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Correlation between Physiological State and Hormonal Levels with Fetal Gender During First Trimester of Pregnancy Iraqi Women

Kaniaw R. Khafar
Sulaimani Polytechnic University, Halabja Technical Institute, Nursing Department (kaniaw.khafar@spu.edu.iq)
009647701591259

Abstract

Physiological and hormonal changes during pregnancy are common, but whether maternal physiological and hormonal status could affect fetal gender remains unclear. To examine the links between physiological and serum hormonal status with fetal sex in the first trimester. A cross-sectional research involving 75 healthy young pregnant women (20-35 years) were selected after ultrasound confirmation of gestational age at conception to 12 weeks of conception. Participants were divided into 2 groups: 38 carried a male fetus, and 37 carried a female fetus. The data acquired through hemodynamic parameters, anthropometric measurements, and determinations of serum glucose, β-hCG, and testosterone levels. Statistical analysis was performed by using SPSS (version 20). The average β-hCG level of male fetuses was lower than that of female fetuses (18129±402 vs 27732±452 U/L, p<0.005). Of note, maternal serum testosterone level was significantly different in those with male and female fetuses (1.49±0.15 vs 2.61±0.14 nmol/L, p<0.05). No significant association was found between maternal glucose concentration and fetal gender. Also, no statistically significant differences were found for hemodynamic parameters (including diastolic pressure, systolic pressure, and mean arterial pressure) and anthropometric measurements (mother's: height, weight, and body mass index) when compared between two groups. It can be said that maternal serum β- hCG and total testosterone levels are a good predictor of fetal sex in the first trimester.

Keywords

Fetal sex**,** Hemodynamic parameters, Anthropometric measurements, β-hCG**,** Testosterone.

1. INTRODUCTION

Pregnancy is a situation of hormonal and physiological adaptations. Of note, all epidemiological studies declare that physiological change is common among pregnant women, since all organ systems sustain the growing fetus and prepare the mother for labour and delivery. Soma- Pillay et al. [1] described that it is important to understand the normal physiological changes that take place in pregnancy as this will help differentiate from adaptations that are abnormal. Factors that lead to changes during conception including the physiologic requirements of the gestation and fetus, and commutes in hormone levels [2]. Some previous studies on pregnant women suggest that fetal gender could play a significant role in maternal physiological processes [3, 4]. In sum, overview

of fetal gender could therefore be a main consideration in exploitation of childbirth and maternity. A healthy first trimester of pregnancy is crucial to the most dramatic changes and development of the fetus.

During recent decades, for every pregnant woman between the 11th and 14th gestational week to determine the risk of Down's syndrome the first-trimester screening tests are routinely recommended [5]. One vital biochemical marker of the first trimester screening test is beta-human chorionic gonadotropin (β-hCG). β-hCG's most well noted role in physiology is that of maintaining during early pregnancy [6], that it is primarily produced by the trophoblastic tissue of the placenta. Maternal serum β-hCG is higher female than male fetus; the difference could be attributed to placental items and not to the effects of the fetal hypothalamic–hypophyseal–gonadal axis [7]. Recent studies reported that in pregnant women during 10–14 weeks gestation with female fetuses have significantly more β-hCG levels in the late first trimester [8].

However, the record is not definitive, and more studies are essential.

The probable link of maternal testosterone level with fetal gender has been a focus of interest in the last decades. The old results suggest that gender of the fetus has no association with maternal serum total testosterone [9]. Recently, Attia et al. [10] showed that the maternal serum testosterone level is not a good predictor of fetal sex. Thus, this hormone should not be selected for gender determination during first trimester of gestation.

The aims of this research were (1) to check determinants of physiological state and hormonal status (β-hCG and testosterone) in maternal blood serum samples, and (2) to evaluate the predicted response the link between hormonal statuses with fetal gender, during first trimester of pregnancy women.

2. MATERIALS AND MEDTHODS

2.1. study design

A cross-sectional survey involving 75 healthy young pregnant women (20-35 years) investigated the link between physiological state and hormonal status with fetal gender during the first trimester of pregnancy conducted in Sulaymaniyah Maternity Hospital (Iraq) during 01 and 31 July 2023.

Gestational age is confirmed by a trained obstetrician using ultrasound examination, expressed in full weeks from the first day of the last menstrual cycle. Data on fetal sexes were prepared retrospectively at ~18th to 21th weeks of gestation. The data acquired through hemodynamic parameters, anthropometric

measurements, and determinations of serum glucose, β-hCG, and testosterone levels.

2.2. Measurements

a) Diastolic pressure (**DP**), systolic pressure (**SP**), and mean arterial pressure (**MAP**) measured by sphygmomanometer (digital) (WelchAllyn, USA). The MAP is estimated by the sum of DP and one-third of the pulse pressure [11].

b) Body mass index (**BMI**): weight (kg)/height (m^2). A healthy range is 18.5 to 24.9, while 25.0 or more is overweight [12].

c) The random blood glucose was determined from a separated serum by Cobas integra 400 plus instrument (Roche Cobas integra 400 plus Reagent, Germany).

d) During the research time, β-hCG and total testosterone levels were assayed at the same endocrine laboratory using electrogenerated chemiluminescence (ECL) (Roche Cobas e 411 Reagent, Germany).

2.3. Statistical analysis

Statistical analysis was performed using the univariate analysis method of SPSS (version 20), and the multiple comparison test method was used for verification. A probability of $p<0.05$ was considered to be statistically significant.

3. RESULTS

Current data showed that the prenatal sex assignment by ultrasound screening has a high accuracy score: 38 carried a male fetus, and 37 carried a female fetus.

The results of hemodynamic parameters and anthropometric measurements are placed in Table 1. Anthropometric measurements (weight and height) were taken for BMI collected. Our results indicated that there was no considerable parity effect found in any regression models ($p>0.05$). No significant difference was detected between mothers carrying male and female fetuses about SP, DP, and MAP during the first trimester of pregnancy ($p>0.05$). Therefore, first-trimester hemodynamic parameters anthropometric measurements are not a dependable predictive exam for fetal gender determination.

Table (1). Hemodynamic parameters anthropometric measurements during first trimester of pregnancy women between mothers carried male and female fetuses (mean±S.D.; $p>0.05$)

Groups Parameters	Male	Female
Hemodynamic		
Weight (Kg)	**75.62±3.14**	**76.53 ±3.18**
Height (M)	**1.721±1.23**	**1.740±1.32**
Body Mass Index (Kg/M^2)	**26.54±0.93**	**26.12±0.46**
Anthropometric		
Systolic Pressure (Mmhg)	**133.8±2.76**	**133.8±2.76**
Diastolic Pressure (Mmhg)	**76.96±3.52**	**77.01±4.73**
Mean Atrial Pressure (Mmhg)	**95.54±3.54**	**94.50±3.56**

The values of glucose and hormonal status are presented in Table 2. The maternal glucose analysis during first trimester revealed that there were no significant ($p>0.05$) differences between in mothers carrying boy or girl. Results indicated that in pregnant women with female fetuses have significantly higher β-hCG concentrations than male fetuses ($p<0.05$). Of note, maternal serum total testosterone concentrations were significantly different in those with male than female fetuses ($p<0.05$).

Table (2). Glucose and hormonal status during first trimester between mothers carried male and female fetuses (mean±S.D.)

Groups Parameters	Male	Female	P-Value
Glucose (Mg/Dl)	**98.57±5.56**	**96.10±3.23**	**>0.05**
Hcg (U/L)	**18129±402**	**27732±452**	**<0.005**
Testosterone (Nmol/L)	**1.49±0.15**	**2.61±0.14**	**<0.05**

Discussion

Early fetal sex determination could predict sex-related pregnancy outcomes such as satisfying the curiosity of parents [13], and preventing unnecessary invasive procedures to recognize genetic disorders [14]. On the other hand, fetal gender plays a main role in complications related to pregnancy and modifying the course and could also have an effect on maternal health [4]. The precise prediction of fetal sex in the first trimester is a significant consideration in exploitation of childbirth and pregnancy. Thus, current study has focused on the determination of fetal gender during first trimester of gestation.

A healthy first trimester is crucial to the most dramatic changes and development of the fetus. To confirm this subject, Pascual and Langaker [15] reported that all medical providers must be aware of these changes present in first trimester (like physiological and hormonal alterations) to be able to process the best possible care for both mother and fetus.

Based on our review, understanding the changes in normal physiological dynamics that occur during the course of gestation is vital for improving our knowledge of pregnancy outcomes. However, our research did not find the physiological changes (hemodynamic parameters and anthropometric measurements) in the first trimester or a possible interaction between maternal physiological alter and fetal gender.

Also, our data showed that no interplay between fetal sex and maternal BMI in the first trimester. Previous research has shown the same patterns when investigating the correlation between BMI

and fetal sex; Teulings et al. [16]. However, prior research has found that the accuracy of fetal sex determination could be influenced by BMI [17]. Generally, gender determination can be clinically important leading to improving overall pregnancy management.

Pregnancy is a situation of extreme hormonal fluctuations and physiological rearrangements [18]. Meanwhile, the endocrinology of human gestation includes metabolic and endocrine adaptations that result from physiological changes at the border between mother and fetus [19]. All identified modifications have a direct correlation with the developing fetus.

Several studies have associated the maternal hormonal serum levels (like β-hCG and testosterone) with fetal sex [8, 10]. The attribution of these factors to fetal sex has not yet been well elucidated. The present study on pregnant Iraqi women has shown that a maternal serum β-hCG and total testosterone level is a good predictor of fetal sex. Early maternal serum of β-hCG and testosterone levels have a low testing power for fetal sexes screening with specificity values and low sensitivity and cannot be used as a good marker alone. It may have a role in combination with other specialized markers such as fetal sampling of chorionic villus for karyotyping and ultrasound scanning. Further researches are needed to investigate the presence of the aromatase enzyme in the placenta, an enzyme system converting androgens into estrogens.

The new research suggests that homeostasis differs between pregnancies carrying a boy versus girl [20]. To confirm this idea, in the study of Retnakaran and Shah [21] a more detailed analysis of glucose metabolism revealed that in mothers carrying male fetuses, the increase in mean adjusted blood glucose at oral glucose tolerance tests. But, in the current study no important association was found between maternal glucose concentration and fetal gender. Regarding the importance of glucose for fetus development, it should be noted that central to the growth of the fetus is the supply with nutrients (foremost with glucose) [22].

4. CONCLUSIONS

Our data are the first to describe data concerning links between physiological and serum hormonal status with fetal gender in the first trimester in our region. As a result, it can be said that maternal serum β-hCG and total testosterone levels are a good predictor of fetal sex in the first trimester.

Conflict of Interest

None.

Data availability

All data will be made available on a reasonable request to the corresponding author.

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None.

Reference

[1] P. Soma-Pillay, C. Nelson-Piercy, H. Tolppanen, and Mebazaa A, "Physiological changes in pregnancy," Cardiovascular Journal of Africa, vol. 27, pp. 89-94, 2016. doi: 10.5830/CVJA-2016-021.
[2] J. M. Kepley, K. Bates, and S. S. Mohiuddin, "Physiology, Maternal Changes. [Updated 2023 Mar 12]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan". Available from: https://www.ncbi.nlm.nih.gov/books/NBK539766/.
[3] A. M. Mitchell, M. Palettas, and L. M. Christian, "Fetal sex is associated with maternal stimulated cytokine production, but not serum cytokine levels, in human pregnancy," Brain Behavior and Immunity, vol. 60, pp. 32-37, 2017. doi: 10.1016/j.bbi.2016.06.015.
[4] M, Al-Qaraghouli, and Y. M. V. Fang, "Effect of Fetal Sex on Maternal and Obstetric Outcomes," Frontiers in Pediatrics, vol. 19, pp. 144. doi: 10.3389/fped.2017.00144.
[5] H, Cokmez, and S. T. Yozgat, "The effect of fetal gender on the biochemical markers of the first-trimester screening," Saudi Medical Journal, vol. 43, pp. 348-352, 2022. doi: 10.15537/smj.2022.43.4.20210906.
[6] J. A. Lee, and R. Ramasamy. "Indications for the use of human chorionic gonadotropic hormone for the management of infertility in hypogonadal men," Translational Andrology and Urology, vol. 7, pp. S348-S352, 2018. doi: 10.21037/tau.2018.04.11.
[7] Y. Yaron, O. Lehavi, A. Orr-Urtreger, I. Gull, J. B. Lessing, A. Amit, et al., "Ben-Yosef D. Maternal serum HCG is higher in the presence of a female fetus as early as week 3 post-fertilization," Human Reproduction, vol. 17, pp. 485-9, 2002. doi: 10.1093/humrep/17.2.485.
[8] S. Lin, R. Li, Y. Wang, M. Li, L. Wang, X. Zhen, et al., "Increased maternal serum hCG concentrations in the presence of a female fetus as early as 2 weeks after IVF-ET," Journal of Gynecology Obstetrics and Human Reproduction, vol. 50, pp. 102053, 2021. doi: 10.1016/j.jogoh.2020.102053.
[9] G. Nabi, T. Aziz, M. Amin, and A. Ali khan A, "Effect of Fetal Sex on Total Levels of Maternal Serum Testosterone," Journal of Biology and Life Science, vol. 5, pp. 58-64, 2014. doi: 10.5296/jbls.v5i2.5228.
[10] A. M. Attia, T. A. Omar, and M. A. El-Melegy, "Effect of fetal sex on maternal total testosterone level," Menoufia Medical Journal, vol. 34, pp. 9-12, 2021. doi: 10.4103/mmj.mmj_108_19.
[11] D. DeMers, and D. Wachs, "Physiology, Mean Arterial Pressure. [Updated 2023 Apr 10]," In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan. Available from: https://www.ncbi.nlm.nih.gov/books/NBK538226/.
[12] C. B. Weir, and A, Jan, "BMI Classification Percentile And Cut Off Points," 2023. PMID: 31082114.

[13] S. Nouri, M. H. Kalantar, F. Safi, and A. Almasi-Hashiani, "The role of fetal heart rate in first trimester sonograms in prediction of fetal sex: a systematic review and meta-analysis," BMC Pregnancy Childbirth, vol. 12, pp. 582, 2023. doi: 10.1186/s12884-023-05908-8.
[14] M. Odeh, V. Granin, M. Kais, E. Ophir, and J. Bornstein, "Sonographic fetal sex determination," Obstetrics & Gynecological Survey, vol. 64, pp. 50–57, 2009. doi: 10.1097/OGX.0b013e318193299b.
[15] Z. N. Pascual, and M. D. Langaker, "Physiology, Pregnancy. [Updated 2023 May 16]," In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK559304/.
[16] N. E. W. D. Teulings, A. M. Wood, Sovio U, S. E. Ozanne, G. C. S. Smith, and C. E. Aiken. Independent influences of maternal obesity and fetal sex on maternal cardiovascular adaptation to pregnancy: a prospective cohort study," International Journal of Obesity, vol. 44, pp. 2246–2255, 2020. doi: 10.1038/s41366-020-0627-2.
[17] S. Manzanares, A. Benítez, M. Naveiro-Fuentes, M. S. López-Criado, and M. Sánchez-Gila, "Accuracy of fetal sex determination on ultrasound examination in the first trimester of pregnancy," Journal of Clinical Ultrasound, vol. 44, pp. 272-7, 2016. doi: 10.1002/jcu.22320.
[18] M. Bralewska, T. Pietrucha, A. Sakowicz, A. Chromogranin, "An Endocrine Factor of Pregnancy," International Journal of Molecular Sciences, vol. 24, pp. 4986, 2023. doi: 10.3390/ijms24054986.
[19] R. Tal, and H. S. Taylor, "Endocrinology of Pregnancy. [Updated 2021 Mar 18]. In: Feingold KR, Anawalt B, Blackman MR, et al., editors. Endotext [Internet]," South Dartmouth (MA): MDText.com, Inc.; 2000-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK278962/.
[20] P. Alur, "Sex Differences in Nutrition, Growth, and Metabolism in Preterm Infants," Frontiers in Pediatrics, vol. 7, pp. 22, 2019. doi: 10.3389/fped.2019.00022.
[21] R. Retnakaran, and B. R. Shah, "Fetal Sex and the Natural History of Maternal Risk of Diabetes During and After Pregnancy," Journal of Clinical Endocrinology & Metabolism, vol. 100, pp. 2574-80, 2015. doi: 10.1210/jc.2015-1763.
[22] C. Stern, S. Schwarz, G. Moser, S. Cvitic, E. Jantscher-Krenn, M. Gauster, et al., "Placental Endocrine Activity: Adaptation and Disruption of Maternal Glucose Metabolism in Pregnancy and the Influence of Fetal Sex," International Journal of Molecular Science, vol. 22, pp. 12722, 2021. doi: 10.3390/ijms222312722.