown in Table 1. However, the level of estrogen concentration was

reached in the seventh week of pregnancy (253.42 ± 92.98) pg/ml, and its level in first week (157.73 ± 119.15) pg/ml.

Table 1: Estrogen levels according to weeks in the first trimester of pregnancy

Number of weeks	Concentration (mean $\pm$ standard deviation) pg/ml	P-value
1	$157.73 \pm 119.15a$	0.23
2	$176.07 \pm 72.86a$	
3	$160.17 \pm 81.23a$	
4	$246.94 \pm 72.19a$	
5	$229.52 \pm 88.67a$	
6	$237.38 \pm 70.08a$	
7	$253.42 \pm 92.98a$	
8	$228.42 \pm 96.99a$	
9	$201.8 \pm 73.4a$	
10	$185.66 \pm 105.2a$	
11	$197.64 \pm 83.47a$	

Similar letters indicate no significant differences.

The findings of the present study indicated a notable elevation in estrogen levels among pregnant women carrying male fetuses in comparison to those with female fetuses, as illustrated in Table 2 and Figure 1.

Table 2: Levels of sex hormones and blood sugar in women in the first trimester of pregnancy

parameters	Pregnancy with female gender	Pregnancy with male gender	P-value
estrogen	210.27 ± 56.55 pg/ml	248.56 ± 82.94 pg/ml	0.041

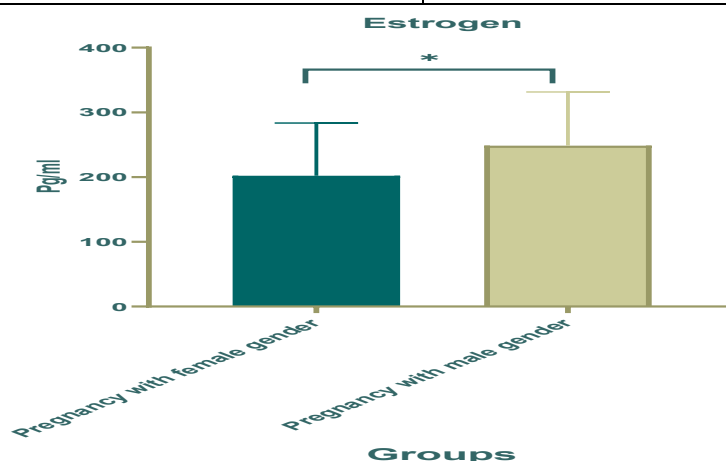
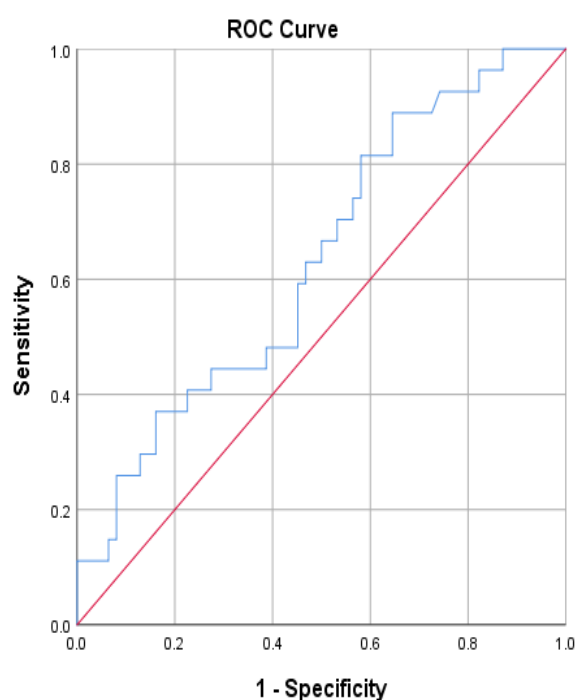


Figure 1: Estrogen levels in pregnant women according to the sex of the fetus

It was found that the AUC value was (0.63), which indicates the possibility of relying on the results of the estrogen hormone in determining the sex of the fetus as male in the first trimester of pregnancy. The cut-off value or the serious value (Cutoff value) of the estrogen hormone was (161.24 picograms/ml), and this value had a degree of sensitivity in determining the sex of the fetus as male and reached 89%, as shown in **Figure (2)**.



Diagonal segments are produced by ties.

Figure 1:

ROC curve for estrogen to determine the sex of the fetus

Progesterone levels were not significant between the eleven weeks of the first trimester of pregnancy, as shown in Table (3). Its level in the first week (3.18 ± 2.25) ng/ml and the eleventh week of pregnancy (2.76 ± 3.55) ng/ml.

Table 3: Progesterone levels according to weeks in the first trimester of pregnancy

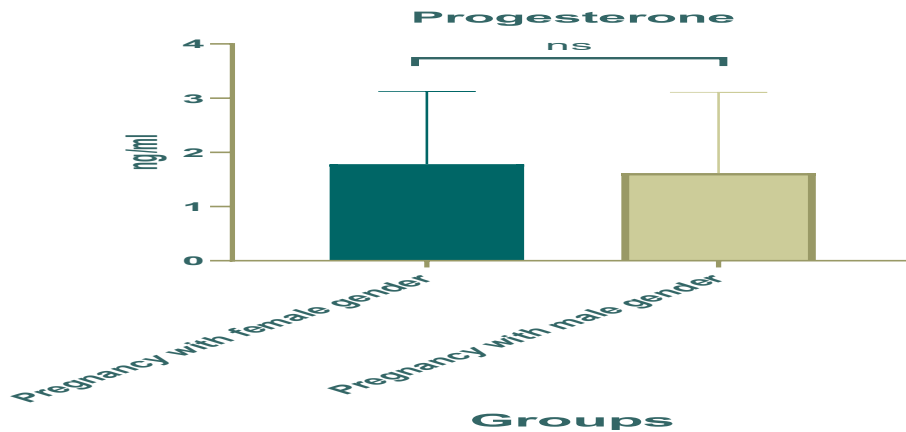
Number of weeks	Concentration (mean $\pm$ standard deviation) ng/ml	P-value
1	3.18 ± 2.25 a	0.34
2	1.67 ± 0.83 a	
3	1.15 ± 0.49 a	
4	2.2 ± 1.04 a	
5	1.88 ± 0.61 a	
6	1.76 ± 1.83 a	
7	1.2 ± 0.64 a	
8	1.4 ± 0.52 a	
9	1.73 ± 1.58 a	
10	1.34 ± 0.79 a	
11	2.76 ± 3.55 a	

Similar letters indicate no significant differences

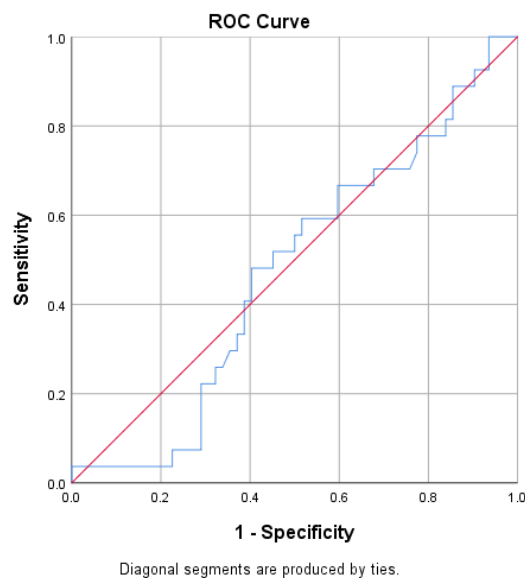
The findings of the present investigation indicated no significant variations in progesterone levels between pregnant women carrying male fetuses and those carrying female fetuses, as illustrated in Table 3 and Figure 3.

Table 3: Levels of progesterone and blood sugar in women in the first trimester of pregnancy

parameters	Pregnancy with female gender	Pregnancy with male gender	P-value
progesterone	1.78±1.34 ng/ml	1.62±1.49 ng/ml	0.61

**Figure 3:** Progesterone levels in pregnant women according to the sex of the fetus

The ROC curve test was conducted to show the possibility of relying on the levels of this hormone in determining the sex of the fetus in the first trimester of pregnancy. Figure (4) show the impossibility of relying on the levels of this hormone in determining the sex of the fetus, as although the Cutoff value for this hormone was (1.69) nanograms/ml to determine the sex of the fetus as male, these values were not significant ($P>0.05$). This is evident from the AUC value, which reached (0.47) and the confidence interval value (0.35-0.6), which is considered low and unreliable.

**Figure 4:** ROC curve for progesterone to determine the sex of the fetus.

The results of the current study showed a significant increase ($p<0.05$) in blood sugar levels among pregnant women in the eleventh week compared to the rest of the weeks, as its level reached (250 ± 35.93) mg/dL, as compared with other weeks.

Table 5: Blood sugar levels according to weeks in the first trimester of pregnancy.

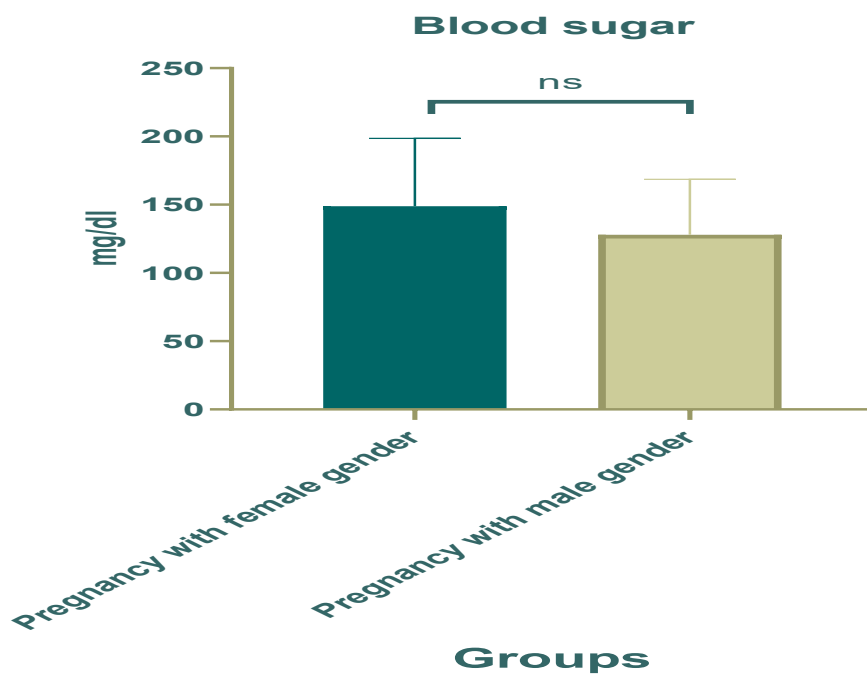
Number of weeks	Concentration (mean $\pm$ standard deviation) mg/dl	P-value
1	103.5 $\pm$ 46.64b	0.02
2	104.9 $\pm$ 30.73b	
3	154.71 $\pm$ 58.21b	
4	121.9 $\pm$ 41.6b	
5	153.2 $\pm$ 76.88b	
6	135.18 $\pm$ 60.03b	
7	145.25 $\pm$ 66.82b	
8	112 $\pm$ 34.39b	
9	138.4 $\pm$ 68.69b	
10	161 $\pm$ 74.86b	
11	250 $\pm$ 35.93a	

Different letters indicate semantic differences.

In general, regarding determining the sex of the fetus in the first trimester, the current study suggests that blood sugar levels cannot be relied upon to determine the sex of the fetus in the first trimester of pregnancy. As shown in Table(6).

Table 6: Levels of sex hormones and blood sugar in women in the first trimester of pregnancy

parameters	Pregnancy with female gender	Pregnancy with male gender	P-value
blood sugar	148.9 $\pm$ 49.73 mg/dl	127.9 $\pm$ 40.67 mg/dl	0.23

**Figure 5:** Blood sugar evels in pregnant women according to the sex of the fetus

The results of the ROC curve analysis, as shown in Figure (6), show the unreliability of relying on blood sugar results and linking them to determining the sex of the fetus, as the AUC value was

(0.42) and the confidence interval was (0.21-0.64). Although the interval value for determining the sex of the fetus for blood sugar was (111.5) mg/dL, this value was not significant ($P>0.05$).

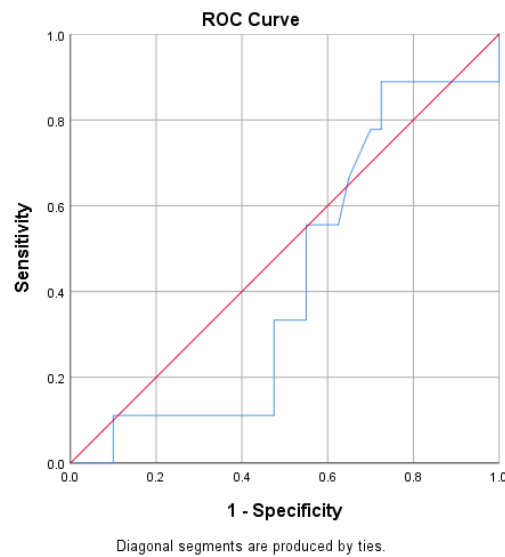


Figure 4: ROC curve for blood sugar to determine the sex of the fetus

DISCUSSION

The findings of the present investigation indicated a notable elevation in estrogen levels among pregnant women carrying male fetuses in contrast to those with female fetuses. This contradicts the results of a study [15], which showed that estrogen levels are higher in pregnant women with a female fetus. Although previous studies showed a significant increase in estrogen concentrations in the first trimester of pregnancy [16], recent studies have not found any relationship between estrogen levels and fetal sex [17].

The findings of the current study align with the majority of prior research. The results of the current study, which showed no significant differences in progesterone levels in pregnant women depending on the sex of the fetus, were consistent with the results of studies [3, 4] as well as the recent study [2], all of which showed no significant differences in progesterone levels depending on the sex of the fetus. However, the results of the current study differed from the results of some previous studies, including the study [15], which stated that progesterone levels are lower for pregnant women of the female sex compared to the male sex. The reason for the discrepancy in the results may be attributed to the size of the study sample and the difference in sample collection times.

The current study demonstrated the difficulty of relying on blood sugar levels in pregnant mothers during the first trimester of pregnancy to determine the sex of the fetus. The study demonstrated no significant differences between blood sugar levels in pregnant women with male and female fetuses. Although these levels were insignificantly higher in cases of pregnancy with female fetuses, this contradicts the findings of a study by [18], which showed that blood sugar levels in pregnant women with female fetuses were higher with impaired beta cell function. The results of the current study were similar to those reported by [19], which showed that female fetuses cause an increase in blood sugar levels in the serum of pregnant women. This was later confirmed by a study by [20].

Conclusion

The current investigation found no significant variations in estrogen and progesterone levels across the weeks. During the eleventh week of pregnancy, there is an elevation in blood glucose levels among women. The findings of the present investigation indicated a notable elevation in estrogen levels among pregnant women carrying male fetuses in comparison to those with female fetuses. The findings of the present investigation indicated no significant changes in progesterone and blood glucose levels between pregnant women carrying male fetuses and those carrying female fetuses.

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