*https://doi.org/10.48047/AFJBS.6.Si3.2024.1436-1444*

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

# Morphometric Analysis of Foetal abdominal circumference and femoral length Using Ultrasonography in the Assamese Population

**Dr Monmoyuri D Mahanta[1], Dr Manickam Subramanian[2], Dr S. Santhosh[3*]**

[1]Professor and HOD Department of Anatomy PA Sangma international medical college and hospital Baridua, Megalaya-793101
Emai: [1]academicsmahanta@gmail.com
[2]Associate professor Department of Anatomy Karpaga Vinayaga Institute of Medical Sciences &Research Centre China kolambakkam, Palayanoor Maduranthagam-603308 Tamilnadu, india
Emai: [2]gandhiayu@hotmail.com
[3*]Assistant Professor Department of Anatomy PA Sangma international medical college and hospital Baridua, Megalaya-793101
Email: [3]santhoshanatomy@gmail.com

Corresponding author: Dr S. Santhosh
Assistant Professor Department of Anatomy PA Sangma international medical college and hospital Baridua, Megalaya-793101
Email: [3*]santhoshanatomy@gmail.com

**Article Info**

Volume 6, Issue Si3, 2024

Received: 08 March 2024

Accepted: 17 April 2024

Published: 23 May 2024

*doi: 10.48047/AFJBS.6.Si3.2024.1436-1444*

**ABSTRACT:**

**Introduction:** The period of intrauterine development constitutes one of the most vulnerable phases in the life cycle, with a lasting profound influence on subsequent growth. It is universally acknowledged that size at birth is an important indicator of foetal and neonatal health. Size at birth is the product of duration of gestation and rate of foetal growth. to evaluate the growth pattern of abdominal circumference (AC) and femoral length (FL) of foetuses Assamese population, which is our local sample of population belonging to state Assam situating in the north-east part of country India. **Materials and method:** This study was carried out in Five hundred and fifty pregnant women attending to the Obstetrics and Gynecology outpatient department as well as those who were admitted as indoor patient in this department of Gauhati Medical College and Hospital. **Results:** Regarding the study group our demographic data Most of the pregnant women were within age group of 21-25(50 %). No. of cases between age group of 26-30 yrs is 220 (40%) and between age group of 31-35 is 40 (8%). No. of cases with 20 years and below is 11(2%) and no. of cases above 35 is 0. **Discussion:** The comparison of our result in the present study with Hadlock`s scale which was compiled in 1984 with help of his co-workers based mainly on Caucasian population and which is commonly used as reference chart for our foetal growth and also with the scale compiled by S.Campbell

**Keywords:** Morphometry, Abdominal circumference, femoral length, ultrasonographic, foetal



## 1. Introduction

Morphometric analysis using ultrasonography is a crucial aspect of prenatall care, offering valuable insights into fetal growth and development. Specifically, measurements such as the fetal abdominal circumference (AC) and head femoral length (FL) are essential for assessing fetal health, estimating gestational age, and identifying potential growth abnormalities.
Babies born to Indian subcontinent mothers weigh between 100 -400g less at term than babies born to Caucasian mothers. Therefore, it has been claimed by a number of authors that it is improper to use Caucasian birthweight standards to determine the birthweight of Indian babies. The use of the two most popular ultrasonic measurements of foetal size—estimated foetal weight (EFW) and abdominal circumferences (AC)—may also is unsuitable because foetal size is likely to differ across the two populations (1,2,3,4,5).
Foetal age and growth are frequently evaluated using ultrasonic foetal morphometry. For medicolegal purposes, this is also helpful.

It is hard to imagine any environmental influence that would lead to faster growth early in the third trimester and slower growth later on, even though it has not been possible to separate nature from nurture in explaining the differences in mean birthweight for gestational age between different racial groups(6,7,8). Genetic determination is most likely the cause of variations in the pace of growth at different stages of gestation, unless evidence to the contrary is presented. Still, these are negligible variances. Stature variation and other age, sex, and race-related characteristics are undoubtedly partially influenced by genetics, but dietary status also has a significant impact, particularly in regard to race(9,10,11,12).

The disparities between the current reference curves are most likely caused by variations in the methods used to determine gestational age, socioeconomic status, and altitude as well as inclusion or exclusion of multiple births, stillbirths, or infants with congenital defects. These factors account for a significantly greater degree of variation than race.In conclusion, foetal sex has a significant impact on birthweight; however, the evidence available today does not support the use of distinct reference curves for each race in cases where race is linked to additional risk factors, such as inadequate nutrition or low socioeconomic status, or where there are significant genetic differences in birthweight among different populations. It is therefore advised to utilise a single, sex-specific international reference. However, a number of studies demonstrate that there are racial differences in the proportion of the foetal body.

It is recommended to perform a multiparameter gestational age evaluation after the first trimester of pregnancy. This should take into account additional metrics such head circumference (HC), occipitofrontal diameter (OFD), abdominal circumference (AC), and humerus length (HL) in addition to at least two foetal measurements, which are typically biparietal diameter and femur length (FL). Studies on the application of sacral length as a useful metric for estimating gestational age in foetuses with normal growth are under underway.
The overall accuracy of modern algorithms that predict birth weight using standard defined foetal measures is generally comparable. These nonstandard measurements do not considerably increase the ability of obstetric sonography to assist in birth weight prediction when combined with other sonographic foetal parameters to estimate foetal weight(13,14,15).
This study aims to analyze these parameters in the Assamese population, providing localized reference data which can enhance the accuracy of fetal health assessments in this specific demographic

## 2. Materials and Method

The study included 550 pregnant patients who were seen in the outpatient obstetrics and gynaecology department at Gauhati Medical College and Hospital, as well as patients who were admitted as indoor patients. The ethics committee gave the study its approval, and informed consent was acquired prior to the patient's involvement.
Sonographic machine is a real time gray scale scanner Make-WIPRO-GE,model RT-3200,Advantage 11.
For abdominal circumference (AC), a transverse section of the foetal abdomen is taken at the level of the stomach and the bifurcation of the main portal vein into its right and left branches. It is made at the widest point in the abdomen, through the liver at the level of the left portal vein or stomach
The sonographically measured femur length is the linear distance between two calcified diaphyseal ends of femur, which corresponds anatomically from the greater trochanter of femur to distal metaphysis.
For obtaining a correct femur length in our study, the following criteria were laid down to minimize erroneous measurements.

**Inclusion criteria**
The patients consisted of Local Assamese population from both rural and urban areas in and around the city of Guwahati and belonging to different socioeconomic classes. And also belonging to different races that is tribes and non-tribes of Assamese population

**Exclusion criteria**

Patients were excluded if they: were not from Assam; had a twin gestation; had a stillbirth; previously delivered a foetus with a congenital foetal anomaly or known chromosomal abnormality; had a diagnosis of either gestational diabetes mellitus, preeclampsia and/or HELLP syndrome or chronic hypertension; had inadequate glucose testing to rule out gestational diabetes; had inadequate gestational dating; smoked cigarettes during pregnancy; or had history of inter racial marriage.

**Statistical analysis**

The findings were presented as Mean Standard Deviation (SD). Shapiro-Wilks normality test and Kruskal-Wallis H test were applied to analyze the data set. The closeness of the percentile values of the studies was determined by hierarchical cluster analysis. Results were shown dendrogram graphics using the Ward Linkage method. A "P" value of 0.05 or less was deemed significant for all parameters.

## 3. Results

Regarding the study group our demographic data Most of the pregnant women were within age group of 21-25(50 %). No. of cases between age group of 26-30 yrs is 220 (40%) and between age group of 31-35 is 40 (8%). No. of cases with 20 years and below is 11(2%) and no. of cases above 35 is 0.

Table: 1 Gestational weeks specifics AC and FL

| Gestation(weeks) | Mean AC(mm) | Mean FL(mm) |
|---|---|---|
| 12 | 60± 6.2 | 8± 2.3 |
| 13 | 70± 5.1 | 11± 1.3 |
| 14 | 75± 4.6 | 13± 2.1 |
| 15 | 86± 6.7 | 17± 1.5 |
| 16 | 100± 11.9 | 19± 2.7 |
| 17 | 120± 9.4 | 24± 1.6 |
| 18 | 125± 15 | 27± 2.4 |
| 19 | 136± 7.8 | 29± 2.9 |
| 20 | 151± 9.5 | 33± 2.5 |
| 21 | 160± 11 | 35± 4.2 |
| 22 | 172±16.8 | 38± 2.5 |
| 23 | 184± 23.7 | 41± 2.9 |
| 24 | 195± 17.6 | 44± 2 |
| 25 | 200± 21.6 | 45± 2.8 |
| 26 | 212± 13.7 | 48± 4 |
| 27 | 220± 24.8 | 50± 5.2 |
| 28 | 235± 21.2 | 54± 3.6 |
| 29 | 245± 9.1 | 56± 1.3 |
| 30 | 248± 26.4 | 58± 4.6 |
| 31 | 255± 29.4 | 59± 5.2 |
| 32 | 263± 16.6 | 62± 4.4 |
| 33 | 276± 19 | 63± 3.8 |
| 34 | 280± 31.7 | 64± 6.3 |
| 35 | 290± 39 | 65± 7.6 |
| 36 | 294± 33.2 | 66± 5 |

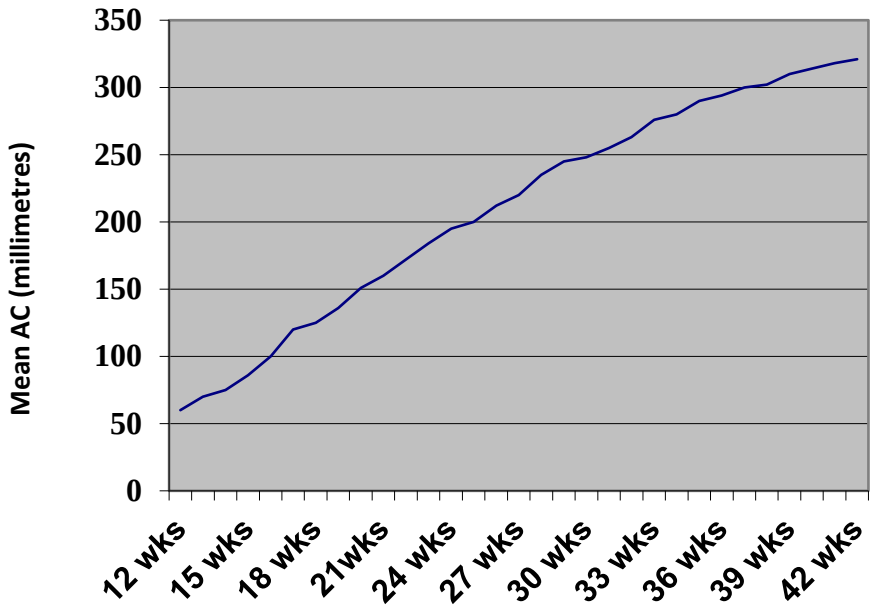
| | | |
|---|---|---|
| 37 | 300± 23.4 | 68± 5.3 |
| 38 | 302± 26 | 69± 3.4 |
| 39 | 310± 31.8 | 71± 5.8 |
| 40 | 314± 25.9 | 72± 4.9 |
| 41 | 318± 8 | 72.5± 4.9 |
| 42 | 321± 13.9 | 73± 3.6 |

(Values are expressed as mean standard deviation, significance levels of p< 0.05)

Fig: 1 ultrasound image of AC

Fig: 2 ultrasound image of FL

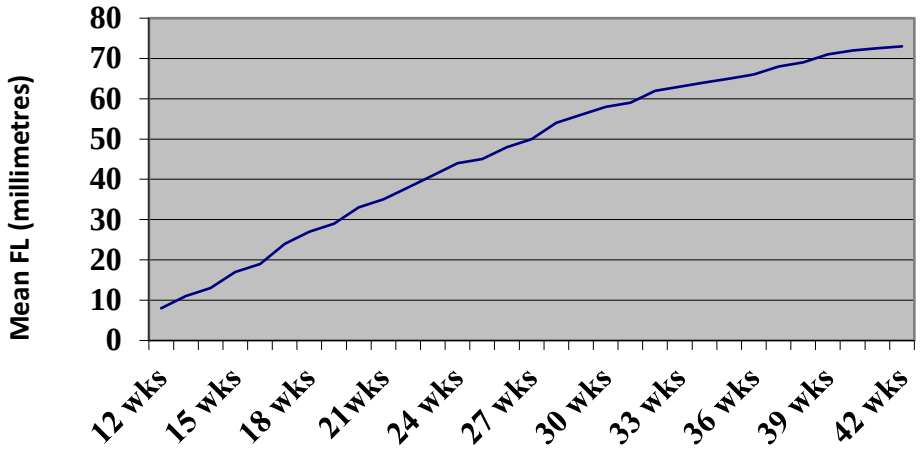
Fig :3Mean AC




From fig 3, it is seen that there is a rapid increase in AC up to 29 weeks. After 29 weeks of gestation the centiles showed a slower growth rate toward 42 weeks.

The rate of growth of AC in the study was observed to be about 10 to 20 mm per week between 12 to 29 weeks and about 3 to 8 mm per week between 29 and 42 weeks.

Fig :4 Mean FL




From Fig 4, it is seen that there is a rapid increase in FL up to 32 weeks. After 32 weeks of gestation the centiles showed a slower growth rate toward 42 weeks.
The rate of growth of FL in the study was observed to be about 2 to 4 mm per week between 12 –32 weeks and about 1 mm per week in most of the weeks between 32 and 42 week.

## 4. Discussion

The present study "ultrasonic foetal morphometry of Assamese population" was carried out on five hundred and fifty normal pregnant women who were sure of their last menstrual period between 12 to 42 weeks of gestation. Patients were excluded if they were not from Assam; had a twin gestation; had a stillbirth; previously delivered a foetus with a congenital foetal anomaly or known chromosomal abnormality; had a diagnosis of either gestational diabetes mellitus, preeclampsia and/or HELLP syndrome or chronic hypertension; had inadequate glucose testing to rule out gestational diabetes; had inadequate gestational dating; smoked cigarettes during pregnancy; or had history of inter racial marriage (16).

Relevant history was taken and the morphometry of the foetuses was done by ultrasound. Most commonly used parameters AC, FL, were measured. The ultrasonic examinations were performed by a real time gray scale scanner machine with a convex curvilinear probe of 3.5 MHz frequencies.

From the fig 5, it is observed that there is a rapid increase in AC upto 24 weeks and is parallel to and almost equal to that of Hadlock`s as well as S.Campbell`s study. Between 24 to 29 weeks of gestational age there is a slight flattening of curve and is at lower level in comparision with Hadlock`s chart and S.Campbell`s chart. After 29 weeks, growth curve is markedly slowed down and at much lower level in comparision with Hadlock`s chart and S.Campbell`s chart(17,18,).

Fig: 5 comparisons of mean AC

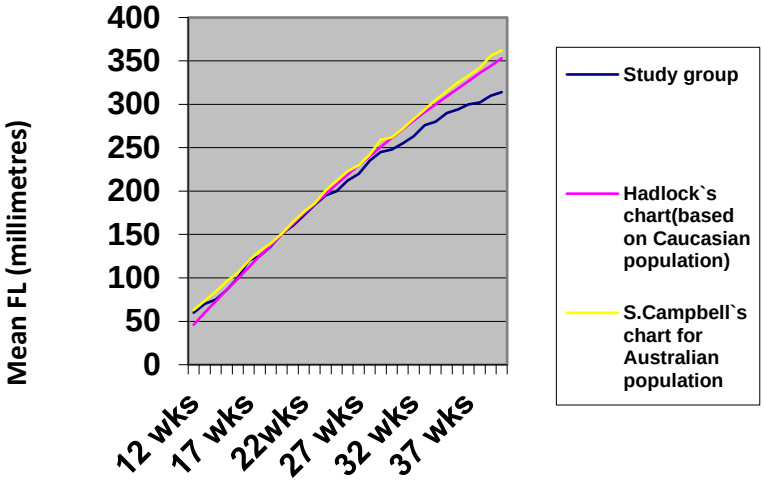
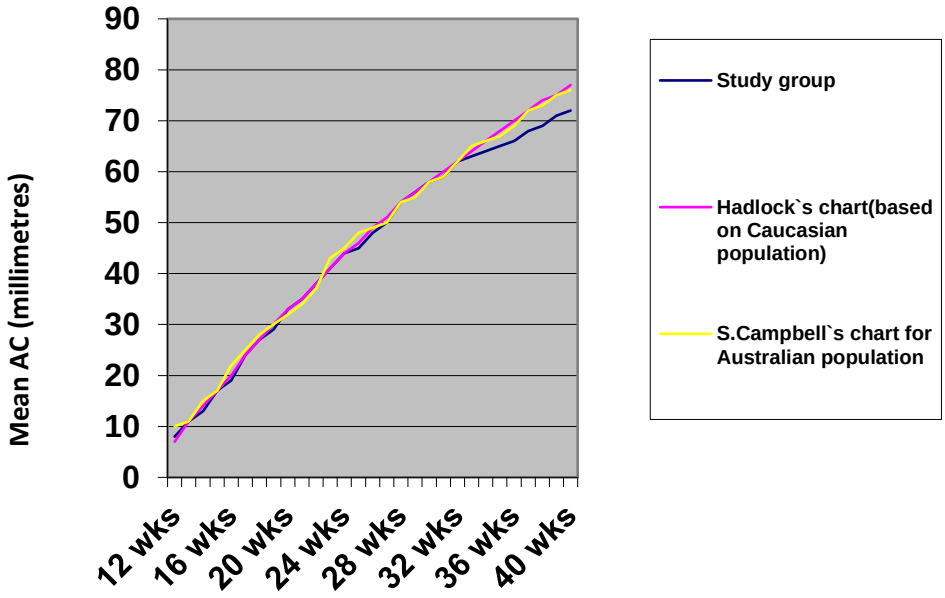



Fig: 6 comparisons of mean FL




From the fig 6, it is seen that there is a rapid increase in FL upto 32 weeks of gestational age and is parallel to that of Hadlock`s chart and S.Campbell`s chart. After 32 weeks of gestation, the centile showed a slower growth rate toward 42 weeks and is at much lower level in comparision to that of Hadlock`s and S.Campbell`s study.

In case of AC after 29$^{th}$ week and FL after 32$^{nd}$ of gestation the centiles showed a slower growth rate toward 42 weeks of pregnancy and are at lower level to that observed in Hadlock`s and S.Campbell`s study. It may be due to the ethnic variation between the two groups of patients studied. The smaller structure, lesser body weight and lower nutrition level of the study group of patient may also play a part. But in the cases belonging to higher socioeconomic condition, it is seen that AC and FL are almost to the same level to that of Caucasian population. So, nutrition of pregnant women does play a very important role in growth of foetus. Variation in stature and other dimensions associated with age, sex and race

are clearly too some degree genetically conditioned, but nutritional levels also have profound effects especially in regard to race(19,20).

The new foetal measurement charts of AC and FL are unique for Assamese population and have not been found similar in the later weeks of pregnancy to those published for Caucasian population and also for those published for Australian population which we have taken for comparision.

charts will help the clinician and sonographer in dating pregnancy, identifying small for date and growth retarded foetus and also for medico legal purposes.

The coefficient of correlation of AC (r=0.990 and FL (0.9851), observed showed a high degree of linear relationship with gestational age. On comparison of the mean values for each gestational age with western standard, initially during the early part of second trimester were of higher level in some of the weeks and almost same in some weeks but are at lower level although parallel to that observed in Hadlock`chart and showed variability of 1 mm in the later part of second trimester and about 3-4 mm in early part of third trimester and 6mm in later part of third trimester. The mean AC value of each gestational age showed variability of 5-10 mm in later part of second trimester and about 15 mm in early third trimester and about 30 –40 mm in later part of third trimester. The mean FL values for each gestational age showed variability of 1-2 mm in the later part of second trimester and of about 4mm in the later part of third trimester. Observations revealed that the specificity and sensitivity FL were more appropriate in predicting gestational age in second trimester and their reliability decreases in third trimester(21,22).

## 5. Bibliography


1. Brooke-Rose, C. (1981). A rhetoric of the unreal: studies in narrative and structure, especially of the fantastic. Cambridge University Press.
2. McFayden, P. J. (1984, August). Introduction of the gall fly Rhopalomyia californica from the USA into Australia for the control of the weed Baccharis halimifolia. In Proc. VI Int. Symp. Biol. Control Weeds (Vol. 19, p. 25).
3. Bennion, L. J., & Grundy, S. M. (1978). Risk Factors for the Development of Cholelithiasis in Man: (First of Two Parts). New England Journal of Medicine, 299(21), 1161-1167.
4. Clarson, C. L., Barker, M. J., Marshall, T., & Wharton, B. A. (1982). Secular change in birthweight of Asian babies born in Birmingham. Archives of disease in childhood, 57(11), 867-871.
5. Chetcuti, P., Sinha, S. H., & Levene, M. I. (1985). Birth size in Indian ethnic subgroups born in Britain. Archives of Disease in Childhood, 60(9), 868-870.
6. Bihoun, B., Zango, S. H., Traoré-Coulibaly, M., Valea, I., Ravinetto, R., Van Geertruyden, J. P., & Robert, A. (2020). Fetal biometry assessment with Intergrowth 21st's and Salomon's equations in rural Burkina Faso. BMC pregnancy and childbirth, 20, 1-12.
7. Peixoto, A. B., da Cunha Caldas, T. M. R., Dulgheroff, F. F., Martins, W. P., & Júnior, E. A. (2017). Fetal biometric parameters: Reference charts for a non-selected risk population from Uberaba, Brazil. Journal of Ultrasonography, 17(68), 23-29.
8. Tarca, A. L., Romero, R., Gudicha, D. W., Erez, O., Hernandez-Andrade, E., Yeo, L., ... & Hassan, S. S. (2018). A new customized fetal growth standard for African American women: the PRB/NICHD Detroit study. American journal of obstetrics and gynecology, 218(2), S679-S691.
9. Aggarwal, N., & Sharma, G. L. (2020). Fetal ultrasound parameters: Reference values for a local perspective. Indian Journal of Radiology and Imaging, 30(02), 149-155.

10. Salomon, L. J., Alfirevic, Z., Berghella, V., Bilardo, C., Hernandez-Andrade, E., Johnsen, S. L., & Lee, W. (2011). Practice guidelines for performance of the routine mid-trimester fetal ultrasound scan. Ultrasound in Obstetrics & Gynecology, 37(1).
11. Louis, G. M. B., Grewal, J., Albert, P. S., Sciscione, A., Wing, D. A., Grobman, W. A., ... & Grantz, K. L. (2015). Racial/ethnic standards for fetal growth: the NICHD Fetal Growth Studies. American journal of obstetrics and gynecology, 213(4), 449-e1.
12. March, M. I., Warsof, S. L., & Chauhan, S. P. (2012). Fetal biometry: relevance in obstetrical practice. Clinical obstetrics and gynecology, 55(1), 281-287.
13. Salomon, L. J., Alfirevic, Z., Da Silva Costa, F., Deter, R. L., Figueras, F., Ghi, T. A., ... & Yeo, G. (2019). ISUOG Practice Guidelines: ultrasound assessment of fetal biometry and growth. Ultrasound in obstetrics & gynecology, 53(6), 715-723.
14. Gardosi, J., Chang, A., Kalyan, B., Sahota, D., & Symonds, E. M. (1992). Customised antenatal growth charts. The Lancet, 339(8788), 283-287.
15. Dawson, W. R. (1982). Evaporative losses of water by birds. Comparative Biochemistry and Physiology Part A: Physiology, 71(4), 495-509.
16. Hadlock, F. P., Harrist, R. B., Deter, R. L., & Park, S. K. (1982). Fetal femur length as a predictor of menstrual age: sonographically measured. American Journal of Roentgenology, 138(5), 875-878.
17. Campbell, J., Henderson, A., & Campbell, S. (1988). The fetal femur/foot length ratio: a new parameter to assess dysplastic limb reduction. Obstetrics & Gynecology, 72(2), 181-184.
18. Wang, L., Takai, Y., Baba, K., Mikami, Y., Saito, M., Horiuchi, I., ... & Seki, H. (2017). Can biparietal diameter-to-femur length ratio be a useful sonographic marker for screening thanatophoric dysplasia since the first trimester? A literature review of case reports and a retrospective study based on 10,293 routine fetal biometry measurements. Taiwanese Journal of Obstetrics and Gynecology, 56(3), 374-378.
19. Khalil, A., Pajkrt, E., & Chitty, L. S. (2011). Early prenatal diagnosis of skeletal anomalies. Prenatal diagnosis, 31(1), 115-124.
20. Hadlock, F. P., Harrist, R. B., & Martinez-Poyer, J. (1991). In utero analysis of fetal growth: a sonographic weight standard. Radiology, 181(1), 129-133.
21. Attali, E., & Yogev, Y. (2021). The impact of advanced maternal age on pregnancy outcome. Best Practice & Research Clinical Obstetrics & Gynaecology, 70, 2-9.
22. Madsen, L. R., Gibbons, K. S., Ma, R. C., Tam, W. H., Catalano, P. M., Sacks, D. A., ... & McIntyre, H. D. (2021). Do variations in insulin sensitivity and insulin secretion in pregnancy predict differences in obstetric and neonatal outcomes?. Diabetologia, 64, 304-312.