

**CORRELATION OF FETAL KIDNEY LENGTH WITH
GESTATIONAL AGE IN NORMAL PREGNANCIES
AMONG NORTH BENGAL POPULATION
THROUGH ULTRASONOGRAPHIC
STUDIES**

**THESIS SUBMITTED FOR THE DEGREE OF PhD IN MEDICINE
(ANATOMY) UNDER THE MEDICAL FACULTY OF THE
UNIVERSITY OF NORTH BENGAL**



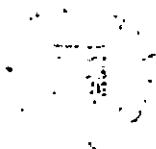
DR. JAYANTA CHANGDAR
North Bengal Medical College & Hospital
Sushrutanagar, Darjeeling, West Bengal, India.

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PARENTS

GOVT. OF WEST BENGAL
North Bengal Medical College & Hospital
Sushrutanagar. Darjeeling - 734012

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This is to certify that DR. JAYANTA CHANGDAR, Medical officer, North Bengal Medical College and Hospital has duly completed the thesis entitled ***“CORRELATION OF FETAL KIDNEY LENGTH WITH GESTATIONAL AGE IN NORMAL PREGNANCIES AMONG NORTH BENGAL POPULATION THROUGH ULTRASONOGRAPHIC STUDIES”***.

He has obtained the required permission for the proposed research methodology from the Ethical committee, N.B.M.C&H prior to proceeding with the study and subsequently conformed to all the institutional rules and regulations during the period of research in this hospital.



PROF. SAMAR DEB
CHAIRMAN

ETHICAL COMMITTEE

NORHT BENGAL MEDICAL COLLEGE & HOSPITAL
SUSHRUTANAGAR. DARJEELING, WEST BENGAL

Date: 31.08.09
Place: NBMCH



Chairman, Ethical Committee,
North Bengal Medical College
Sushrutanagar, Dist. Darjeeling

PROF. SAMAR DEB

Professor & Ex-Head of the Department of Anatomy
North Bengal Medical College & Hospital.
Sushrutanagar, Darjeeling, West Bengal.

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All the procedures, observations and results included in this thesis in pursuance of the research work have been conducted independently by the candidate under my direct guidance and supervision.

During the entire period of all the procedures and findings were directly verified by me and found to be reliable and satisfactory.

I wish him all success in life.



PROF. SAMAR DEB

EX-HEAD OF THE DEPARTMENT
DEPARTMENT OF ANATOMY

NORTH BENGAL MEDICAL COLLEGE & HOSPITAL
SUSHRUTANAGAR, DARJEELING, WEST BENGAL

Date: 21.08.09
Place: NBMCH

DEPARTMENT OF RADIODIAGNOSIS

North Bengal Medical College & Hospital
Sushrutanagar. Darjeeling - 734012

CERTIFICATE FROM THE CO-GUIDE

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All the ultrasonographic procedures and observations for the study were reliably carried out by the candidate himself under my supervision during the entire period of study and verified to be authentic and satisfactory.

Asit Chandra Roy.

DR. ASIT CHANDRA ROY

ASSOCIATE PROFESSOR

DEPARTMENT OF RADIODIAGNOSIS

NORTH BENGAL MEDICAL COLLEGE & HOSPITAL

SUSHRUTANAGAR. DARJEELING. WEST BENGAL

Date: 31.08.09

Place: N B M C H .



GOVT. OF WEST BENGAL
North Bengal Medical College & Hospital
Sushrutanagar. Darjeeling - 734012

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He has fulfilled all the conditions and requisites of the University and obtained the necessary consent from the Ethical Committee, N.B.M.C&H in the preparation and completion of the thesis.

I wish him success in life.



PROF. JYOTI BIKASH SAHA
PRINCIPAL

Date:

21-8-2009

Place:

N.B.M.C.H

NORHT BENGAL MEDICAL COLLEGE & HOSPITAL
SUSHRUTANAGAR. DARJEELING. WEST BENGAL



Principal
North Bengal Medical College

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DR. JAYANTA CHANGDAR

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INTRODUCTION

INTRODUCTION

Medicine is an ever changing science. We could not have seen a caterpillar turning to butterfly unless there would have been a change. Hence, Sir George Bernard Shaw rightly said, "Change is the only constant thing in the World."

Anatomy, long viewed as a complex catalog of structure is changing its attitude by leaning towards the philosophy which takes it beyond what is regarded as science. From scalp to sole, every anatomical structure needs philosophical introspection for the betterment of medical science. During embryogenesis the three layered (ectoderm, endoderm and mesoderm) embryonic disk folds on itself to an embryonic cylinder which undergoes some invaginations and evaginations to give shape to a complex and complete individual. In this regard, all morphogenic processes during the period of embryogenesis may be regarded as variants of behavior of a fertilised ovum.

The philosophisation of anatomy in this new millennium will tune it to a celestial song. Anatomy is the foundation on which the towering edifice of clinical medicine is built up. It is the only branch of medical science which deals with human being before birth and after death.

Now-a-days, the study of anatomy is a better integrated subject with which clinical science tunes in harmony like a synthesizer. Anatomy today continues to extend its way over every speciality of medicine.

It is now a common practice to precede the word anatomy with an adjective that defines the angle of observation e.g. Developmental Anatomy; Radiological Anatomy; Surgical Anatomy etc. The study of Anatomy gets a momentum when it is interpreted with the help of modern imaging systems like Ultrasonography (USG), Computed tomography (CT), Magnetic Resonance Imaging (MRI) and conventional Radiology. Radiographic Anatomy may be considered as a wing of various aspect of study of Anatomy in details.

Assessment of gestational age has become very important in each and every pregnancy for observation of proper fetal growth and development and also its ultimate outcome.

In previous days, assessment of gestational age was done on the basis of menstrual history and clinical examination (e.g. fundal height estimation, maternal weight gain etc.) and there was no imaging technique for assessment of gestational age.

Previously X-ray was used to detect mainly intrauterine fetal death and abdominal pregnancy. Unfortunately in X-Ray and CT scan, exposure to radiation during the period of organogenesis and development of fetus very frequently leads to congenital anomaly of the fetus. So, not recommended during pregnancy.

Similarly use of MRI needs absence of any movement for a period of half to one hour for producing image and data acquisition, though, recently some highly sophisticated procedure for MR(Magnetic Resonance) scan has been developed on moving object (e.g. Cardiac MR scan) but not

easily applicable in all purposes. Normal fetal movement during MR (Magnetic Resonance) Scan hampers data acquisition. Hence, proper image production is not possible by MRI during pregnancy. Moreover, the safety of MRI in pregnancy has not yet been established. So, of all the currently available imaging techniques ultrasonography is the only non-invasive, non-ionising, non-hazardous, high accuracy, safe, cost effective, reproducible and easy available method for assessment of gestational age and fetal well-being.

In the year 1958, Sir Ian Donald (an Obstetrician) and his colleagues in Royal Maternity Hospital at Glasgow, first applied principle of ultrasound in obstetrics, which was considered as one of most important step in the field of diagnostic imaging. In 1959 Professor Ian Donald discovered that clear echoes could be obtained from the fetal head and he started to apply this information for diagnosing the size and growth of the fetus at the Royal Maternity Hospital Rotternrow. Within next few years it became gradually possible to monitor the pregnancy sonologically from beginning to end including assessment of gestational age and diagnosis of various complications like twin pregnancy, fetal abnormality, placenta praevia etc.

In the past, Obstetricians had to compromise with many untoward incidences in prenatal, parital and postnatal periods due to lack of prior information regarding abnormality in uterine and adnaexal anatomy and feto-placental profile. High maternal and fetal morbidity and mortality rate was a global problem at that time. So, sonographic evaluation of antenatal mother became essential in every pregnancy. It is done for

confirmation of pregnancy, fetal viability and number, evaluation of fetal growth, fetal presentation, estimation of gestational age with known and unknown LMP(first day of last menstrual period), verification of EDD(expected date of delivery), evaluation of molar pregnancy and ectopic pregnancy at any stage, evaluation of placental maturity, position and abnormalities, umbilical cord, amniotic fluid volume, assessment of congenital anomaly of the fetus, detection of causes of hemorrhage in pregnancy, congenital anomaly of uterus and associated uterine and ovarian pathology, assessment of fetal growth in successful in vitro fertilization, selection of cases for elective cesarean section and deciding cases of elective termination of pregnancy etc.

For assessment of gestational age presently used conventional fetal biometric parameters are Crown Rump Length (CRL), Biparietal diameter (BPD), Head circumference (HC), Abdominal circumference (AC) and Femoral length (FL). Among these parameters CRL is measured (done only in first trimester of pregnancy) with an accuracy of ± 0.5 weeks. It is found that CRL is till the best parameter for determination of accurate gestational age during the first trimester. In subsequent trimesters CRL becomes fallacious as the fetus turns to fold after 1st trimester and so, it is not applicable for accurate estimation of gestational age after 1st trimester of pregnancy. In 2nd and 3rd trimester other biometric parameters like BPD, HC, AC, FL etc. which are commonly used (average of all the parameters) for fetal age determination, vary in accuracy by ± 1.2 to 3.5 weeks approximately. Variation of measurements of

Head circumference (HC) is ± 1.2 to ± 1.9 weeks, Biparietal diameter (BPD) is ± 1.2 to ± 1.9 weeks, Femoral length (FL) ± 2.1 to 3.5 weeks (Ref. Carol M. Rumack, *et al*, in "Diagnostic Ultrasound" Vol. 2, Second Edition, Chapter 33; 1997; Page 1021). In case of measurement of Abdominal circumference (AC) it is done mainly to determine fetal weight measurement with the help of other biometric parameters and its individual variation is so high, it is not used as single parameter for estimation of gestational age. Moreover all of these parameters have limitations of application and naturally cannot be applied at any condition of pregnancy e.g. when head has engaged, BPD and HC cannot be measured and estimation of gestational age has to be done only on FL and AC which itself varies in a wider range.

Other than conventionally used fetal biometric parameters few more fetal parts/organs like bi-ocular distance, cerebellar diameter, length of humerus, foot length, talus length, kidney length etc are being tried for accurate estimation of gestational age. Of these fetal kidney length estimation for gestational age determination is comparatively measured more accurately and can be employed at any point of time during pregnancy. The process of determination of gestational age by fetal kidney length measurement has been done by many researchers and still it is under extensive research trial throughout the various countries. In 1983, Bertagnoli L, Lalatta F, *et al* [6]. of Ultrasound School of Obstetrics and Gynecology, Italy, showed in their study that there was no significant difference between right and left fetal renal length and measurements of fetal

kidney can be used as an additional parameter in the routine assessment of fetal well being and gestational age. In the year 1991, HL Cohen, J Cooper, Eisenberg P, et al. [26] of North Shore University Hospital Cornell University Medical College, Manhasset, made a study on renal length and its correlation with gestational age and results showed that fetal renal lengths were longer than previously reported. In 1997, Saha M, Paul AK *et al* [54] of Nuclear Medicine Centre, Khulna, Bangladesh, did an ultrasonographic study in normal pregnancies between 16 and 40 weeks of gestation. Their study showed an excellent correlation between gestational age, biparietal diameter, femoral length and renal length measurements and the average kidney length at full term was 3.95 cm. In 1997, Carol M. Rumack, Stephanie R. Wilson, *et al*, in their highly esteemed text book "Diagnostic Ultrasound" Vol. 2, Second Edition, 1997, Chapter 37, Page 1094, mentioned the often quoted rule of thumb is that "renal length in millimeters approximates gestational age in weeks". [13]

In the year 2002, Konje J C, Abrams KR. *et al*. [35] of UK mentioned in their study that fetal kidney measurement was easy to make and could therefore be easily incorporated into the model for dating pregnancies after 24 weeks of gestation, in particular when measurements of the biparietal diameter and head circumference are difficult. In the year 2006, Slobodan Vljaković, Ljiljana Vasović, *et al*, [59] Department of Anatomy, Faculty of Medicine, University of Niš, Niš, Serbia and Montenegro, mentioned in their study, the importance of

determining the average fetal kidney dimensions, which could be used as standard values in obstetrics.

Hence a trial has been done to search for a new biometric parameter like fetal kidney length measurement to determine the gestational age more accurately which can be employed at any point of time during pregnancy for estimation of gestational age, as it is not affected by the factors like ruptured membranes, engagement of head, lie and presentation of the fetus etc. Moreover in advanced pregnancy cases where there is no information regarding first day of last menstrual period (L.M.P), sonography was not performed during the early weeks of pregnancy, fetal kidney length measurement may play a vital role in determination of gestational age. This effort may be treated as a tribute to the betterment of service to the suffering humanity in the reproductive medicine for betterment of perinatal care by exact assessment of gestational age and timely medical intervention to reduce the perinatal morbidity and mortality.

AIM AND OBJECTIVES

AIM AND OBJECTIVES

The aim of this research work was an effort to an accurate estimation of gestational age by assessment of fetal kidney length, as we may have antenatal mothers having no definite history of LMP (first day of last menstrual period) and who did not attend for antenatal sonographic check up and also in conditions like engaged head, ruptured membranes, breech presentation, where use of conventional fetal biometric parameters become difficult for assessment of accurate gestational age.

Ultrasound is being utilised for estimation of gestational age of the fetus by utilising different parameters like Crown rump length (CRL), Biparietal diameter (BPD), Head circumference (HC), Abdominal circumference (AC), Femoral length (FL) etc. During the first trimester, fetal maturity is estimated by evaluation of Crown rump length (CRL). It is found that CRL is the best parameter for determination of accurate gestational age in the first trimester of pregnancy but in subsequent trimesters CRL becomes fallacious as the fetus turns to fold and so it is not applicable for accurate estimation of gestational age after 1st trimester of pregnancy. In 2nd and 3rd trimester other biometric parameters like BPD, HC, AC, FL etc. which are commonly used for fetal age determination, vary in accuracy by ± 1.2 to 3.5 weeks approximately. To overcome this problem of variation a trial has been done to search for a new biometric parameter like fetal kidney length measurement to determine

the gestational age more accurately and it can be employed at any point of time during pregnancy for estimation of gestational age, as it is not affected by the factors like ruptured membranes, liquor volume, engagement of head, lie and presentation of the fetus etc. As a rule of thumb (Ref. Stephanie R.Wilson, Carol M. Rumack, *et al*, [19] in their highly esteemed text book "Diagnostic Ultrasound" Vol. 2, Second Edition (1997), Chapter 37, Page1094], it is said that the length of fetal kidney expressed in millimeter corresponds more to gestational age expressed in terms of weeks. In advanced pregnancy cases where there is no information regarding first day of last menstrual period (L.M.P), sonography was not performed during the pregnancy period or when use of other fetal biometric parameters are difficult to assess gestational age (e.g. head has engaged, membranes ruptured, breech presentation etc.), fetal kidney length measurement may play a vital role in determination of gestational age.

The process of determination of gestational age by fetal kidney length estimation is under research throughout the various countries and as no definite unanimously acceptable conclusion has been derived till now, it remains a field of extensive research which will help to determine its accuracy, particularly when compared with other traditional fetal gestational age determination parameters, as more accurate estimation of gestational age may help in various decision making processes and timely intervention by the Obstetricians to reduce the perinatal morbidity and mortality.

On the footings of the entire facts and findings, this research work has been conducted with the following objectives:

1. Sonographic estimation of gestational age of the fetus by using different conventional parameters in respect to different trimesters.
2. Sonographic estimation of fetal kidney length.
3. To find out the correlation between fetal kidney length and gestational age.
4. To reduce the perinatal mortality and morbidity rate by determining more accurate gestational age with the estimation of fetal kidney length, where application of other conventional biometric parameters are difficult or inaccurate.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

❖ **Review of literature on use of ultrasonography:**

Carol M. Rumack, Stephanie R. Wilson, *et al*, in their highly esteemed text book "Diagnostic Ultrasound" Vol. 2, Second Edition(1997), Chapter 31, Page 961, mentioned "The introduction of sonography to obstetrics by Ian Donald and his colleagues in 1958 is now regarded as one of the major milestones of modern medicine. For the first time it became possible to obtain information about the fetus and its environment directly with a noninvasive diagnostic procedure considered safe even when used repeatedly. Recent advances in technology and expertise have enhanced image quality allowed for considerable insight into fetal anatomy." [12]

Wilson Stephanie R, Carol M. Rumack, *et al*, in Diagnostic Ultrasound, Vol. 2, Second Edition(1997), Chapter 33, Page 1013, stated that by convention, pregnancies are dated beginning from the first day of the last menstrual period (LMP). In women with regular 28 day cycles, conception occurs approximately two weeks after the LMP. Gestational age, the term commonly used to date the pregnancy, is thus defined as conceptual age plus two weeks. In women with regular 28 day cycles, gestational age and menstrual age are the same. Accurate knowledge of gestational age is important for better diagnosis and management. [68]

In "Diagnostic Ultrasound", Vol. 2, Second Edition (1997), Chapter 31, Page 962, Stephanie R Wilson, Carol M. Rumack, *et al*, gives the guidelines for the first trimester ultrasound examination which includes confirmation of the location of the gestational sac, the presence or absence of fetal life, fetal number, and evaluation of the uterus and adnexae. The second and third trimester examinations include these parameters and as well as documentation of fetal presentation, amniotic fluid volume (AFV), location of the placenta, assessment of gestational age using biparietal diameter(BPD), femur length(FL) abdominal circumference(AC) and fetal anatomy.^[62]

Seeds JW. *et al*, in the journal of "Obstet Gynecol", 1982 Dec; 60(6):680-5 said that ultrasonic long bone imaging is a potentially valuable index of fetal growth. Reported here are fetal limb measurements in normal pregnancies, produced with readily available ultrasound equipment and described using simple statistical techniques. Lengths of femur, humerus, tibia/fibula, and radius/ulna are related to gestational age. Femur and humerus measurements are also related to biparietal diameter. Linear correlation is high and with few exceptions these results confirm those of other investigators. Comparability between these data and previously published work is examined and the utility of these standards of growth discussed. Long bone imaging is confirmed as being reliable, reproducible, and a viable alternative to the measurement of biparietal diameter in the biophysical assessment of fetal development. ^[58]

In the journal of "Obstet Gynecol Surv", 1989 Jul; 44(7):544-55, Reece EA, Gabrielli S, *et al*, Department of Obstetrics and Gynecology, Yale University School of Medicine, New Haven, Connecticut - 06510, mentioned that the accurate estimation of gestational age is an essential part of pregnancy management, since the consequences of erroneous dating carry increased risks of perinatal morbidity and mortality. Ultrasonography offers a unique opportunity to objectively measure quantitative changes in growth increments of various fetal structures, as well as qualitative changes occurring near term which are indicative of fetal maturity. Therefore, dating through pregnancy is possible by the use of various parameters such as the crown-rump length, the trunk circumference, and the biparietal diameter in the first trimester; the biparietal diameter, the cerebellum, orbital distance, clavicular length, lengths of the long bones of the upper and lower extremities, and the foot length in the second and third trimesters; and the indices of maturity in the late third trimester such as fetal renal length and epiphyseal ossification centers of the long bones of the upper and lower extremities. Using a combination of fetal biometry and maturity indices permit dating through pregnancy as a measure of growing up of fetus.^[51]

The American Institute of Ultrasound in Medicine (AIUM) in the journal of Ultrasound in Medicine 1991; 10:576-78, formulated a guide line for the first trimester ultrasound examination which includes confirmation of the location of the gestational sac, the presence or absence of fetal life, fetal number and evaluation of the uterus and adnexae. The fetal anatomic

assessment includes the evaluation of intracranial anatomy, heart, spine, abdomen (including kidneys, bladder and stomach) and cord insertion in their study. [3]

Society of Obstetricians and Gynecologist of Canada (SOGC) in 1993 recommended that all patients be offered a mid trimester fetal ultrasound examination. They suggested that 18 weeks is the ideal time to perform the scan that should combine an evaluation of dates, biometry, number of fetuses and assessment of fetal abnormalities and also gave specific recommended images and measurements. [61]

❖ **Review of literature on conventionally used fetal biometric parameters for assessment of gestational age:**

Stephanie R. Wilson, Carol M. Rumack, *et al*, in “Diagnostic Ultrasound”, Vol. 2, Second Edition(1997), Chapter 32, Page 987, proposed that using endovaginal ultrasonography (EVS), an embryo with a crown rump length (CRL) of as small as 1 to 2 mm may be identified immediately adjacent to the yolk sac. Embryonic cardiac activity can be identified routinely by EVS when the CRL is greater than 5mm. [63]

Carol M. Rumack, Stephanie R. Wilson *et al*, in “Diagnostic Ultrasound” Vol. 2, Second Edition(1997), Chapter 32, Page 989, mentioned that using endovaginal sonography (EVS), the embryo can be visualized from the 5th menstrual week onward. A well performed crown rump length (CRL) measurement in the first trimester of pregnancy is accurate up to 5 to 7 days and is equivalent to or greater in accuracy than the biparietal diameter measured early in the second trimester. [11]

Willocks J, Donald I, *et al*, In the Journal "J Obstet Gynaecol Br Common" 1967; 74:639-647, "Intrauterine growth assessed by ultrasonic fetal cephalometry", Willocks J, Donald I, *et al*, mentioned that BPD increases steadily throughout gestation but that after about 32 weeks the rate of changes decreases and difficulty of accurate measurement increases. [67]

In "Br J Obstet Gynaecol" 1975; 82: 702-710, in a study "A critical evaluation of sonar 'crown rump length' measurements", Robinson HP, *et al*, mentioned that from 6 weeks until the end of the first trimester, gestational age correlates closely with the crown rump length (CRL) of the embryo or fetus. The term "embryo" applies up to the end of organogenesis at 10 weeks' gestation; the term "fetus" applies thereafter. The CRL is the length of the embryo or fetus from the top of its head to the bottom of its torso. It is measured as the longest dimension of the embryo, excluding the yolk sac and extremities. The CRL of the longer, more developed fetus becomes less reliable. At this later stage, the CRL is affected by the fetal position, measuring shorter in a fetus whose spine is flexed and longer in a fetus whose spine is straight. [52]

AB Kurtz, Wapner RJ, *et al*, in "J Clin Ultrasound" 1980; 8:319-326, mentioned in their study "Analysis of biparietal diameter as an accurate indicator of gestational age", that there have been 25 studies attempting to correlate biparietal diameter and gestational age; of these, 17 meet specific criteria and thus are included in this evaluation. Although all studies have shown an increase in biparietal diameter with advancing gestational age, between 17 wk and term there is a discrepancy of

approximately 3 wk. In this evaluation the charts are compared and the variations analyzed. An ideal table is constructed by combining the mean gestational age, calculated from a statistical analysis, and the variation at each millimeter point, determined by comparison of all the studies. It is hoped that this new 90% composite table, which consists of a range of gestational ages in weeks for each biparietal diameter, will not only provide more realistic indications of fetal age but also will serve as a reminder to sonographers, obstetricians, and patients of the relative accuracy and variations of biparietal diameter measurements. [1]

In "Am J Obstet Gynecol", 1981 Dec 1; 141(7):759-62, in a study "Comparison of ultrasound femur length and biparietal diameter in late pregnancy", Quetel TA, *et al*, showed a linear relationship between growth of fetal femur length (FL) and biparietal diameter (BPD) after 22 weeks' gestation is described. The normal ratio of femur length to BPD (FL/BPD ratio) was found to be 79 +/- 8%. Effective uses of the FL/BPD ratio include its use as a quality control check on femur length and BPD measurements and its use to diagnose short-limbed dwarfism, hydrocephalus, and microcephaly. Pregnancy dating by means of BPD can now be cross checked by use of femur measurements and new observations on normal and abnormal fetal growth will now be possible. [50]

In "AJR Am J Roentgenol" 1982 Aug; 139(2):367-70, Deter RL, Hadlock FP, *et al*, made a study on "Fetal abdominal circumference as a predictor of menstrual age". In their study the relation between fetal abdominal circumference and

menstrual cycle age was determined by cross-sectional analysis of 400 fetuses (15-41 weeks) examined with a linear-array real-time ultrasound scanner using specifically defined methodology. Predicted abdominal circumference values at specific points in gestation were comparable to the data reported by other investigators using static-image equipment. Predicted menstrual age values associated with a given abdominal circumference measurement were calculated and are presented in tabular form. The variability (+/- 2 SD) in predicting menstrual age from abdominal circumference measurements is broader than that observed with the fetal biparietal diameter; nonetheless, this measurement can be useful as an adjunct in predicting menstrual age in cases in which the biparietal diameter is technically inadequate or impossible to obtain due to unusual positioning.^[19]

In "Br J Obstet Gynaecol", 1982 Oct; 89(10):836-8, Parker AJ, Davies P, *et al*, made a study on "Assessment of gestational age of the Asian fetus by the sonar measurement of crown-rump length and biparietal diameter". In their study two populations of pregnant Asian and European women were scanned using linear array real-time ultrasound machines. Measurements were made of fetal crown-rump length (CRL) up to 14 weeks gestational age and of biparietal diameter (BPD) up to 20 weeks gestational age. There were no significant differences between the Asian and European parameters for the CRL and BPD curves. European nomograms may be used to establish Asian fetal gestational age up to 20 weeks.^[46]

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Hadlock F P, Deter R L, *et al*, in "AJR Am J Roentgenol". 1982 Aug; 139(2):367-70, mentioned in the study "Fetal head circumference: relation to menstrual age" that a number of groups have produced charts of HC against gestational age and the two most often used are very similar. Both shows that changes in HC, like BPD, tend to tail off towards term but the standard deviations are much smaller. [27]

In "J Ultrasound Med" 1982; 1:281-288, in a study "Head circumference as an index of fetal age", Law RG, *et al*, showed that head circumference (HC) plays an important role in sonographic determination of fetal age. [38]

David Cosgrove, Hiltone Meire, *et al*, in "Ultrasound in Obstetrics and Gynaecology" 2nd Edition (2001); Vol.3; Chapter 10; Page 229, mentioned that the AC is undoubtedly the best index with which to assess both fetal size and growth because the measurement is taken at the level of the fetal liver, which constitute about 4% of the total fetal weight and which steadily increases in size with gestational age. [17]

Hobbins JC, Jeanty P, *et al*, in the journal "Clin Obstet Gynecol" 1983 Dec; 10(3):423-44, mentioned that reliable fetal age assessment is possible using antenatal sonography. Crown-rump length, biparietal diameter, head perimeter and femur length are the most widely used parameters, while biocular distance and humerus length are of ancillary value. Techniques of sonographic measurement and clinical applications are reviewed and nomograms relating these parameters to

gestational age are presented. Multiple sonographic parameters have been used to diagnose altered fetal growth. [31]

In "J Ultrasound Med", 1983 Apr; 2(4):147-50, Smazal SF Jr, Weisman LE, *et al*, mentioned in their study "Comparative analysis of ultrasonographic methods of gestational age assessment". That the measurement of crown-rump length (CRL) is widely accepted as the most accurate method of gestational dating. The statistical accuracy of growth-adjusted sonographic age (GASA) determinations has been demonstrated to be similar. Ninety-six patients were prospectively examined by use of serial ultrasonography, and findings were evaluated to correlate CRL with a single biparietal diameter (BPD) obtained between 20 and 24 weeks of gestation, with GASA, and with accurate maternal dates. Growth-adjusted sonographic age was shown to be not as accurate as CRL and no more accurate than a single BPD obtained between 20 and 24 weeks or reliable maternal dates. [60]

Fendel H, Giani G, *et al*. in "Zeitschrift für Geburtshilfe und Perinatologie". 1984 Jul-Aug; 188(4):161-6, in a German article "Determination of gestational age using crown-rump length and the biparietal diameter in the 1st half of pregnancy--comparison of 2 methods" stated that they made ultrasound investigations on women with known gestational age by regular menstruation or conception in the first half of pregnancy. In 221 cases of single pregnancies fetal crown rump length was measured. Biparietal cephalometry was performed in 198 single fetuses. Growth curves and the velocity of growth from biparietal diameter and from crown-rump length were

determined and compared. The accuracy of the estimation of gestational age was observed to be +/- 10 days (2 SD) with both methods. [23]

Hohler CW, *et al*, in "Clin Obstet Gynecol", 1984 Jun; 27(2):314-26 said in their study "Ultrasound estimation of gestational age" that many ultrasonologists feel that if they are unable to obtain a BPD measurement at the time of an ultrasound examination that they have somehow failed to do an adequate job. However, from the information outlined in this chapter, it can be seen that the biparietal diameter is only one measurement that can be taken of the fetus in order to estimate gestational age. Furthermore, since the recognition of variability in fetal head shape, absolute reliance on measurement of the fetal biparietal diameter for estimation of gestational age has become much less common, especially after 20 weeks of gestation. The move toward measurement of several parts of the fetal anatomy has been called fetal biometry. The purpose of this approach is to evaluate body proportion and symmetry of growth of different organ systems, in the hope of elucidating subtle patterns which might be recognized as abnormal in very early stages when some form of prenatal management might improve reproductive outcome. Simultaneously, with the implementation of this approach to estimating age, a desire to inject an element of "quality control" into the obstetric ultrasound examination has come about. It has been found that measurement of more than one fetal parameter, in a sense, prevents over reliance on any single measurement, which, by itself, might mislead the clinician. While an error of clinically

significant magnitude can be made in any measurement, it is unlikely that an error of the same magnitude, in "the same direction" of over or underestimation of the actual, would occur. Thus, there is an element of protection of the patient built into this approach which makes it appealing intuitively. However, it is uncertain that measurement of BPD, head circumference, abdominal circumference, and femur length will, in all cases, give a better estimate of gestational age than will measurement of the BPD alone. Recent data from Hadlock et al. showed that in 177 normal pregnancies, there was significant improvement in the ultrasound estimation of estimated date of delivery when two or more parameters were used to make that estimate rather than just BPD alone. Prior to 36 weeks, the optimal combination of parameters included the biparietal diameter, the abdominal circumference, and the femur length. However, after 36 weeks, the head circumference, abdominal circumference, and femur length gave the best estimate, with significant reduction in the mean errors, standard deviations, and size of maximum errors. [32]

In "J Ultrasound Med", 1984 Feb; 3(2):75-79. Jeanty PJ, Rodesch F, *et al*, in their study "Estimation of gestational age from measurements of fetal long bones", have mentioned in their study regarding sonographic measurement of fetal long bones (femur, humerus, tibia, and ulna) from 12 to 40 weeks of gestation. The combined use of the four bones allowed a good estimation of gestational age. [34]

Tse CH, *et al*, in "Aust N Z J Obstet Gynaecol", 1984 Aug; 24(3):186-8, conducted a study on "A comparison of the fetal femur length and biparietal diameter in predicting gestational age in the third trimester". In their study the accuracy of predicting gestational age, fetal femur length was compared with the biparietal diameter after 28 weeks' gestation in 50 patients. The results showed that ultrasonic fetal femur length was more accurate than the biparietal diameter in predicting gestational age in the third trimester. Ultrasonic fetal femur length provides an additional parameter in assessing gestational age in late pregnancy. [65]

In "J Reprod Med", 1984 May; 29(5):323-6, Allen G, Quinlan RW, *et al*, in a study "Clinical utility of the relationship between fetal femur length and biparietal diameter", showed the relationship between fetal femur length and biparietal diameter on ultrasound examination was evaluated in a large, unselected obstetric population of 12-40 weeks' gestational age. The derived ratio of fetal femur length to biparietal diameter was evaluated retrospectively as a tool for examining the technical reliability of fetal measurements obtained and as a screening mechanism for detecting asymmetric fetal development. The ratio of femur length to biparietal diameter is of value as an aid to the detection of fetal developmental and these should be a routine parameter considered in the performance of an obstetric ultrasound examination.[2]

Schmidt W, *et al*, in an Article of German, "Geburtshilfe und Frauenheilkunde", 1985 Feb; 45(2):91-7, "Fetal femur length in the 2nd and 3rd trimester of pregnancy", presented results of

sonographic determination of the length of femur between the 12th and 42nd week of pregnancy. The length of femoral diaphysis was determined as part of a cross-sectional study on a total of 595 patients who were not at risk, and where the gestation age was known and confirmed. The growth function of the foetal femoral length was determined via a polynomic regression equation. The foetal femoral length growth presents a characteristic appearance between the 12th and 42nd pregnancy week. In the 12th pregnancy week it is 11 mm on the average, 33 mm in the 20th, 58 mm in the 30th, and 76 mm at birth. After an almost linear progression up to about the 30th week of pregnancy, the growth curve gradually begins to flatten out from that time. The mean growth rate of foetal femoral length during the entire period under observation is about 1 to 3 mm per pregnancy week. A relatively accurate estimate of the gestational age is particularly possible in the "early" range between 5 and 32 mm (corresponding to the 12th to 20th week of pregnancy), namely, +/- 9.7 to 10.3 days. [57]

Ott WJ, in the journal "Obstet Gynecol", 1985 Sep; 66(3):311-5, conducted a study "Accurate gestational dating" and calculated gestational age by four ultrasonic parameters (biparietal diameter, head circumference, abdominal circumference, and femur length). 210 normal obstetric patients divided into four gestational age groups based on time of first ultrasound examination. Accuracy of the calculations was determined by comparison of each technique and a simple arithmetic average of the four techniques to the gestational age calculated from the Dubowitz examination of the neonate after delivery. The

analysis indicated that each ultrasonic technique has certain advantages and disadvantages, but that the simple arithmetic average of the four techniques had the lowest systematic and random error. [43]

In the journal "Obstet Gynecol", 1985 May; 65(5):613-20, in the study "Routine ultrasound screening for the prediction of gestational age", Campbell S, Little D, *et al*, described that clinical dating of pregnancy is usually based on the patient's recollections of the first day of her last menstrual period and on physical examination of uterine size. Unfortunately both these methods are subject to imprecision, leading to inaccuracies in gestational age assignment. Dating by the last menstrual period may be inaccurate because of variability in length of menstrual cycles, faulty memory, or bleeding during early pregnancy. Determining gestational age from the palpated dimension of the uterus may be affected by uterine fibroids and maternal body habitus. [10]

In the journal "Obstet Gynecol", 1985 Jul; 66(1):69-75. Warda AH, *et al*, did an investigation on "Fetal femur length: a critical reevaluation of the relationship to menstrual age". This investigation had reexamined the measurement of the femur length and the use of this measurement as a growth and dating parameter. Straight-line measurements of shaft length were found to be smaller than measurements made along the bone curvature. However, the maximum difference did not exceed 2 mm. Thus, because of its simplicity, use of straight-line measurements appears justified. The variability associated with age estimates increased with femur length. These data were

used to construct new standard curves for growth assessment and dating of fetuses using femur length measurements. [66]

In the journal "J Ultrasound Med", 1986 Mar;5(3):145-49, the study "Comparison of biparietal diameter and femur length in the third trimester: effects of gestational age and variation in fetal growth", conducted by Wolfson RN, Peisner DB, *et al*, did a multiple regression-based statistical model capable of quantitatively comparing two or more sonographic parameters for the effects of gestational age, variation in fetal growth and error in sonographic measurement is presented and then used to compare the biparietal diameter and femur length as estimators of gestational age in late pregnancy. A total of 311 patients were studied between 24 and 42 weeks' gestation. Variation in fetal growth was expressed as the birth weight percentile for gestational age. Biparietal diameter and femur length correlated equally well with gestational age. However, the biparietal diameter was more than twice as sensitive as the femur length to variation in fetal growth. Femur length had a larger error associated with its measurement. These results suggest that the biparietal diameter and femur length in late pregnancy are equal estimators of gestational age; that the femur length is a more stable estimator of gestational age when fetal growth deviates from normal; and that the femur length is technically more difficult to obtain. [70]

In "Am J Perinatol", 1986 Apr; 3(2):77-9, in the study "Femur length versus biparietal diameter for estimating gestational age in the third trimester", Egley CC, Seeds JW, *et al*, established that ultrasound measurement of femur length and biparietal

diameter is comparably accurate estimators of gestational age when obtained in the first half of pregnancy. Both estimators, however, become less accurate later in pregnancy. The present study compares the relative accuracy of these estimators when obtained in the third trimester. It is concluded from linear regression analysis that the correlation between gestational age estimated from femur length and the actual gestational age is stronger than that between gestational age estimated from biparietal diameter and actual gestational age. Furthermore, gestational age calculated from femur length is significantly more likely to be within 2-3 weeks of actual gestational age than is gestational age calculated from biparietal diameter. Estimating gestational age from the mean of the gestational age based on biparietal diameter and that based on femur length is less accurate than estimating gestational age from femur length alone. [22]

In the journal published from Denmark "Acta Obstet Gynecol Scand", 1986; 65(5):481-3, in the study "The reliability of ultrasound fetometry in estimating gestational age in the second trimester", Persson PH, *et al*, evaluated biparietal diameter (BPD), occipitofrontal diameter (OFD), mean abdominal diameter (AD), and femur length (FL), each value being taken as the mean of five measurements. Of the individual variables, BPD gave the best precision, with a standard deviation (SD) from true GA of 3.2 days. Using a combination of all four variables, GA could be estimated with a SD of 2.2 days. The maximum difference between GA estimated by BPD and by FL was 7 days. Using a combination of BPD and

FL to estimate GA in the total population, the number of post-term deliveries was only marginally less than when using BPD alone. [48]

Yagel S, Adoni A, *et al*, in "Br J Obstet Gynaecol", 1986 Feb; 93(2):109-15, in the study "A statistical examination of the accuracy of combining femoral length and biparietal diameter as an index of fetal gestational age". mentioned that the use of femur length (FL) and biparietal diameter (BPD) for estimation of gestational age (GA) was investigated using 1123 ultrasound measurements between the 14th and 41st week of gestation. Femur length was found to provide a more accurate index than BPD for the entire range of gestational age considered. If an interval of approximately +/- 2.5 weeks is considered 'satisfactory', the accuracy of FL past the 31st week is not sufficient to justify its use. Combining the FL and BPD measurements provides an index of gestational age accurate to approximately +/- 2.5 weeks up to the 32nd week of gestation and accurate to approximately +/- 2.75 weeks up to the 34th week of gestation. This is the first time that combining FL and BPD in a statistically rigorous manner has been proposed as an index of gestational age, and was suggested that this combination be used as a routine tool in its assessment. [71]

In "Am J Obstet Gynecol", Harrist RB, Hadlock FP, *et al* (1987), reported that in the second and third trimesters, the mean menstrual age defined as the mean of menstrual ages predicted by the biparietal (BPD), head circumference (HC), abdominal circumference (AC) and femoral length (FL) may be used to eliminate errors caused by inaccuracy of any one parameter. [29]

Needleman L, Kurtz AB, *et al*, in "Ultrasound Obstet Gynecol", 2nd edition, Philadelphia: WB Saunders, 1988:47-64, in their study "Ultrasound assessment of fetal age" mentioned that by the end of first trimester measurement of biparietal diameter (BPD) becomes more accurate than the crown rump length (CRL), which by that time reflects errors associated with fetal flexion and extension. [42]

Benson CB, *et al*, in the journal of United States "Radiology" 1988; 169(P):210, said in their study "Fetal measurements for predicting gestational age in the second and third trimesters: a reappraisal with a more reliable gold standard" that in the second trimester, biparietal diameter (BPD) and head circumference (HC) measurements are the best predictors of gestational age. In the third trimester, these two head measurements, the femoral length (FL) and the composite age formulas all predict gestational age with similar accuracy. [5]

In "Asia Oceania J Obstet Gynaecol", 1989 Sep; 15(3):223-7, Dali SM, *et al*, did a study on "Biparietal diameter of nepalese foetus in different periods of gestation by ultrasonography". In their study presented an analysis of 316 primigravida with their known date of last menstruation. These cases have been attending antenatal clinic from 14 to 40 weeks of gestation. The mean BPD (Biparietal Diameter) values and percentile values were calculated. It was observed that there is a steep rise of growth up to 31 weeks and thereafter a gradual rise up to 40 weeks. The maximum BPD from 31 to 40 weeks was 90.9 mm whereas western workers like Hansmann and Campbell reported 99 mm and 98.1 mm, respectively. [15]

Miller JM Jr, Foster TA, *et al* , Department of Obstetrics and Gynecology, Louisiana State University School of Medicine, New Orleans 70112. in "J Clin Ultrasound", 1989 Mar-Apr; 17(3):193-6, mentioned in a study of 324 term pregnancies, fetal measurements (biparietal diameter, femur length, and abdominal diameter) obtained within one week of delivery correlated more strongly with relative birth weight than with menstrual age. [41]

Hadlock FP, Baylor College of Medicine, Houston, Texas, in "Radiol Clin North Am", 1990 Jan; 28(1):39-50, mentioned in their study "Sonographic estimation of fetal age and weight" that real-time ultrasound is a very effective tool in the estimation of fetal age and weight. The most accurate fetal age estimates are from crown-rump length measurements in early pregnancy. Late pregnancy age estimates are less accurate, but the use of multiple body measurements provides a composite age estimate generally accurate to within 7 per cent of actual age. Estimates of fetal weight are improved with the use of head, body, and femur measurements, and generally are accurate to within 15 per cent of actual birth weight. [28]

In "AJR. Am J Roentgenol", 1991 Dec; 157(6):1275-7, in a study "Sonographic prediction of gestational age: accuracy of second and third-trimester fetal measurements". Doubilet PM, *et al*, Department of Radiology, Harvard Medical School, Brigham and Women's Hospital, Boston, measured the accuracy of second and third-trimester sonographic predictors of gestational age against highly reliable gold standard (crown-rump length) in a group of fetuses. Using a prospectively collected computerized

data base, They selected 460 fetal sonograms obtained at 14-42 weeks of gestation in which age could be reliably established on the basis of crown-rump length in the first trimester. They used data obtained from these sonograms to compare several predictors of fetal age. The accuracy of all predictors worsened progressively as pregnancy proceeded. In the second trimester, corrected biparietal diameter and head circumference were more accurate predictors of gestational age than were biparietal diameter, femoral length, and abdominal circumference. In the third trimester, the corrected biparietal diameter, head circumference, and femoral length were the best predictors, significantly better than biparietal diameter and abdominal circumference. Prediction of gestational age that relies on a single sonographic measurement should be based on the head circumference or corrected biparietal diameter in the second trimester and on one of these two predictors or the femoral length in the third trimester. [20]

In "Am J Obstet Gynecol", Volume 168(3), March 1993, Page 903-08, in a study "Accuracy of Gestational Age Estimation by Means of Fetal Crown-Rump Length Measurement" Daya Salim MB, MSc, Department of Obstetrics and Gynaecology, McMaster University, developed a gestational age table by means of crown-rump length measurements in the first trimester in pregnancies conceived through in vitro fertilization. Ninety-four infertile women with singleton intrauterine pregnancies resulting from in vitro fertilization underwent ultrasonographic examinations in the first trimester. The relationship between gestational age (calculated with the day of

oocyte retrieval used as day 14) and the crown-rump length was explored with regression analysis. A more accurate equation for gestational age estimation with crown-rump length measurements in early pregnancy has been developed with in vitro fertilization pregnancy data.^[18]

In "Clin Exp Obstet Gynecol", 1994; 21(2):108-18. Piantelli G, Sacchini C, *et al*, Department of Obstetrics and Gynecology, University of Parma, Italy, mentioned that the accurate assessment of gestational age is very important in everyday practice. By the use of multiple regression analysis, in a longitudinal study, ultrasound dating-curves were calculated for the crown-rump length, biparietal diameter, femur length, humerus length, binocular distance and transverse cerebellar diameter. All the examined parameters showed a good statistical correlation with gestational age; however, the earlier the estimation of the gestational age, the more accurate it is. The crown-rump length has been shown as the best parameter during the first trimester. Later on, the other biometric parameters become easier and more reliable. If determination of gestational age is required during the third trimester, the use of multiple parameters is recommended. ^[49]

In "Am J Perinatol", 1994 Nov; 11(6):404-8, Ott WJ, Department of Obstetrics and Gynaecology, St. John's Mery Medical Center, St. Louis, Missouri 63131, in their study "Accurate gestational dating: revised", mentioned that using first trimester fetal crown-rump length (CRL) measurements as the criterion for gestational dating, rather than menstrual history or neonatal gestational age evaluation after birth, may be a more accurate

way of evaluating the accuracy of second or third trimester ultrasonic measurements for gestational age estimation. This hypothesis was tested using two study groups to evaluate the accuracy of second or third trimester ultrasound measurements for the estimation of gestational age. Three hundred twenty normal obstetric patients who had first trimester CRL measurements were evaluated in the first study. Stepwise multiple regression analysis was used to determine the best combination of multiple ultrasonic parameters for calculation of gestational age, using each patient's CRL as control. The best formula derived from the first set of patients was used in a second set of 138 high-risk patients to determine the accuracy of multiple ultrasonic parameters obtained during the second or third trimester to date gestation accurately. The analysis confirmed the accuracy of multiple ultrasonic parameters for gestational dating and indicated that the use of two parameters (head circumference and femur length) was as accurate as the traditional four-parameter technique. [44]

In "Singapore Med J", 1995 Dec; 36(6):628-36), Lai FM and Yeo GS, Department of Maternal-Foetal Medicine, Kandang Kerbau Hospital, Singapore, in their study "Reference charts of foetal biometry in Asians", constructed reference ranges for foetal biometry measurements of biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), femur length (FL), humerus length (HL) and mandible length (ML) for the Asian population in Singapore. A prospective, cross-sectional study done in the obstetric ultrasound services and the labour ward of the department of Obstetrics and

Gynaecology in Singapore General Hospital. The fetuses of 6,374 women whose delivery date was within 2 weeks of their estimated date of delivery (EDD) as calculated from the last menstrual period. A total of 6131 measurements of BPD, 6117 measurements of HC, 6017 measurements of AC, 6078 measurements of FL, 2863 measurements of HL and 2029 measurements of ML were obtained and a regressed reference chart prepared for Asian Foetus from parametric analysis of cross sectional data.^[37]

J. William Charboneau, Carol M. Rumack, *et al*, in “Diagnostic Ultrasound”, Vol. 2, Second Edition (1997), Chapter 33, Page 1015, said that many sonographic parameters have been proposed for estimating gestational age in the second third trimesters. These include several fetal measurements: biparietal diameter (BPD), head circumference (HC), abdominal circumference (AC), femur length (FL), length of other long bones and biocular distance. Measurements of structurally abnormal fetal body parts should not be used in the assignment of gestational age.^[33]

In the journal “Obstet Gynecol”, 2001 Feb;97(2):189-94, Taipale P, *et al*, Department of Obstetrics and Gynecology, Jorvi Hospital, Espoo, Finland, in the study “Predicting delivery date by ultrasound and last menstrual period in early gestation”, compared last menstrual period and ultrasonography in predicting delivery date. They used ultrasound to scan 17,221 nonselected singleton pregnancies at 8-16 completed weeks. The last menstrual period (LMP) was considered certain in 13,541 and uncertain in 3680 cases. The duration of pregnancy

from the scan to the day of spontaneous delivery was predicted by crown-rump length, biparietal diameter (BPD), and femur length (FL) using linear regression models and the results were compared with estimates based on LMP. At all gestational ages, ultrasound was superior to certain LMP in predicting the day of delivery by at least 1.7 days. When deliveries before 37 weeks were excluded, crown-rump length measurement of 15-60 mm (corresponding to 8-12.5 weeks) had the lowest prediction error of 7.3 days. After that time, BPD (at least 21 mm) showed a similar error (7.3 days) and was more precise than crown-rump length. Femur length was slightly less accurate than crown-rump length or BPD. Regression models using a combination of any two or three ultrasonic variables did not improve accuracy of prediction. When ultrasound was used instead of certain LMP, the number of post term pregnancies decreased from 10.3% to 2.7% ($P < .001$). Ultrasound was more accurate than LMP in dating, and when it was used the number of post term pregnancies decreased. Crown-rump length of 15-60 mm was superior to BPD, but then BPD (at least 21 mm) was more precise. Combining more than one ultrasonic measurement did not improve dating accuracy in their study.^[64]

Chowdhury SB, Jehan AH, *et al*, Deptt. of Obstetrics & Gynaecology, Bangabandhu Sheikh Mujib Medical University, Dhaka, in "Bangladesh Med Res Counc Bull", 2003 Aug; 29(2):67-77, said that Infants born of small for date (SFD) fetuses have an increased risk of perinatal mortality and morbidity. Different methods have been applied to identify these fetuses including history, clinical examination and ultrasonography.

Ultrasonography has a better predictive value and majority of such fetuses can be identified. Measurements of the fetal biparietal diameter (BPD), abdominal circumference (AC) and femur length (FL) charts are widely used in dating pregnancies and follow-up of pregnant women in assessing fetal growth, identification of small for date (SFD) and growth retarded fetuses. This prospective study was performed to construct fetal chart for BPD, AC and FL at different gestational weeks from the Bangladeshi pregnant women. Seven hundred and ten women had ultrasonic measurements of fetal BPD, AC and FL between 12 to 42 weeks of pregnancy. In cases of BPD and AC, after 38th weeks of gestation showed a slower growth rate towards 42 weeks of pregnancy. This slower growth rate from 38 weeks of pregnancy was not noted in case of femur length. The new fetal measurement charts of BPD, AC and FL are unique for the Bangladeshi population and have not been found similar in the later weeks of pregnancy to those published for other Caucasian populations. These charts will help the clinicians and sonographers in dating pregnancy, identifying SFD and growth retarded fetuses.^[14]

Wilson Stephanie R, Carol M. Rumack *et al*, in "Diagnostic Ultrasound", Vol. 2, Second Edition (1997), Chapter 33, Page 1017, proposed that the fetal abdominal circumference (AC) is the length of the outer parameter of the fetal abdomen, measured on the transverse scan at the level of stomach and intra-hepatic portion of the umbilical vein.^[69]

Hiltone Meire, David Cosgrove, *et al*, in “Ultrasound in Obstetrics and Gynaecology” 2nd Edition; Vol.3; Chapter 10; Page 229, mentioned that femoral length(FL) is primarily a measurement for the estimation of gestational age with good accuracy from around 15 to 25 weeks. Its use in estimation of fetal growth is limited, although it has been combined with other measurements to estimate fetal size.^[30]

In “West Afr J Med”, 2004 Jan-Mar; 23(1):24-6, Dare FO, Smith NC, *et al*, of Ultrasound Department, Aberdeen Maternity Hospital, Corn Hill Road, Aberdeen, UK, in their study “Ultrasonic measurement of biparietal diameter and femur in foetal age determination” mentioned that their objective was to verify ultrasonic measurement of biparietal diameter and femur in foetal age determination in the second and third trimester of pregnancy. The prospective cross sectional study was carried out at the ultrasound department of Aberdeen Maternity Hospital Scotland. The study population consisted of 716 pregnant Scottish (Caucasian) women who were certain of their gestational ages and had their gestational ages confirmed in the first trimester by ultrasound. The findings revealed: (1) Linearity through out pregnancy using the femur length measurements while that of the biparietal diameter demonstrated poor correlation after 32 weeks of gestation. The results suggest that femur length measurement is a more reliable index of late third trimester gestational age prediction than biparietal diameter.^[16]

❖ **Review of literature on fetal kidney length measurement for assessment of gestational age:**

Lawson TL, Foley WD, *et al*, in the journal "Radiology", 1981 Jan; 138(1):153-6, in a study "Ultrasonic evaluation of fetal kidneys" stated the fetal renal morphology, technique and frequency of reliable visualization of the kidneys, and also renal size was evaluated in 177 apparently normal fetuses. The kidneys were not reliably identified before 15 post-menstrual weeks and were seen in fewer than 50% of cases prior to 17 weeks. However, between 17 and 22 weeks (the critical time for genetic counseling) one or both kidneys were seen in 90% of cases, with both being identified in 75%. After 20 weeks, one or both kidneys were identified in approximately 95%. With high-resolution equipment, positive identification of one or both fetal kidneys should be possible in a large percentage of cases after 20 post-menstrual weeks.^[39]

In "J Ultrasound Med", 1983; 2: 505-07, "The changing sonographic appearance of fetal kidneys during pregnancy", Bowie JD, Rosenberg ER *et al*. (1983) showed that with transabdominal sonography fetal kidneys can be demonstrated by 14 to 16 menstrual weeks as hypoechoic structures adjacent to the fetal spine. As the fetus matures, the kidneys become delineated because of fat deposition in the perinephric and renal sinus regions.^[7]

In "J Clin Ultrasound", 1983; 11:349-356, in the study "Quantitative characterization of the growth of the fetal kidney", Bertagnoli L, Lalatta F, *et at*, of Ultrasound School of Obstetrics

and Gynecology, Ospedale S. Giuseppe, Milan, Italy, mentioned that there is a time-dependent change in the antero-posterior (A-P) diameter and length (L) of fetal kidneys and this has been evaluated by means of statistical analysis of measurements made during the third trimester in a normal population. Two hundred eighty pregnant women were examined between 22 and 40 weeks of gestation. The relationships of the A-P diameter and length to menstrual age were determined in cross-sectional and longitudinal studies of kidney growth. The results obtained confirmed that there was no significant difference between right and left fetal renal length and measurements of fetal kidney can be used as an additional parameter in the routine assessment of fetal well being and to rule out kidney malformations characterized by changes in kidney size.^[6]

Sato A, Yamaguchi Y, *et al*, in the journal of "Gynecol Obstet Invest", 1985; 20(1):1-5, published a study "A cross-sectional study of changes in fetal renal size with gestation in appropriate and small-for-gestational-age fetuses", presented a method for measuring the size of the fetal kidney by real-time ultrasound. They examined 241 normal pregnancies and 27 pregnancies with intrauterine growth retardation by this method. The cross-sectional area of the kidney (KA) increases linearly from 20 weeks to term whereas the relative size of the kidney to the abdomen (KA/AA ratio) remains constant during this period. Growth-retarded fetuses had significantly smaller KA values than normal fetuses but their KA/AA ratios were generally in the normal range. The results showed that the growth of the

fetal kidney correlates well with that of the abdomen and could be an additional parameter for the detection of intrauterine growth retardation.^[56]

Callan NA, Otis CS, *et al*, in "J Reprod Med", 1985 Jun; 30(6):485-8, in their study "Growth of the fetal kidney. Ultrasonographic measurement of the ratio of average kidney diameter to biparietal diameter", studied Kidney size ultrasonographically in 101 normal fetuses. A ratio of average kidney diameter to biparietal diameter was established and found to be constant across gestation. Three fetuses with known urinary tract pathology were then studied and were found to have ratios significantly different from normal ones.^[9]

Duval JM, Milon J, *et al*, in the journal "Anat Clin", 1985; 7(2):107- 23, said in their study "Ultrasonographic anatomy and physiology of the fetal kidney", that the aim of this work was to demonstrate the impact of ultrasonography in utero to gain a better understanding of the anatomy, growth, anatomical variations and function of the fetal kidney and urinary tract. Three main topics are discussed in this paper based on the authors' personal experience and data from the literature: 1) the technique of ultrasonography in utero, including the main difficulties encountered and limitations of this technique; 2) ultrasonographic study of the morphology, growth and anatomical variations of the fetal kidney. The length of the fetal kidney was found to be the most significant parameter for assessment of its growth. At term, the kidney measures slightly more than 4 cm in length. 3) current knowledge of the physiology of the fetal urinary apparatus especially the kidney,

the excretory function of which begins in the third month of gestation and its main role involves the regulation of the amniotic fluid.^[21]

Sagi J, Vagman I, *et al*, in "Gynecol Obstet Invest", 1987; 23(1):1-4, assessed in their study "Fetal kidney size related to gestational age", fetal renal anatomy of 660 apparently normal fetuses ultrasonographically. The problems of visualization of kidneys were outlined. A correlation of fetal kidney length and gestational age was presented. The results were presented to be used as an adjunct in establishing fetal gestational age and as well as the assessment of normal renal morphology in routine obstetric ultrasound assessment.^[53]

Kushnir O, Bronshtein M, *et al*, in "J Clin Ultrasound", 1990; 18: 299-301, mentioned in their study "Transvaginal sonographic measurement of fetal kidneys in the first trimester of pregnancy" that the fetal kidneys may be identified late in the first trimester as hyperechoic structures, distinguishable from the hypoechoic adrenal glands on transvaginal sonography.^[36]

Bronshtein M, Kushnir O, *et al*, of Rambam Hospital, Haifa, Israel, In "J Clin Ultrasound", 1990 May; 18(4):299-301, in the study "Transvaginal sonographic measurement of fetal kidneys in the first trimester of pregnancy" measured fetal renal size late in the first trimester of pregnancy by transvaginal ultrasonography in 50 patients not at risk for congenital kidney disease and whose pregnancies resulted in a normal outcome. Both kidneys were reliably identified in all patients scanned at 12 weeks, 13 weeks, and 14 weeks, menstrual age. Kidney

diameter measurements obtained in this study are presented for reference in evaluating patients in late first trimester whose fetuses are at risk for kidney abnormalities.^[8]

Pattern RM, Mack LA, *et al*, in their study "The fetal genitourinary tract" in "Radiol Clin North Am" 1990; 28(1) :115-130, mentioned that fetal kidneys may be imaged in the first trimester, but with transabdominal ultrasound are more easily seen from 14 weeks onward and reliably visualised in 90 % of cases between 17 and 22 weeks.^[47]

Sampaio FJ, *et al*, Department of Anatomy, State University of Rio de Janeiro, U.E.R.J., Brazil, in the journal of "Eur Urol", 1990; 17(1):62-5, "Study of the fetal kidney length growth during the second and third trimesters of gestation" studied the fetal kidney length growth in 240 kidneys ranging from 10 to 36 weeks of gestation. Each kidney was quantitatively evaluated considering its greatest longitudinal length. The data were correlated with gestational age. Equation and growth curve of right and left kidneys and the whole sample during the second and third trimesters were presented. The study showed the practical utility in the quantitative determination of the renal anomalies and in the determination of gestational age.^[55]

HL Cohen, J Cooper, *et al*, Department of Radiology, North Shore University Hospital Cornell University Medical College, Manhasset, in "AJR Am J Roentgenol" 1991 Sep; 157(3):545-8, in their study "Normal length of fetal kidneys: sonographic study in 397 obstetric patients" made a study on renal length and its correlation with gestational age. This study was done to measure normal

lengths of fetal kidneys sonographically during pregnancy. The greatest length of each kidney in fetuses between 18 and 41 weeks gestation was measured on sonograms. Gestational ages were determined by last menstrual period and biometry; Abnormal fetuses, twins, offspring of diabetic mothers, and fetuses with renal pelvic dilatation of 4 mm or greater were excluded to avoid any questionable measurements. The results show that mean lengths are greater and confidence intervals are wider than previously reported. Strong correlation exists between renal length and gestational age, determined by biparietal diameter, femoral length, and abdominal circumference, and an average of the three. No significant difference was found between right and left renal lengths in fetuses in whom both kidneys were imaged. No correlation is seen between parental height or weight and fetal renal length. Results show that fetal renal lengths are longer than previously reported.^[26]

A Bulgarian Article published in "Akusherstvo i ginekologija." 1991; 30(3):11-6, in the study "Ultrasonic biometry of the fetal kidney", by Pandurski F. *et al*, showed that there was no statistically significant difference in the biometric parameters of the right and left kidney of the fetus in their study. Renal biometry of the fetus was carried out on 1200 women when difference between renal and surrounding tissue became distinct. Three dimensions of the kidney were measured and in their study it was established that the ratio between the circumference of the kidney and the abdominal circumference was a constant, preserving itself during the whole pregnancy.^[45]

In "International Society of Ultrasound in Obstetrics and Gynecology", 1996 Aug; 91(2)169-75, in a study "Human fetal kidney morphometry during gestation and the relationship between weight, kidney morphometry and plasma active renin concentration at birth" Bell SC, J. C. Konje, *et al*, Department of Obstetrics and Gynaecology, University of Leicester Medical School, Robert Kilpatrick Clinical Sciences Building, Leicester Royal Infirmary, Leicester, UK, performed a cross-sectional study aimed to determine whether there are differences in kidney size and shape in small- and appropriate-for-gestational-age fetuses at different gestations. They studied cross-sectionally at different gestational ages from 22 to 38 weeks. They found that the circumference and transverse and anterior-posterior diameters were significantly greater in the appropriate-for-gestational-age fetuses from about 28 weeks' gestation.^[4]

In the journal "Australasian Radiology", Vol 41, issue:1-February 1997(1-90), in a study "Ultrasonographic study of 793 foetuses: Measurement of normal foetal kidney lengths in Bangladesh", Saha M, Paul AK, *et al*, Nuclear Medicine Centre, Khulna, Bangladesh, did an ultrasonographic study in normal pregnancies between 16 and 40 weeks of gestation. An excellent correlation was seen between gestational age, biparietal diameter, femoral length and renal length measurements. It is well known that, structurally, the people of Asia are shorter than Europeans. The size of different organs of the foetus may also vary accordingly. To assess this, 793 foetuses between 16 and 40 weeks' gestation were studied and kidneys were

measured on ultrasonograms. Only normal pregnancies were included in the study. The results show that the mean length of foetal kidneys in the present study is either slightly higher or similar to that previously reported by many authors. In this study, the average kidney length at full term is 3.95 cm. An excellent correlation was seen between gestational age, biparietal diameter, femoral length and renal length measurement.^[54]

Carol M. Rumack, Stephanie R. Wilson, *et al*, in their highly esteemed text book “Diagnostic Ultrasound” Vol. 2, Second Edition(1997), Chapter 37, Page 1094, mentioned the often quoted rule of thumb is that “renal length in millimeters approximates gestational age in weeks”. However, a recent study and their own experience showed that renal lengths are longer than previously reported.^[13]

Gloor JM, Breckle RJ, *et al*, in an American journal “Mayo Clinic proceedings”. 1997 Feb; 72(2):124-9. Division of Nephrology and Internal Medicine, Mayo Clinic Rochester, MN 55905, USA, performed prenatal ultrasonography of 100 pregnant women between 18 and 39 weeks of gestation. Fetal renal length and volume were determined by prenatal ultrasonography and compared with gestational age and obtained a reference range as a function of gestational age for renal length and renal volume which helps to identify fetal abnormalities in renal size or growth patterns.^[24]

Guariglia L, *et al*, Department of Obstetrics and Gynecology, Catholic University of the Sacred Heart, Rome, Italy, in "Fetal diagnosis and therapy". 1998 May-Jun; 13(3):154-6, made a study on "Transvaginal sonographic fetal biparietal diameter/kidney length ratio in early pregnancy as a screening tool for renal malformations". In this prospective cross-sectional study, a transvaginal high-resolution sonography was performed between 11 and 16 weeks' gestation in 807 pregnant women with a history of regular cycles, singleton pregnancies and absence of fetal malformations. Measurements of kidney length and biparietal diameter were obtained in all cases and biparietal diameter/kidney length ratio was plotted against gestational age. The values of biparietal diameter/kidney length ratio were found to be fairly constant throughout the period evaluated.^[25]

Lotan.D, Zalel Y, *et al*, Department of Obstetric and Gynaecology in the journal "Prenatal Diagnosis", 2002 Nov; 22(11):962-5. The Chaim Sheba Medical Center Tel- Hashomer, Sackler School of Medicine, Tel Aviv University, Israel, in their study "The early development of the fetal kidney an in uteri sonographic evaluation between 13 and 22 weeks' gestation" presented a data which established normogram for kidney length from early stages of gestation, which will help to assess the correct gestational age of fetal development. The study was a prospective evaluation of 275 fetuses between 13 and 22 weeks in normal singletone pregnancies. Measurements of fetal kidney length were performed by high resolution transvaginal sonography between 14 and 17weeks gestation and by

transabdominal sonography beyond 18 weeks of gestation. Kidney length as a function of gestational age was expressed by equation. The normal mean and the 90% prediction limits were defined and the data offered a normal range of fetal kidney length from early stage of gestation that may allow intrauterine assessment of its development.^[40]

Konje J C, Abrams KR. *et al*, of Robert Kilpatrick Clinical Sciences Building, Leicester, UK, in "Ultrasound in obstetrics & gynecology" volume 19, Page 592-7, June 2002, in their study "Determination of gestational age after the 24th week of gestation from fetal kidney length measurements", reported the measurement of fetal kidney length by ultrasonography between 24 & 38 weeks' gestation to be very useful and recommended its incorporation into the model for dating pregnancies after 24 weeks of gestation, in particular when measurement of the bi-parietal diameter and head circumference are difficult. Kidney length is a more accurate method of determining gestational age than the fetal biometric indices of biparietal diameter, head circumference, femur length and abdominal circumference between 24 and 38 weeks' gestation. When combined with biparietal diameter, head circumference and femur length, the precision of dating is improved by 2 days. This measurement is easy to make and could therefore be easily incorporated into the model for dating pregnancies after 24 weeks of gestation, in particular when measurements of the biparietal diameter and head circumference are difficult.^[35]

Slobodan Vlajković, *et al*, Department of Anatomy, Faculty of Medicine, University of Niš, Niš, Serbia and Montenegro in the journal "Cells Tissues Organs" 2006;182:193-200 2006; Vol. 182, No. 3-4, 2006, in their study "Age-Related Changes of the Human Fetal Kidney Size" evaluated normal fetal anatomy ultrasonographically. This study was also created to estimate the changes in kidney size during gestation in fetuses and concluded that the period from the 14th to 16th week of intrauterine life is the fastest period of kidney growth during fetal development. Measurements of kidney dimensions (length, width, thickness) were performed in 110 fetuses. The importance of this study lies in determining the average fetal kidney dimensions, which could be used as standard values in obstetrics.^[59]

MATERIALS AND METHODS

MATERIALS AND METHODS

Type of study:

An analytical epidemiological study was carried out to determine the different ultrasonographic interpretations concerned.

Study Design:

The present study was a cross sectional hospital based one conducted to determine the different parameters of the fetus.

Study Duration:

The study was conducted during the period of three and a half years from September 2005 to February 2009.

Study setting:

The study was done in the department of Anatomy in collaboration with the Department of Radiodiagnosis of North Bengal Medical college and Hospital, Sushrutanagar, Dist. Darjeeling; the only medical teaching institution in the northern part of West Bengal.

Study population:

The subset of antenatal mothers attending the Department of Radiodiagnosis of North Bengal Medical College and Hospital for assessment of their feto-placental profile.

Sampling:

The study was carried out throughout the span of three years and six months from September 2005 to February 2009. All the

subjects were chosen from the antenatal mothers attending the Department of Radiodiagnosis for ultrasonographic fetoplacental profile and having the OPD ticket along with documented 1st trimester CRL (Crown Rump Length) in previous ultrasonography report. Study subjects were selected according to the inclusion and exclusion criteria mentioned later on.

The data collection was carried out through five days span of every week i.e. from Monday to Friday, mostly from 12noon to 3 pm excluding the Government holidays and the days of leave of the investigator.

The subject who has been examined once was never repeated for participation in this study.

Maintaining the criteria of inclusion and exclusion at first 1002 antenatal mothers were approached for this study but unfortunately 63 of them denied for participation. So, finally 939 subjects included in this study.

Study Plan:

At first on the month of January 2005, the study was planned to be done. It was discussed with the then Head of the Department of Anatomy and Head of the Department of Radiodiagnosis of North Bengal Medical College & Hospital and feasibility of the study was judged by a trial in the Department of Radiodiagnosis and according to the consultation of them a proforma was prepared. After that, the study proposal was submitted to the Faculty Council for Post Graduate studies in

Science & Medicine of University of North Bengal for their final approval which was sanctioned in the month of August' 2005.

After that it was placed to obtain the permission from the Chairman of Ethical Committee of north Bengal Medical College & Hospital and with the permission of Head of the Department of Anatomy and Radiodiagnosis data collection started.

Eligibility of the study population.

A. Inclusion Criteria:

1. Pregnancy having 24 weeks onwards.
2. Having documented 1st trimester CRL.
3. Uneventful pregnancy till date or without any bad obstetric history.
4. Given informed consent.

B. Exclusion Criteria:

1. Having no documented 1st trimester CRL.
2. High risk pregnancy or in emergency crisis.
3. Documented or reported any associated disorders (medical/surgical) of the mother.
4. Documented any fetal anomaly.
5. Not given the consent.

Data collection:

For data collection same machine, same probe and same observer maintained throughout the study period. In all the measurements average of three values were considered.

Tools:

1. Ultrasonography machine: Agilent Image Point Hx.

Company: H.P (Hewlett- Packard)

Model: Image Point Hx.

Serial NO.US99602612.

Screen size=14inches.



Ultrasonography Machine

Probe (Transducer): 3.5 MHz curvilinear electronic Transducer.

No.c3540.

Company: H.P (Hewlett- Packard)



Ultrasonography Probe

2. Ultrasound Gel: The gel is prepared using the following ingredients:

Carbomer ----- 10.0 gm
EDTA -----0.25 gm
Propylene Glycol -----75.0 gm
Trolamine -----12.5 gm
Distilled water ----- up to 500ml

'Medigold' ultrasound gel was used.



Ultrasound Gel

3. Predesigned proforma.

4. Pen, Pencil and eraser.

5. Digital camera: SAMSUNG, 7.2 Mega Pixels.

6. Computer: HP Pavilion, Pentium 4

Technique of data collection:

Patient was examined in the presence of a nursing staff. Transabdominal ultrasonography was done in optimally distended bladder. Ultrasound Gel was applied over the abdomen prior to probe placement and then sonography was performed.



Ultrasonography being performed for fetoplacental profile

After assessing the fetal number, viability, lie, presentation and fetoplacental anomaly, subjects were selected finally. Then Biparietal diameter (BPD), Head circumference (HC), Abdominal circumference (AC), Femoral length (FL) and Fetal kidney length (FKL) were measured to assess the gestational age.



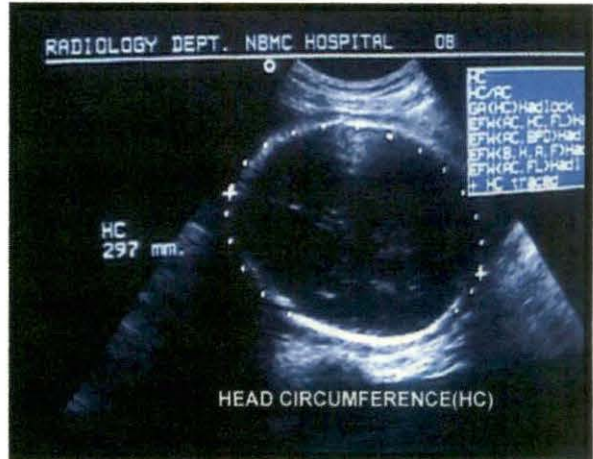
A fetus in the womb, viewed on ultrasonogram.
SP = Spine, PL= Placenta

Biparietal diameter (BPD) was measured from the transaxial sonogram of fetal head at the level of paired thalami and cavum septum pallucidum. BPD was measured from the outer edge of the cranium nearest the transducer to the inner edge of the cranium farthest from the transducer. Distance between these two points was defined as BPD and was expressed in millimeter (mm).



Sonographic measurement of fetal Biparietal diameter

With the help of electronic ellipse available in ultrasound scanner the cranial circumference was also measured at the same level of measurement of BPD which was defined as **Head circumference (HC)** and was expressed in millimeter (mm).



Sonographic measurement of fetal Head circumference

Abdominal circumference (AC) was obtained by placing electronic calipers at the outer perimeter of the fetal abdomen measured on transverse scan at the level of stomach and intrahepatic portion of umbilical vein. This measurement of **AC** was expressed in millimeter (mm).



Sonographic measurement of fetal Abdominal circumference

For the purpose of measurement of **Femoral length (FL)**, fetal spine was traced up to the sacrum and transducer moved to image femur. The length of entire femur was measured by placing electronic calipers at two ends of the femur excluding the thin bright reflection of cartilaginous epiphysis. This measurement of FL was expressed in millimeter (mm).



Sonographic measurement of fetal Femoral length

Last of all, it was approached to document the **Fetal kidney length (FKL)**. At first the transducer (probe) was placed in such manner that the longitudinal view of the fetal spine becomes prominent. Then the probe was moved along paravertebral plane until the long axis of fetal kidney was visualized. At first the left kidney was approached and in case its view was not clear, the right kidney was approached. The kidney lies lateral to the spine and dorsolateral to the abdominal great vessels. With the use of caliper first point



Sonographic measurement of Fetal kidney length

was taken on the outer most point on the proximal curved border and the second point was taken on outer most point on the distal most curved border along the long axis of the kidney. The distance of these two points was noted in millimeter (mm).

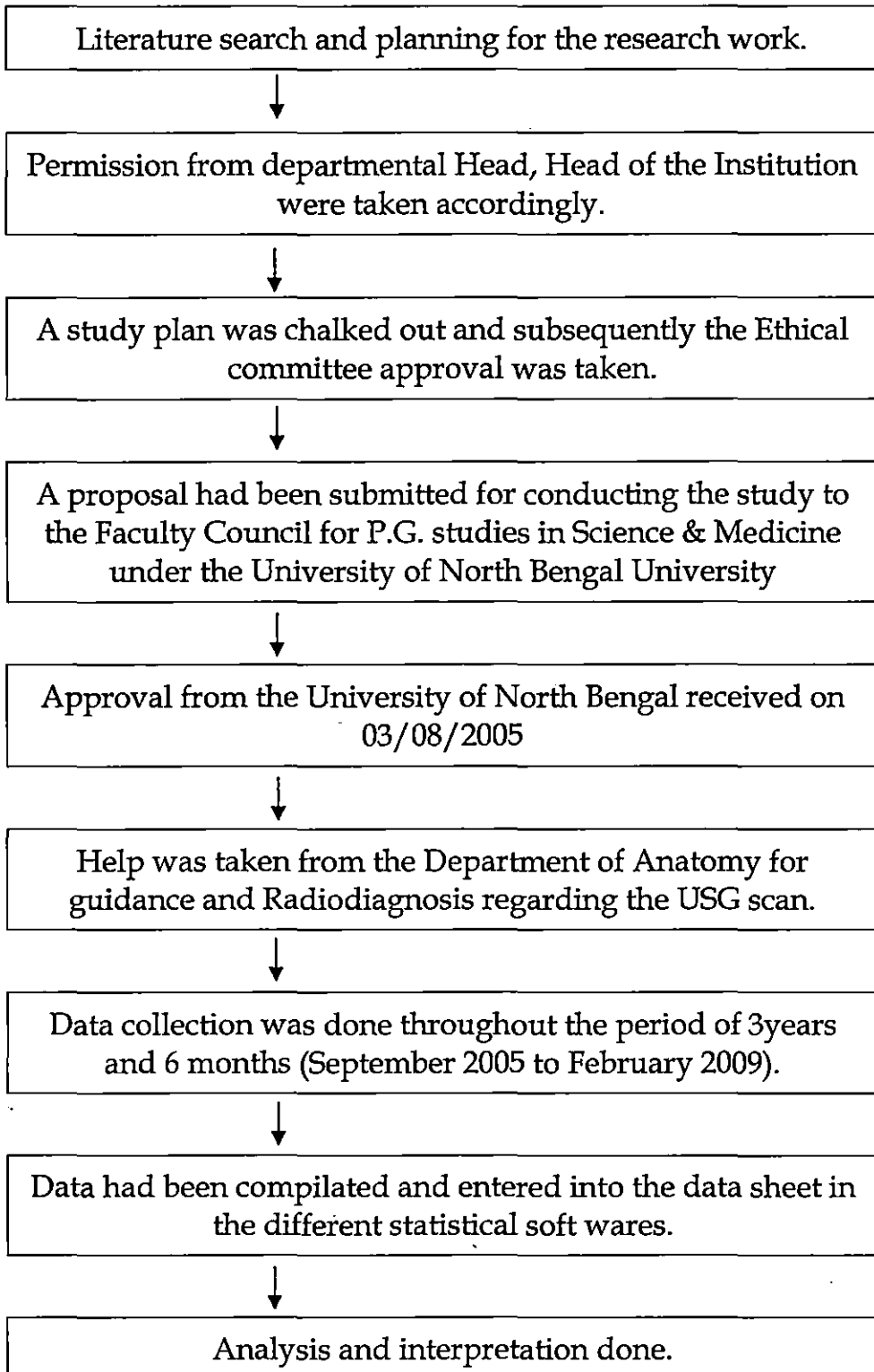
Variables used:

1. **Age of the mother:** Age of the mother was noted in completed years.
2. **Gravida:** Noted as the times of conception. Subjects were classified as “primi” having first time conception and “multi” those have conceived more than once.
3. **Biparietal diameter (BPD):** The fetal Biparietal diameter noted in millimeter(mm), as measured from ultrasonogram.
4. **Head circumferences (HC):** The fetal Head circumferences noted in millimeter(mm), as measured from ultrasonogram.
5. **Abdominal circumference (AC):** The fetal Abdominal circumference noted in millimeter (mm), as measured from ultrasonogram.
6. **Femoral Length (FL):** The fetal Femoral Length noted in millimeter (mm), as measured from ultrasonogram.
7. **Fetal kidney length:** Fetal kidney length noted in millimeter (mm), as measured from ultrasonogram.
8. **Gestational age:** Gestational age was calculated as per pre-existing documented first trimester CRL (Crown Rump Length) and noted in weeks.

Scheme of analysis:

These data were noted on the space schedule in the master sheet previously made ready. Variables were explored and analysed using appropriate statistical methods. The data those entered in Excel data sheet were compiled and converted to different codes and finally analysed by using the Epi-info 3.5.1 and SPSS (Stastical Package for Social Science) 12 version. Various parametric and non-parametric statistical analysis methods were used like Students T test, Chi-square test, Regression analysis and other suitable methods where applicable accordingly.

FLOW CHART SHOWING DIFFERENT STAGES OF THE STUDY:



Limitations of study:

1. The machine used for this study shows measurement of fetal biometric parameters in centimeter and its fractions. So, during data tabulation the first decimal of the fraction of a centimeter was taken into consideration for the purpose of expression of the data in millimeters.
2. All measurements though taken as average of 3 values but definitely not beyond subjective error.
3. The data collected and analysed in this study was solely dependent on antenatal mothers of a particular region i.e. North Bengal zone of India. To generalise the findings there is a strong need to conduct the study among the representative population of wide area and should not be confined in a particular region.
4. Intra-observer variations also could not be eliminated.

RESULTS AND ANALYSIS

RESULTS AND ANALYSIS

In this study a total number of 939 antenatal mothers were examined sonographically. They were grouped according to their calculated gestational age e.g. 24-28weeks, 29-32weeks, 33-36weeks and 37weeks to term.

The data derived from observations were arranged according to the different variables such as gravida, maternal age, gestational age, conventionally used biometric parameters like BPD, HC, AC and FL were compared with Fetal kidney length(FKL) at different gestational age.

These data were tabulated, analysed and the results were shown in tables and diagrams to arrive at a conclusion based on this study.

Table No.1

Frequency distribution of antenatal mothers according to their age groups (Years). n=939

Mothers Mother's age groups(Years)	Absolute nos.	Percentage
19-24	415	44.2
25-29	260	27.7
30-34	264	28.1
Total	939	100

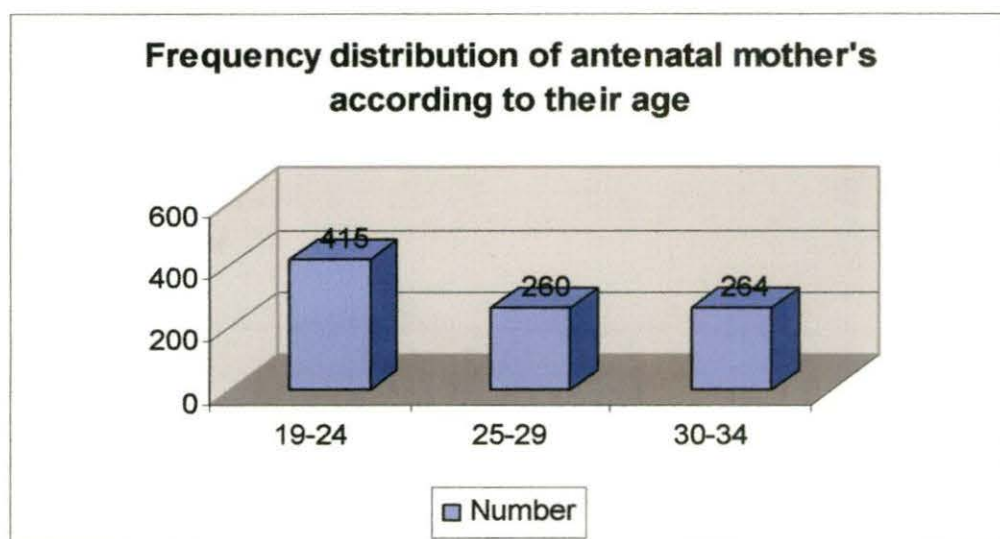


Fig: 1, Frequency distribution of antenatal mothers according to their age.

Table No.1 and Bar diagram of Fig:1, revealed the distribution of antenatal mothers according to age groups, where majority (44.2%) were below 25years; 27.7% in 25-29 years and rest 28.1% above 30years.

Table No.2

Frequency distribution of the fetuses according to the gestational age (weeks)

n=939

Gestational Age (wk)	Cases	Absolute nos.	Percentage
24-28		263	28
29-32		238	25.3
33-36		228	24.3
>36		210	22.4
Total		939	100

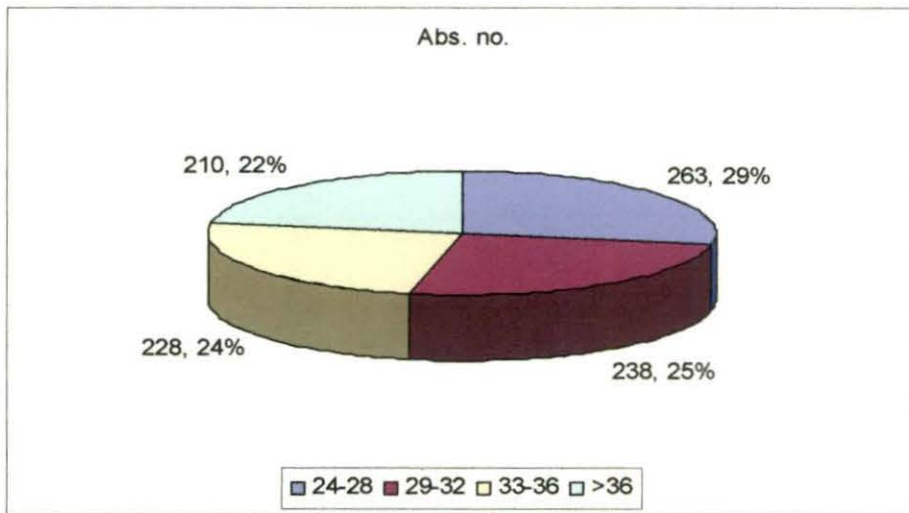


Fig: 2: Frequency distribution of fetuses according to gestational age in weeks and percentage.

Table No.2 and associated Pie diagram of Fig: 2, showed that, 28% of the cases were in 24-28 wks, 25.3% in 29-32 wks, 24.3% in 33-36 wks and rest (22.4%) of them having gestational age more than 36 weeks.

Table No.3

Frequency distribution of antenatal mothers according to gravida.

n=939

Gravida \ Number of mothers	Absolute nos.	Percentage
Primi	511	54.42
Multi	428	45.58
Total	939	100

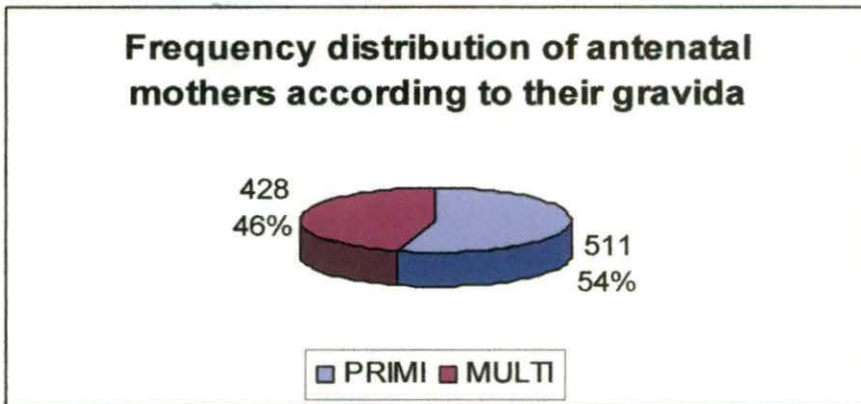


Fig: 3: Frequency distribution of antenatal mothers according to their gravida.

Table No.3 and Pie diagram of Fig:3, revealed the distribution of antenatal mothers according to gravida, 54 % (511) was primi and 46% (428) was multi gravida.

Table No.4

Frequency distribution of fetus according to Biparietal diameter (BPD) in millimeter (mm).

n=939

BPD(mm) \ Fetus	Absolute nos.	Percentage
60-69	221	24
70-79	280	29
80-89	281	30
90-99	157	17
Total	939	100

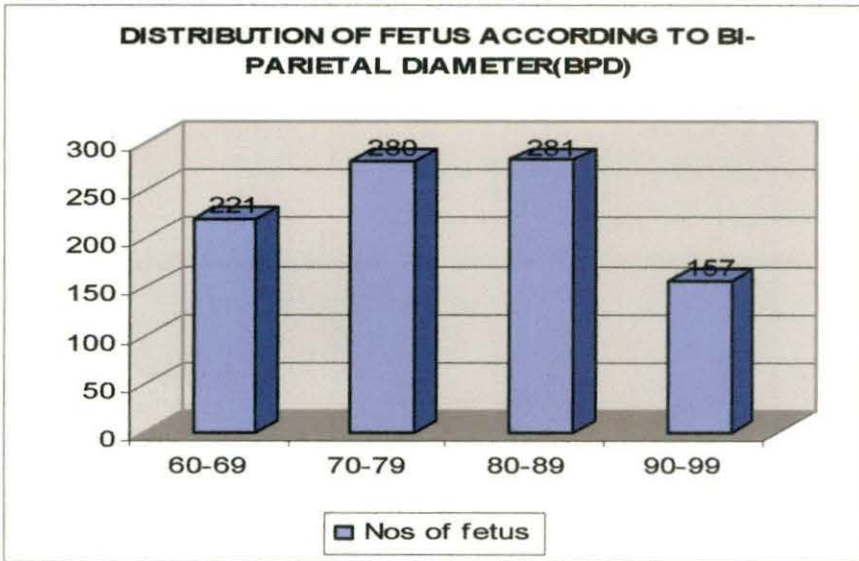


Fig: 4: Frequency distribution of fetus according to Biparietal diameter (BPD) in millimeter (mm).

Table No.4 and Bar diagram of Fig:4, showed the distribution of fetus according to Biparietal diameter (BPD) in millimeter, where 24% were in 60-69 mm, 29% in 70-79mm, 30% in 80-89mm and rest 17% in 90-99 mm.

Table No.5

Frequency distribution of fetus according to Head circumference (HC) in millimeter (mm).

n=939

HC(mm) \ Fetus	Absolute nos.	Percentage
222-253	221	24
254-285	210	22
286-317	221	24
318-349	287	30
Total	939	100

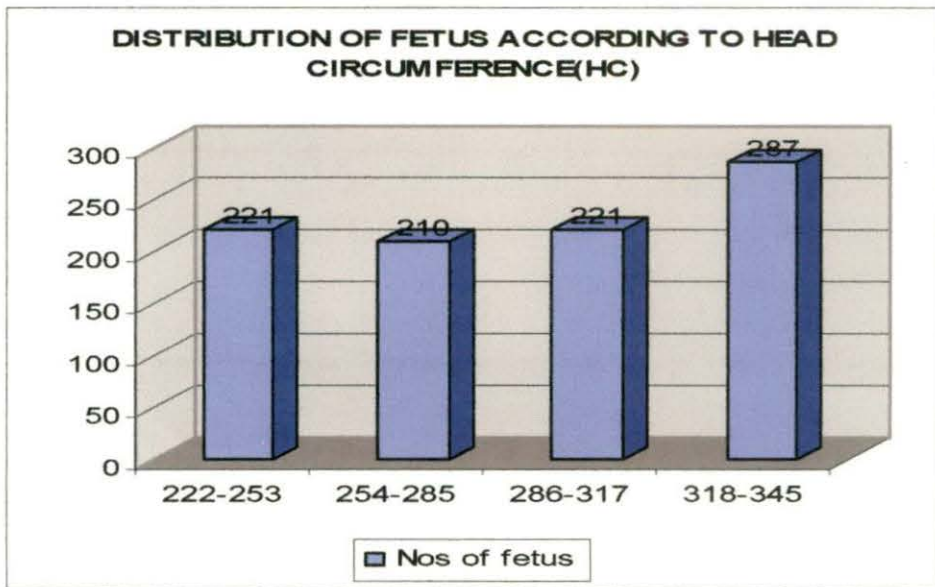


Fig: 5: Frequency distribution of fetus according to Head circumference (HC) in millimeter (mm).

Table No.5 and Bar diagram of Fig:5 , revealed the distribution of fetus according to Head circumference (HC) in millimeter, where 24% were in 222-253mm; 22% in 254-285; 24% in 286-317 and rest 30 % in 318-349 mm.

Table No.6

Frequency distribution of fetus according to Abdominal Circumference (AC) in millimeter (mm):

n=939

Fetus AC(mm)	Absolute nos.	Percentage
207-244	263	29
245-282	238	25
283-320	228	24
321-358	210	22
Total	939	100

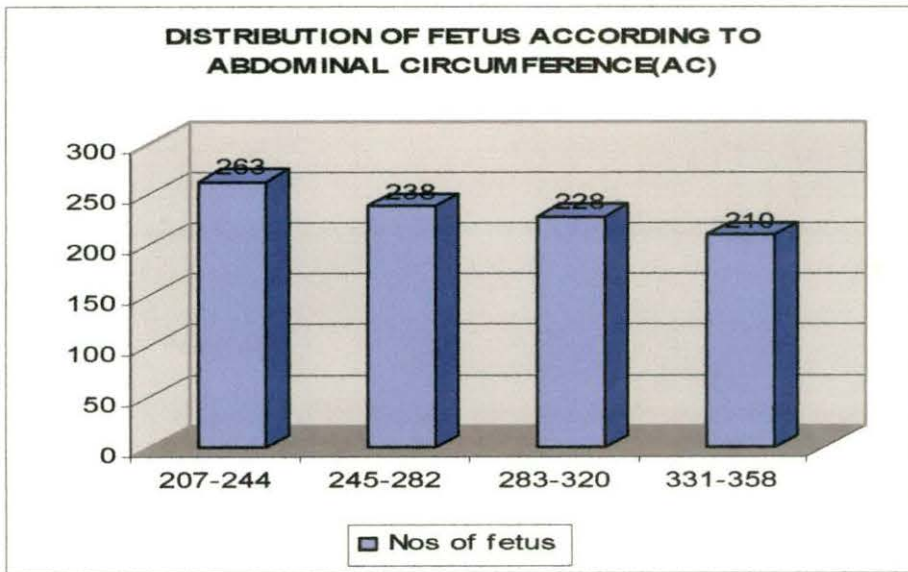


Fig: 6: Frequency distribution of fetus according to Abdominal circumference (AC) in millimeter (mm).

Table No.6 and Bar diagram of Fig:6, revealed the distribution of fetus according to Abdominal circumference (AC) in millimeter, where 29% were in 207-244 mm; 25% in 245-282; 24% in 283-320 and rest 22% in 321-358 mm.

Table No.7

Frequency distribution of fetus according to Femoral length (FL) in millimeter (mm):

n=939

Fetus FL(mm)	Absolute nos.	Percentage
43-51	221	24
52-60	210	22
61-69	298	32
70-78	210	22
Total	939	100

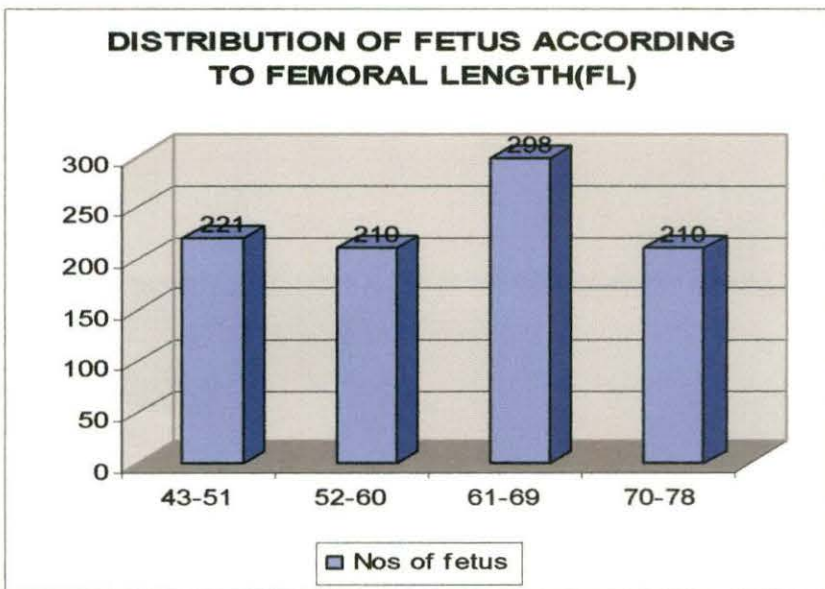


Fig: 7: Frequency distribution of fetus according to Femoral length (FL) in millimeter (mm):

Table No.7 and Bar diagram of Fig:7, showed the distribution of fetus according to Femoral length (FL) in millimeter where 24% were in 43-51 mm; 22% in 52-60; 32 % in 61-69 and rest 22 % in 70-78 mm.

Table No.8

Distribution of fetal kidney length according to gravida in different gestational age:

n=939

Gestational age group calculated as per CRL.	Average fetal kidney length in study population according to gravida				Total (n)		Statistical Significance
	Primigravida		Multigravida		Number	Mean (range)	
	Number	Mean (range)	Number	Mean (range)			
24-28 weeks	159	26.04 (22-29)	104	25.22 (22-28)	263	25.72 (22-29)	P>0.05
29-32 weeks	170	30.63 (28-33)	68	30.50 (28-33)	238	30.59 (28-33)	P>0.05
33 -36 weeks	33	33.70 (32-35)	195	35.15 (33-37)	228	34.94 (32-37)	P>0.05
> 36 weeks	149	38.58 (36-41)	61	38.30 (37-40)	210	38.50 (36-41)	P>0.05
Total	511		428		939		

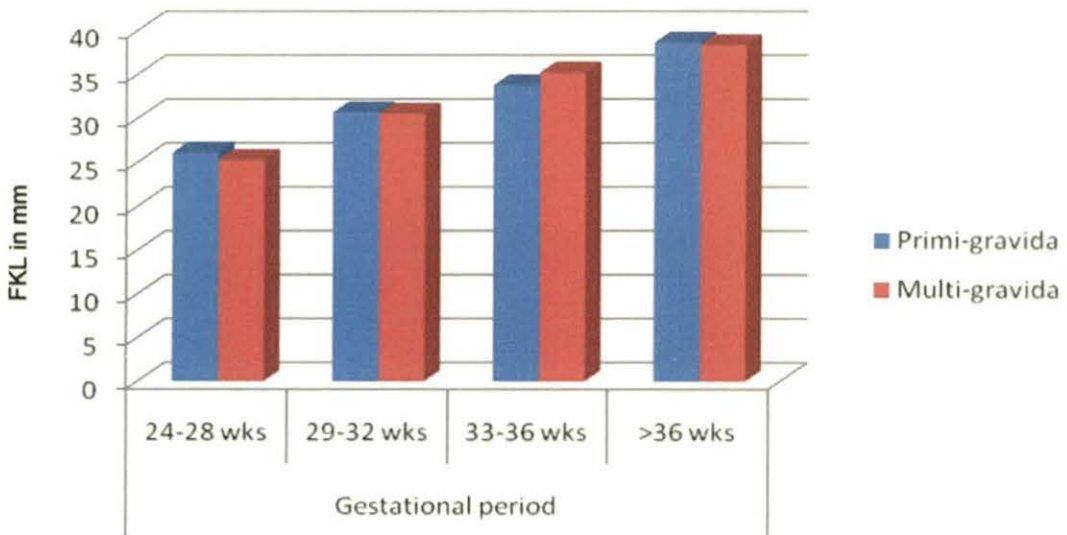


Fig 8: Mean distribution of fetal kidney length according to gravida in pregnant women of different gestational age groups.

FKL = Fetal Kidney Length, **wks** = weeks

From the Table No.8 and composite Bar diagram of Fig:8, it was found that there was no significant difference in the fetal kidney length related to the gravida of the mother in different gestational age.

Table: 9.

Distribution of fetal kidney length expressed in millimeter (mm) compared with different maternal age group in different gestational periods.

Gestational age group calculated as per CRL.	Average fetal kidney length in study population of different maternal age group						Total (n)		Statistical Significance
	19-24 years		25-29 years		30 - 34 years		Number	Mean (range)	
	Number	Mean (range)	Number	Mean (range)	Number	Mean (range)			
24-28 weeks	176	25.64 (22-29)	39	25.79 (22-29)	48	25.96 (22-29)	263	25.72 (22-29)	p>0.05 (0.584)
29-32 weeks	59	30.29 (28-33)	136	30.70 (28-33)	43	30.67 (28-32)	238	30.59 (28-33)	P>0.05 (0.139)
33 -36 weeks	67	34.90 (32-36)	68	34.93 (33-37)	93	34.99 (33-37)	228	34.94 (32-37)	p>0.05 (0.896)
> 36 weeks	62	38.26 (37-41)	52	38.65 (36-40)	96	38.56 (36-41)	210	38.50 (36-41)	p>0.05 (0.170)
Total	364		295		280		939		

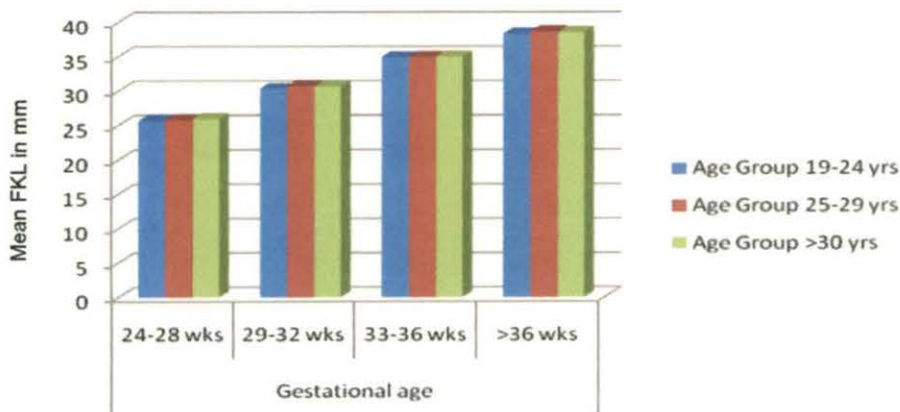


Fig.No.9: Showing the mean fetal kidney length in different maternal age groups as per gestational age.

FKL = Fetal kidney length. **wks** = weeks.

The Table No.9 and the composite Bar diagram of Fig:9, showed that the age group wise mean distribution of fetal kidney length was not significantly different in different gestational weeks of different aged antenatal mothers.

Table: 10

Ultrasonographic assessment of gestational age as determined from Biparietal diameter (BPD) estimation and its correlation with average fetal kidney length expressed in millimeter (mm).

Biparietal diameter in mm	Gestational age in weeks as determined from BPD estimation	Mean fetal kidney length(mm)	Correlation Coefficient
60 - 69	24 - 28	25 (22 - 29)	p<0.05 r=0.854
70 - 79	29 - 32	30 (28 - 33)	p<0.05 r=0.763
80 - 89	33 - 36	35 (32 - 37)	p<0.05 r=0.826
90 - 99	37 - 40	38 (36 - 41)	p<0.05 r=0.902

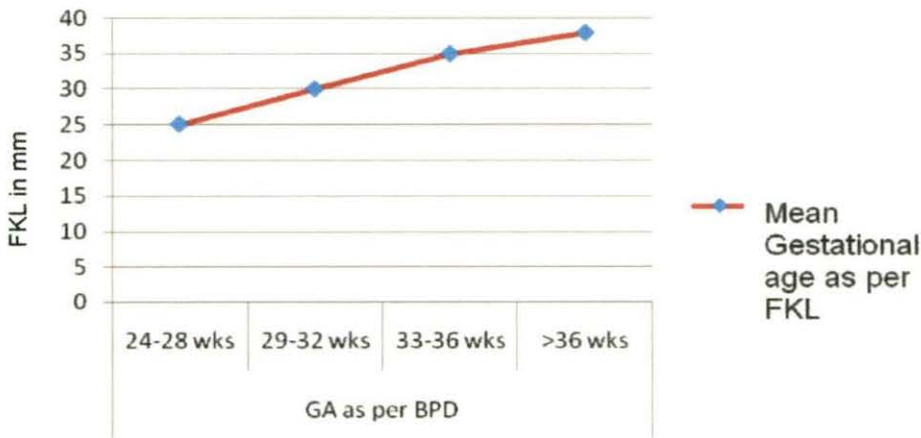


Fig: 10: Distribution of mean of Fetal Kidney Length according to the Gestational age (in weeks) calculated on the basis of BPD.

FKL = Fetal kidney length. **GA** = Gestational age. **BPD** = Biparietal diameter. **wks** = weeks.

From the Table No.10, in a comparative analysis it was found that the fetal kidney length (in mm) closely approximates with gestational age with the advancement of pregnancy, as derived from Biparietal diameter (BPD). This has been represented in the Line diagram of Fig:No.10.

Table: 11

Ultrasonographic assessment of gestational age as determined from Head circumference (HC) estimation and its correlation with average fetal kidney length expressed in millimeter (mm).

Head circumference (mm)	Gestational age in weeks as determined from HC estimation	Mean fetal kidney length(mm)	Correlation Coefficient
222 - 253	24 - 28	25 (22 - 29)	p<0.05 r=0.854
254 - 285	29 - 32	30 (28 - 33)	p<0.05 r=0.763
286 - 317	33 - 36	35 (32 - 37)	p<0.05 r=0.826
318 - 349	37 - 40	38 (36 - 41)	p<0.05 r=0.902

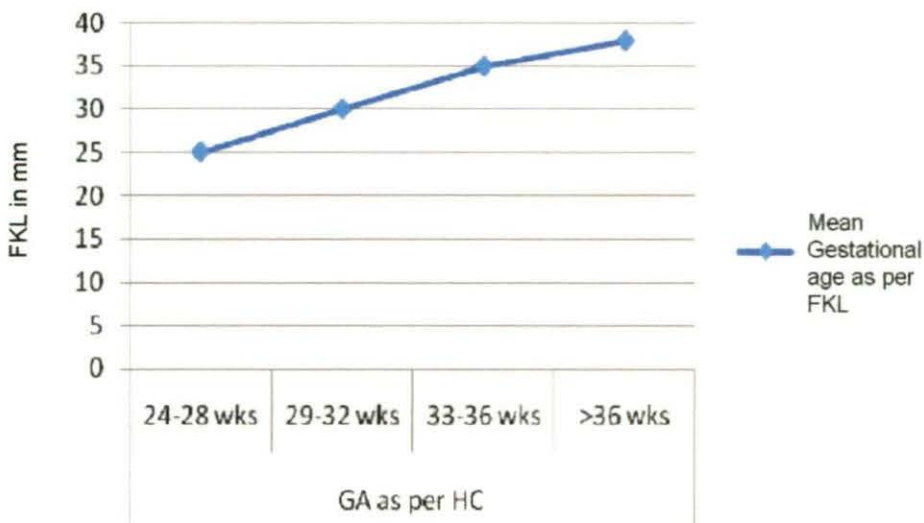


Fig:11. Distribution of mean of Fetal Kidney Length according to the Gestational age (weeks) calculated on the basis of HC.

FKL = Fetal kidney length. **GA** = Gestational age. **HC** = Head circumference. **wks** = weeks.

From the Table No.11, the comparative analysis of fetal kidney length (in mm) with head circumference (HC), it was found that the fetal kidney length in millimeter (mm) closely approximates with gestational age with advancement of pregnancy, as derived from Head circumference (HC). This has been represented in the Line diagram of Fig: No.11.

Table: 12

Ultrasonographic assessment of gestational age as determined from Abdominal circumference (AC) estimation and its correlation with average kidney length expressed in millimeter (mm).

Abdominal circumference in mm.	Gestational age in weeks as determined from AC estimation	Mean fetal kidney length expressed in mm	Correlation Coefficient
207 – 244	24 – 28	25 (22 – 29)	p<0.05 r=0.854
245 – 282	29 - 32	30 (28 – 33)	p<0.05 r=0.763
283 – 320	33 - 36	35 (32 – 37)	p<0.05 r=0.826
321 – 358	37 – 40	38 (36 – 41)	p<0.05 r=0.902

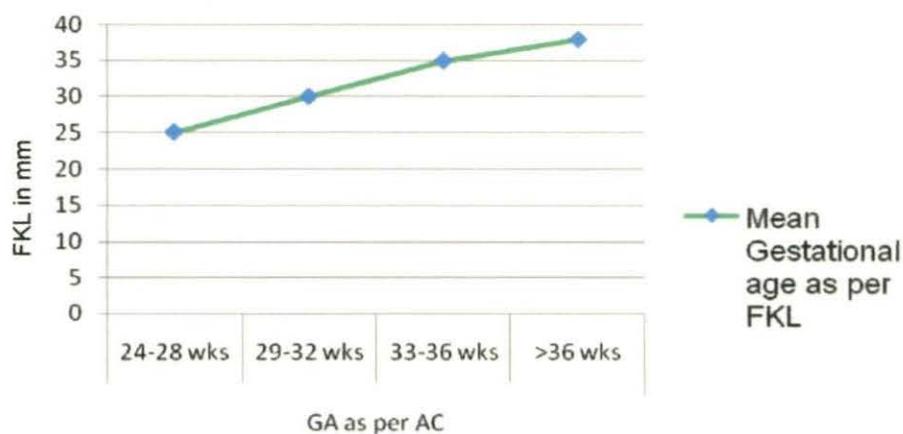


Fig:12: Distribution of mean of Fetal Kidney Length according to the Gestational age (weeks) calculated on the basis of AC.

FKL=Fetal kidney length. **GA**=Gestational age. **AC**=Abdominal circumference. **wks** = weeks.

From the Table No.12, in a comparative analysis, it was found that the fetal kidney length in millimeter (mm) closely approximates with gestational age with advancement of pregnancy, as derived from Abdominal circumference (AC). This has been represented in the Line diagram of Fig: No.12.

Table: 13

Ultrasonographic assessment of gestational age as determined from femoral length (FL) estimation and its correlation with average kidney length size expressed in millimeter (mm).

Femoral length in mm.	Gestational age in weeks as determined from FL estimation	Mean fetal kidney length expressed in mm	Correlation Coefficient
43 – 51	24 – 28	25 (22 – 29)	p<0.05 r=0.854
52 – 60	29 - 32	30 (28 – 33)	p<0.05 r=0.763
61 – 69	33 - 36	35 (32 – 37)	p<0.05 r=0.826
70 – 78	37 – 40	38 (36 – 41)	p<0.05 r=0.902



Fig:13: Distribution of mean of Fetal Kidney Length according to the Gestational age (in Weeks) calculated on the basis of FL.

FKL = Fetal kidney length. **GA** = Gestational age. **FL** = Femoral length. **wks** = weeks

From the comparative analysis as shown in Table No.13, it was found that the fetal kidney length in millimeter (mm) closely approximates with gestational age with the advancement of pregnancy as derived from femoral length (FL). This has been represented in the Line diagram of Fig: No.13.

Table: 14.

Distribution of fetal kidney length (right & left) according to different gestational age group.

n=939

Gestational age group calculated as per CRL.	Average fetal kidney length in study population (Right & Left) in mm				Total (n)	Statistical significance
	Right Kidney		Left Kidney			
	Number	Mean (Range) in mm	Number	Mean (Range) in mm		
24-28 weeks	137	25.68 (22-26)	126	25.76 (22-27)	263	P>0.05
29-32 weeks	111	30.76 (29-32)	127	30.45 (28-33)	238	P>0.05
33 -36 weeks	115	34.91 (33-37)	113	34.97 (32-37)	228	P>0.05
> 36 weeks	102	38.39 (36-40)	108	38.59 (36-41)	210	P>0.05
Total	465		474		939	

In this analysis as shown in Table No.14, it was found that there was no significant difference in the fetal kidney length whether right or left kidney was measured.

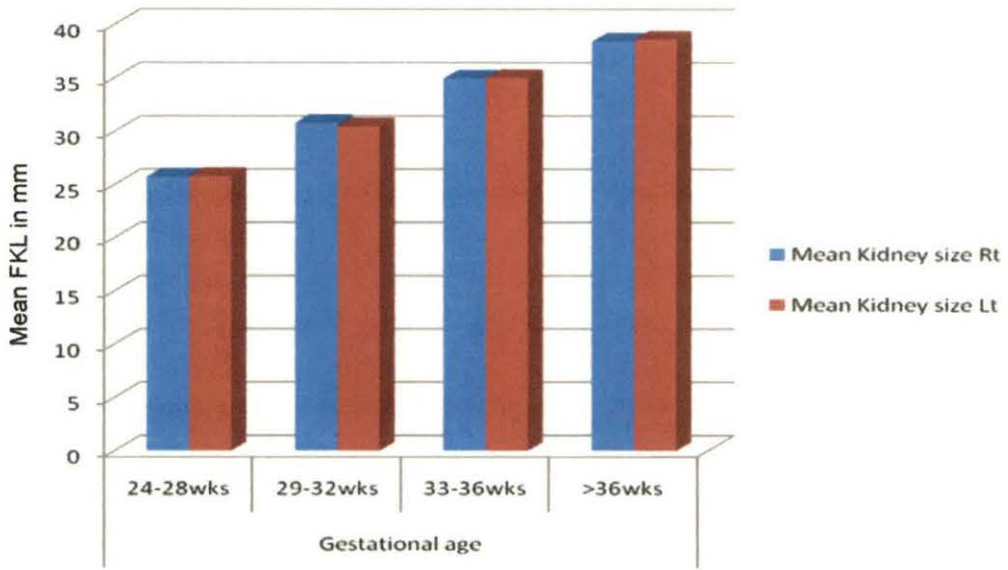


Fig: 14: Mean fetal kidney length (right & left) according to different gestational age groups.

FKL = Fetal kidney length. **wks** = weeks. **Rt**= Right. **Lt**= Left

Table: 15

Table showing distribution of the incidence of inclination to and / or deviation from the rule of thumb ("Renal length in millimeters approximates gestational age in weeks") according to gestational age.

Gestational age in weeks	No. of cases studied in different gestational age group.	Study of cases showing inclination to the "Rule of thumb"			Study of cases showing deviation from the "Rule of thumb".		
		Range of Kidney Length in mm.	No. of cases	Percentage of accuracy (%)	Range of Kidney Length in mm.	No. of cases	Percentage of accuracy (%)
24 - 28	263	25 - 28	23	8.74	22 - 29	240	91.25
29 - 32	238	28 - 31	53	22.26	30 - 33	185	77.73
33 - 36	228	35 - 37	105	46.05	32 - 34	123	53.94
37- 40	210	37 - 40	152	72.38	40 - 42	58	27.61

Analysis of Table No. 15, it was found that the fetal kidney length(mm) showed an inclination with standardised gestational age by 8.74% during 24 to 28 weeks of gestational age, 22.26% during 29 to 32 weeks of gestational age, 46.05% during 33 to 36 weeks of gestational age and 72.38% during 37 to 40 weeks respectively.

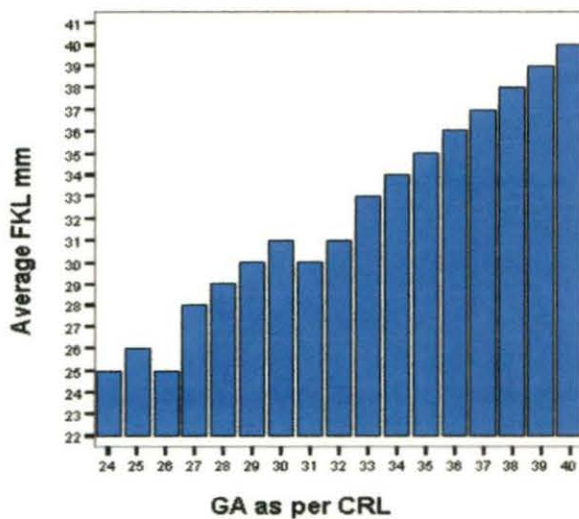


Fig:15: Histogram of different modes of Fetal Kidney Length in millimeter(mm) with Gestational age as per Crown Rump Lengths(CRL).

FKL = Fetal kidney length. **GA** = Gestational age. **CRL** = Crown rump length

The histogram showed in Figure: 15, the fetal kidney length in millimeter (mm) was not so much linear in early pregnancy till 32 weeks but very much linear in late pregnancy i.e. 33 weeks to term.

Table: 16

Table showing fetal kidney length (mm) in different gestational age groups which showed the percentage of accuracy and deviation in relation to gestational age of the fetus derive from other biometric parameters.

Total No. of cases studied in different gestational age groups.	Gestational age as derive from CRL,BPD, HC, AC, FL (weeks)	No. of cases where the fetal kidney length (mm) accurately matched with the gestational age, erived from other parameters	Total No. of cases in different gestational age groups (week) where fetal kidney(mm) matched with estimated gestational age	Percentage of accuracy in different gestational age groups	Gestational age as derive from CRL,BPD, HC, AC, FL (weeks)	No. of cases where the fetal kidney length (mm) deviated from Gestational age derived from other parameters	Total No. of cases in different gestational age groups (mm) where fetal kidney length(mm) deviated from the estimated gestational age	Percentage of deviation in different gestational age groups.
263 in 24-28 weeks	24 weeks	3	23	8.74%	24 weeks	67	240	91.25%
	25 weeks	3			25 weeks	56		
	26 weeks	4			26 weeks	48		
	27 weeks	5			27 weeks	35		
	28 weeks	8			28 weeks	34		
238 in 29-32 weeks	29 weeks	10	53	22.26%	29 weeks	39	185	77.73%
	30 weeks	11			30 weeks	43		
	31 weeks	13			31 weeks	52		
	32 weeks	19			32 weeks	51		
228 in 33- 36 weeks	33 weeks	20	105	46.05%	33 weeks	13	123	53.94%
	34 weeks	24			34 weeks	29		
	35 weeks	29			35 weeks	36		
	36 weeks	32			36 weeks	45		
210 in 37- 40 weeks	37 weeks	35	152	72.38%	37 weeks	18	58	27.61%
	38 weeks	40			38 weeks	15		
	39 weeks	38			39 weeks	17		
	40 weeks	39			40 weeks	8		

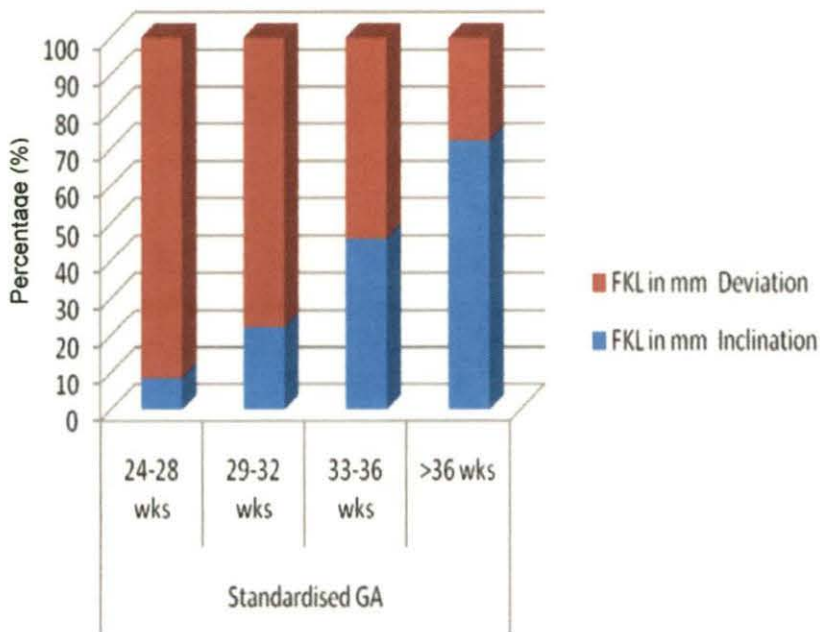


Fig: 16: Proportion of the incidence of inclination and/or deviation of the FKL in millimeter (mm) with standardised GA in different weeks of gestation.

FKL= Fetal kidney length. **GA**= Gestational age. **wks** = weeks.

From the Table No.16 and Bar diagram of Fig:16, it was found that the accuracy in determining gestational age from fetal kidney length (mm) increased from 8.74% during 24 to 28 weeks of gestational age, 22.26% during 29 to 32 weeks of gestational age, 46.05% during 33 to 36 weeks of gestational age and 72.38% during 37 to 40 weeks of gestation. The percentage of deviation was more in early weeks of gestation and reduced with the advancement of pregnancy.

With the advancement of pregnancy the percentage of accuracy of fetal kidney length (mm) increased to the extent of 72.38% from 37 weeks to term pregnancy, when fetal kidney length (mm) was used as a parameter for determination of gestational age.

Table: 17.

Regression analysis between Average Fetal Kidney length (mm) and Gestational age (weeks).

Variable	Coefficient	Std Error	F-test	P-Value
Independent: Average Fetal kidney length(mm) Dependent : Gestational age (wks)	0.98	0.005	33170.7861	0.000
CONSTANT	1.162	0.172	45.9137	0.000

In this study the regression coefficient of the fetal kidney length was + 0.98 with a standard error of 0.005 and p value of 0.000.

As the correlation coefficient (r) value was very close to +1, the fetal kidney length in millimeter (mm) was strongly related with the calculated standardised gestational age in weeks.

Table: 18.

The value of standard deviation of fetal kidney length in millimeter (mm) calculating from weeks as per documented CRL:

Weeks as per documented CRL.	Standard deviation of fetal kidney length in mm.
24	1.244
25	0.9772
26	0.9631
27	0.9055
28	0.8007
29	0.8993
30	0.8990
31	0.8666
32	0.8567
33	0.6307
34	0.7348
35	0.7338
36	0.7604
37	0.5834
38	0.5267
39	0.5584
40	0.4148

If fetal kidney length in millimeter (mm) was considered as equivalent to gestational age in weeks then it was found from the Table No:18, that the maximum variation found in 24 weeks of gestation i.e. $1.244 \times 2 = 2.488$ weeks = $2.488 \times 7 = 17.416$ days and minimum of $0.4148 \times 2 = 0.8296 \times 7 = 5.8072$ days in late pregnancy. So, from the above calculation it was found that the variation in determination of gestational age in relation to fetal kidney length at term was ± 6 days (95% CI).

Table No.19

Correlation between Fetal Kidney length (mm) and Gestational Age (wk):

Variables	Independent	Fetal Kidney length (mm)
	Dependent	Gestational Age (wk)
Regression	Coefficient	Unstandardized.(B)= 0.963 (p=0.000; significant) Standardized (β)= 0.986 (p=0.000; significant)
	Curve plot	<p>The graph plots Average FKL (mm) on the vertical axis against Gestational age in weeks on the horizontal axis. The vertical axis has major tick marks at 25, 30, 35, and 40. The horizontal axis has major tick marks every 1 unit from 24 to 40. A smooth curve is drawn through the data points, showing a consistent upward trend. The curve starts at approximately (24, 23.5) and ends at (40, 40).</p>
	Equation	Gestational Age in weeks(Y) = 0.963 × X [FKL(mm)] + 1.165(y intercept)
Conclusion	<p>1. The Gestational age (wk) has a significant positive correlation with FKL (mm). 2. Derivation of Gestational age (wk) can be done from FKL (mm) by the above mentioned equation.</p>	

FKL= fetal kidney length. **wk**= week

DISCUSSION

DISCUSSION

It was an analytical epidemiological study done in the purview of Department of Anatomy in collaboration with the Department of Radio diagnosis of North Bengal Medical College and Hospital, Sushrutanagar, Dist. Darjeeling; the only medical teaching institution in the northern part of West Bengal.

In this study an effort has been made to correlate fetal kidney length with the gestational age by analysing the observations, correlating the findings with that of other biometric parameters and concluded to a decision.

The subset of antenatal mothers attending the ultrasonography clinic was interviewed and maintaining the inclusion and exclusion criteria finally 939 subjects were included in this study.

- For easy interpretation, mothers were clubbed in three groups of their gestational age i.e. 19 to 24years, 25 to 29 years and 30 to 34 years where majorities (44.2%) were below 25years; 27.7% were in 25-29years and rest 28.1% of them above 30years. [Vide Table:1; Page No. 61].
- Again 28% of the total fetuses were in 24-28 wks, 25.3% of them were in 29-32 wks, 24.3% were in 33-36 wks and rest 22.4% of them having gestational age more than 36 weeks. [Vide Table:2; Page No. 62].
- Among all the antenatal mothers, 54.42 % (511) was primigravida and 45.58 %(428) was multigravida [Vide Table:3; Page No. 63].

- In the distribution of fetus according to Biparietal diameter (BPD) in mm, it was found that 24% was between 60-69 mm, 29% between 70-79, 30% between 80-89 and rest 17% was between 90-99 mm [Vide Table:4; Page No. 64].
- In the distribution of fetus according to Head circumference (HC) in mm, it was found 24% was 222-253mm; 22% was 254-285; 24% was 286-317 and rest 30% was 318-349 mm [Vide Table:5; Page No. 65].
- From the distribution of fetus according to Abdominal circumference (AC) in mm, it was seen that 29% was 207-244 mm; 25% was 245-282; 24% was 283-320 and rest 22% was 321-358 mm [Vide Table:6; Page No. 66].
- It was observed that the distribution of fetus according to Femoral length (FL) in mm, was 24% was 43-51 mm; 22% was 52-60; 32 % was 61-69 and rest 22 % was 70-78 mm [Vide Table:7; Page No. 67].
- To find out the dependence of fetal kidney length on gravida of the mothers this study could reveal that there lies no significant change among these variables [Vide Table No.8; Page No. 68].
- Age group wise mean distribution of fetal kidney length was not significantly different in different gestational weeks of different aged antenatal mothers [Vide Table No.9; Page No.69].

- Strong correlation was found with the Fetal kidney length and conventionally used fetal biometric parameters like Biparietal diameter (BPD), Head circumference (HC), Abdominal circumference (AC) and Femoral length (FL) when compared individually and in combination ($p < 0.05$) [Vide Table No.10;11;12 & 13; Page No. 70,71,72 & 73]. This finding was parallel to the conclusion of previous researchers, HL Cohen, J Cooper et al [26] 1991 where they showed “Strong correlation exists between renal length and gestational age, determined by biparietal diameter, femoral length, and abdominal circumference, and an average of the three”. Another researchers Saha M, Paul AK *et al* [54] 1997, mentioned in their study that the average kidney length at full term was 3.95 cm and an excellent correlation was seen between gestational age, biparietal diameter, femoral length and renal length measurement.
- Fetal kidney length in millimeter can be used as another biometric parameter as good as other conventionally used biometric parameters like BPD, HC, AC and FL [Vide analysis of Table No.10; 11;12 & 13; Page No. 70,71,72 & 73]. Again, the figure No. 10, 11, 12 and 13 shown in line diagram, the fetal kidney length(mm) compared with the gestational age (weeks) were identical whether the gestational age was derived from BPD, HC, AC, or FL. This also signified that fetal kidney length may be used as another biometric parameter as good as other

conventionally used biometric parameters like BPD, HC, AC and FL for determination of gestational age.

Similar findings showed by Bertagnoli L, Lalatta F, *et al* [6] (1983) in their study, that measurements of fetal kidney can be used as an additional parameter in the routine assessment of fetal well being.

- Age group wise mean distribution of fetal kidney length (left and right) was not significantly different in different gestational weeks of different aged antenatal mothers. The mean effect of fetal kidney length of different gestational age groups were not significantly different ($p > 0.05$) [Vide Table No.14, Page No. 74]. This finding was similar to the conclusion of previous researchers, Bertagnoli L, Lalatta F, *et al* [6] 1983 where they showed that there was no significant difference between right and left renal length. Similar finding was also mentioned by HL Cohen, J Cooper *et al* [26] 1991, in their study that there was no significant difference was found between right and left renal lengths in fetuses in whom both kidneys were imaged.
- In this study accuracy of fetal kidney length measurement expressed in millimeter increased with advancement of pregnancy and was 72.38% accurate during 37 weeks to term [Vide Table No.15; Page No.76]. This finding was supported by the previous researchers like -
 - i) Sagi J, Vagman I, *et al*, [53] 1987, was presented a correlation of fetal kidney length and gestational age. The

results were presented to be used as an adjunct in establishing fetal gestational age and as well as the assessment of normal renal morphology in routine obstetric ultrasound assessment.

ii) Saha M, Paul AK *et al* [54] in 1997, mentioned that the mean length of fetal kidneys in their study was either slightly higher or similar to that previously reported by many authors and the average kidney length at full term was 3.95 cm.

iii) Carol M. Rumack, Stephanie R. Wilson, *et al*, [13] in 1997, mentioned the often quoted rule of thumb "renal length in millimeters approximates gestational age in weeks". However, a recent study and their own experience showed that renal lengths are longer than previously reported.

iv) Konje J C, Abrams KR. *et al*, [35] 2002, in their study reported the measurement of fetal kidney length by ultrasonography between 24 & 38 weeks' gestation to be very useful and recommended its incorporation into the model for dating pregnancies after 24 weeks of gestation, in particular when measurement of the bi-parietal diameter and head circumference are difficult. Kidney length is a more accurate method of determining gestational age than the fetal biometric indices of biparietal diameter, head circumference, femur length and abdominal circumference between 24 and 38 weeks' gestation. When combined with biparietal diameter, head

circumference and femur length, the precision of dating was improved by 2 days. This measurement was easy to make and could therefore be easily incorporated into the model for dating pregnancies after 24 weeks of gestation, in particular when measurements of the biparietal diameter and head circumference are difficult.

- From this study it was found that the linear regression coefficient of the fetal kidney length was 0.98 with a standard error of 0.005 and p value of 0.000; the correlation coefficient: $r = 0.98$. [Vide Table No.17; Page No.80].
- In this study, as the correlation coefficient (r) value was very close to +1, the fetal kidney length in millimeter was strongly related with the calculated standardised gestational age in weeks. This finding was supported by Carol M. Rumack, Stephanie R. Wilson, *et al*, [13] in their highly esteemed text book "Diagnostic Ultrasound" Vol. 2, Second Edition (1997), Chapter 37, Page 1094, "renal length in millimeters approximates gestational age in weeks".
- If fetal kidney length in millimeter was considered as equivalent to gestational age in weeks then the maximum variation found in 24 weeks of gestation i.e. $1.244 \times 2 = 2.488$ weeks = $2.488 \times 7 = 17.416$ days and minimum of $0.4148 \times 2 = 0.8296 \times 7 = 5.8072$ days in late pregnancy. So, from the calculation it was found that the variation in determination of gestational age in relation to fetal kidney

length at term is ± 6 days (95% CI) [Vide Table No. 18; Page No. 81].

Finally in the present study an equation was found based on the regression coefficient;

i.e. Gestational Age in weeks(Y) = 0.963 x X [FKL(mm)] + 1.165 (y intercept).

(Where Slope m = 0.963 and Constant = 1.165).

SUMMARY

SUMMARY

It was an analytical epidemiological hospital based study done in the purview of the Department of Anatomy in collaboration with the Department of Radiodiagnosis of North Bengal Medical college and Hospital, Sushrutanagar, Dist. Darjeeling; the only medical teaching institution in the northern part of West Bengal.

An effort has been made in this study to correlate fetal kidney length with the gestational age by analysing the observations, correlating the findings with that of other biometric parameters and concluded to a decision.

The subset of antenatal mothers attending the ultrasonography clinic was interviewed and maintaining the inclusion and exclusion criteria finally 939 subjects were included in this study.

The frequency distribution of antenatal mothers according to their age, where majorities (44.2%) were below 25years; 27.7% were in 25-29 years and rest 28.1% of them above 30years and age group wise mean distribution of fetal kidney length was not significantly different in different gestational weeks of different aged antenatal mothers.

Again, frequency distribution of antenatal mothers according to their gravida, 54 % (511) was primigravida and 46 %(428) was multigravida and it was found that there was no significant difference in the fetal kidney length related to the gravida of the mother in different gestational age.

In the analysis it was also found that the age group wise mean distribution of fetal kidney length was not significantly different in different gestational weeks of different aged antenatal mothers. The mean effect of fetal kidney length of different gestational age groups were not significantly different ($p > 0.05$). So, there was no significant difference in the fetal kidney length whether right or left kidney was measured.

It was further observed in this study that the assessment of gestational age by the widely used conventional biometric parameters like Biparietal diameter (BPD), Head circumference (HC), Abdominal circumference (AC) and Femoral length (FL) correlated very well with fetal kidney length when compared individually and in combination. This signified that fetal kidney length may be used as another fetal biometric parameter like BPD, HC, AC and FL.

In further analysis it was found that the fetal kidney length (mm) showed an inclination with standardised gestational age by 8.74% during 24 to 28 weeks of gestational age, 22.26% during 29 to 32 weeks of gestational age, 46.05% during 33 to 36 weeks of gestational age and 72.38% during 37 to 40 weeks respectively and it was found from the histogram (Figure No: 15), that the fetal kidney length (mm) was not so much linear in early pregnancy till 32 weeks but was very much linear in late pregnancy i.e. 33 weeks to term.

In this study the linear regression coefficient of the fetal kidney length was 0.98 with a standard error of 0.005 and p value of 0.000; The correlation coefficient: $r = 0.98$

As the correlation coefficient (r) value was very close to +1, the fetal kidney length in millimeter was strongly related with the gestational age in weeks.

If the fetal kidney length in millimeter(mm) was considered as equivalent to gestational age in weeks then the maximum variation found in 24 weeks of gestation i.e. $1.244 \times 2 = 2.488$ weeks = $2.488 \times 7 = 17.416$ days and minimum of $0.4148 \times 2 = 0.8296 \times 7 = 5.8072$ days. So, from the above calculation it was found that the variation in determination of gestational age in relation to fetal kidney length at term was ± 6 days and 95% CI (Confidence interval).

Finally in the present study an equation was found based on the regression coefficient;

Gestational Age in weeks(Y) = $0.963 \times X$ [FKL(mm)] + 1.165(y intercept).

(Where Slope m = 0.963 and Constant = 1.165.).

CONCLUSION

CONCLUSION

In this study it was found that the fetal kidney length was not affected by the maternal age and gravida for the purpose of estimation of gestational age.

The fetal kidney length may be used as another biometric parameter as good as other conventionally used biometric parameters like BPD, HC, AC and FL for the assessment of gestational age.

It was found that the fetal kidney length (mm) approximates closely with the gestational age (weeks) with advancement of pregnancy.

The fetal kidney length in millimeter (mm) was strongly correlated with the calculated standardised gestational age in weeks.

There was no significant difference in the fetal kidney length measurement whether the right kidney or the left kidney was measured for the purpose of assessment of gestational age.

As the fetal kidney length (mm) was strongly correlated with the calculated standardised gestational age in weeks, it can be used as a very useful fetal biometric parameter for assessment of gestational age, particularly when LMP was uncertain, no previous biometrically assessed fetal maturity was available or when the measurement of other conventional fetal biometric parameters were difficult for accurate assessment of gestational age.

LIST OF ABBREVIATIONS

ABBREVIATIONS

AC = Abdominal circumference

BPD = Bi-parietal diameter

CRL = Crown rump length

cm = centimeter

CI = Confidence interval

Fig: = Figure

FKL = Fetal kidney length

FL = Femoral length

HC = Head Circumference

LMP = First day of last menstrual period

mm = millimeter

USG = Ultrasonography

Vol = volume

wk = week

OFFICIAL ABBREVIATIONS FOR JOURNALS

Acta Obstet Gynecol Scand = Acta obstetricia et gynecologica Scandinavica (Denmark).

AJR Am J Roentgenol = AJR. American journal of roentgenology.

Akush Ginekol (Sofia) = Akusherstvo i ginekologiã (Bulgarian).

Am J Obstet Gynecol = American Journal of Obstetrics & Gynecology.

Am J Perinatol = American journal of perinatology.

Anat Clin = Anatomia clinica (Germany).

Asia Oceania J Obstet Gynaecol = Asia-Oceania Journal of Obstetrics and Gynaecology.

Aust N Z J Obstet Gynaecol = The Australian and New Zealand Journal of Obstetrics and Gynaecology.

Australasian Radiology = "Australasian Radiology" is the official journal of the Royal Australian and New Zealand College of Radiologists.

Bangladesh Med Res Counc Bull = Bangladesh Medical Research Council bulletin.

Br J Obstet Gynaecol = British Journal of Obstetrics and Gynaecology.

Cells Tissues Organs = Cells Tissues Organs.

Clin Exp Obstet Gynecol = Clinical and experimental obstetrics & gynecology (Italy).

Clin Obstet Gynecol = Clinical obstetrics and gynecology (United States).

Clin Sci (Lond) = Clinical Science (An international journal of clinical and molecular investigation a journal Printed in Great Britain).

Eur Urol = European Urology (Official Journal of the European Association of Urology).

Fetal Diagn Ther = Fetal diagnosis and therapy (Switzerland).

Geburtshilfe Frauenheilkd = Geburtshilfe und Frauenheilkunde (Germany).

Gynecol Obstet Invest = Gynecologic and Obstetric Investigation.

J Clin Ultrasound = Journal of Clinical Ultrasound (United States).

J Obstet Gynaecol Br Common = The Journal of Obstetrics and Gynaecology of the British Commonwealth.

J Reprod Med = The Journal of reproductive medicine (United States).

J Ultrasound Med = Journal of ultrasound in medicine (official journal of the American Institute of Ultrasound in Medicine).

Mayo Clin Proc = Mayo Clinic proceedings (an American journal).

Obstet Gynecol = Obstetrics and gynecology (United States).

Obstet Gynecol Surv = Obstetrical & gynecological survey (United States).

Prenatal Diagnosis = Prenatal Diagnosis.

Radiol Clin North Am = Radiologic clinics of North America (United States).

Radiology = Radiology (United States).

Singapore Med J = Singapore medical journal.

Ultrasound Obstet Gynecol = Ultrasound in obstetrics & gynecology: the official journal of the International Society of Ultrasound in Obstetrics and Gynecology.

West Afr J Med = West African journal of medicine (Nigeria).

Z Geburtshilfe Perinatol = Zeitschrift für Geburtshilfe und Perinatologie (Germany).

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ANNEXURE

Informed consent from for antenatal mother

Institution: North Bengal Medical College & Hospital. Sushrutanagar.
Darjeeling. WB.

Title of the Research work: Correlation of fetal Kidney length with gestational age in normal pregnancies among North Bengal population through ultrasonographic studies.

For the study “Correlation of fetal Kidney length with gestational age in normal pregnancies among North Bengal population through ultrasonographic studies.”

I, _____ exercising my free power of choice, here by giving consent to be included as a subject. I have been informed to my satisfaction by the attending physician for the purpose of the clinical and ultrasonographic examination and follow up. I am also aware of my right to opt out of the clinical and ultrasonographic examination at any stage during the course of this study without having to give reasons for doing so.

(Signature of attending Physician)

(Signature of antenatal mother)

Date: _____

Date: _____

1) Witness – 1

2) Witness – 2

Signature

Signature

Name:

Name:

Address:

Address:

PROFORMA

Section A: [Direct interview]

1. Date of interview: ___/___/___.
2. Serial number of antenatal mother:
3. Regd. No:
4. Age of the antenatal mother: ___ years.
5. Gravida: Primi / Multi:
6. Baby moving (Fetal movement): Yes / No
7. Whether undergone ultrasonography for present pregnancy: Yes / No
If yes, gestational age as per documented 1st trimester CRL: _____ weeks
____ days.
8. Associated disorder (any):

Medical	Surgical	Gynecological

9. Any documented fetal anomaly: Yes / No

Section B: [Ultrasonographic evaluation]

- 1) Any fetoplacental anomaly present: Yes / No.
- 2) Measurement of:
 - Biparietal diameter (BPD): _____ mm.
 - Head circumference (HC): _____ mm.
 - Abdominal circumference (AC): _____ mm.
 - Femoral length (FL): _____ mm.
 - Fetal Kidney Length (FKL): _____ mm (Right/Left, which is more accessible)

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
1	24	Primi	29	72	265	248	55	28	Right
2	29	Primi	33	81	298	290	63	33	Right
3	32	Multi	24	60	222	207	43	23	Right
4	34	Multi	37	88	325	327	70	37	Left
5	29	Primi	39	92	340	345	73	39	Left
6	31	Multi	35	85	311	310	67	35	Right
7	33	Primi	36	87	320	318	68	35	Left
8	19	Primi	24	60	222	207	43	25	Left
9	22	Primi	38	90	332	335	72	39	Left
10	25	Primi	30	74	275	260	57	30	Left
11	28	Primi	32	79	290	280	61	31	Left
12	21	Multi	26	65	240	219	49	25	Right
13	23	Primi	28	70	258	240	53	29	Left
14	26	Primi	31	77	282	272	59	30	Left
15	19	Primi	24	60	222	207	43	25	Left
16	24	Primi	29	72	265	248	55	30	Left
17	28	Primi	32	79	290	280	61	31	Left
18	34	Multi	37	88	325	327	70	37	Right
19	29	Primi	39	92	340	345	73	39	Right
20	31	Multi	35	85	311	310	67	36	Left
21	33	Multi	36	87	320	318	68	35	Right
22	23	Primi	38	90	332	335	72	38	Right
23	29	Primi	33	81	298	290	63	33	Right
24	29	Primi	32	79	290	280	61	31	Right
25	33	Multi	24	60	222	207	43	23	Right

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
26	21	Primi	25	62	230	209	46	24	Left
27	23	Primi	28	70	258	240	53	29	Right
28	25	Primi	30	74	275	260	57	31	Right
29	24	Primi	29	72	265	248	55	30	Right
30	29	Primi	33	81	298	290	63	33	Right
31	31	Multi	24	60	222	207	43	23	Right
32	34	Multi	37	88	325	327	70	37	Left
33	29	Primi	39	92	340	345	73	39	Left
34	31	Multi	35	85	311	310	67	35	Right
35	33	Primi	36	87	320	318	68	35	Left
36	19	Primi	24	60	222	207	43	23	Left
37	22	Primi	38	90	332	335	72	39	Left
38	25	Primi	30	74	275	260	57	30	Left
39	28	Multi	32	79	290	280	61	31	Left
40	21	Multi	26	65	240	219	49	25	Right
41	23	Primi	28	70	258	240	53	29	Left
42	26	Primi	31	77	282	272	59	30	Left
43	19	Primi	24	60	222	207	43	25	Left
44	24	Primi	29	72	265	248	55	30	Left
45	28	Primi	32	79	290	280	61	31	Left
46	34	Multi	37	88	325	327	70	37	Right
47	29	Multi	39	92	340	345	73	40	Right
48	31	Multi	35	85	311	310	67	36	Left
49	33	Multi	36	87	320	318	68	35	Right
50	23	Primi	38	90	332	335	72	38	Right

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
51	29	Primi	33	81	298	290	63	33	Right
52	29	Primi	32	79	290	280	61	31	Right
53	34	Multi	24	60	222	207	43	23	Right
54	21	Primi	25	62	230	209	46	24	Left
55	23	Primi	28	70	258	240	53	29	Right
56	25	Primi	30	74	275	260	57	31	Right
57	19	Multi	24	60	222	207	43	23	Right
58	24	Primi	29	72	265	248	55	30	Right
59	29	Primi	33	81	298	290	63	33	Right
60	34	Multi	37	88	325	327	70	37	Left
61	29	Primi	39	92	340	345	73	39	Left
62	31	Multi	35	85	311	310	67	35	Right
63	33	Primi	36	87	320	318	68	35	Left
64	19	Primi	24	60	222	207	43	23	Left
65	22	Primi	38	90	332	335	72	39	Left
66	25	Primi	30	74	275	260	57	30	Left
67	29	Primi	33	81	298	290	63	33	Left
68	21	Primi	26	65	240	219	49	25	Right
69	23	Primi	28	70	258	240	53	29	Left
70	26	Primi	31	77	282	272	59	30	Left
71	19	Primi	24	60	222	207	43	25	Left
72	24	Primi	29	72	265	248	55	30	Left
73	28	Primi	32	79	290	280	61	31	Left
74	34	Multi	37	88	325	327	70	37	Right
75	29	Multi	39	92	340	345	73	40	Right

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
76	31	Multi	35	85	311	310	67	36	Left
77	33	Multi	36	87	320	318	68	35	Right
78	23	Primi	38	90	332	335	72	38	Right
79	29	Multi	24	60	222	207	43	22	Right
80	29	Multi	33	81	298	290	63	33	Right
81	29	Primi	32	79	290	280	61	31	Right
82	21	Primi	26	65	240	219	49	26	Left
83	23	Primi	28	70	258	240	53	29	Right
84	25	Primi	30	74	275	260	57	31	Right
85	19	Multi	24	60	222	207	43	23	Right
86	24	Primi	29	72	265	248	55	30	Right
87	28	Multi	32	79	290	280	61	31	Right
88	34	Multi	37	88	325	327	70	37	Left
89	29	Primi	39	92	340	345	73	39	Left
90	31	Multi	35	85	311	310	67	35	Right
91	33	Primi	36	87	320	318	68	35	Left
92	19	Primi	24	60	222	207	43	23	Left
93	22	Primi	38	90	332	335	72	39	Left
94	25	Primi	30	74	275	260	57	30	Left
95	29	Primi	33	81	298	290	63	33	Left
96	21	Primi	26	65	240	219	49	25	Right
97	23	Multi	29	72	265	248	55	29	Left
98	26	Primi	31	77	282	272	59	30	Left
99	19	Primi	24	60	222	207	43	25	Left
100	24	Primi	29	72	265	248	55	30	Left

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
101	28	Primi	32	79	290	280	61	31	Left
102	34	Multi	37	88	325	327	70	37	Right
103	22	Primi	37	88	325	327	70	37	Right
104	29	Multi	39	92	340	345	73	40	Right
105	31	Multi	35	85	311	310	67	36	Left
106	23	Primi	38	90	332	335	72	38	Right
107	26	Multi	24	60	222	207	43	22	Right
108	29	Primi	33	81	298	290	63	33	Right
109	29	Primi	32	79	290	280	61	31	Right
110	21	Primi	26	65	240	219	49	26	Left
111	23	Primi	28	70	258	240	53	29	Right
112	26	Primi	31	77	282	272	59	30	Right
113	19	Multi	24	60	222	207	43	23	Right
114	24	Primi	29	72	265	248	55	30	Right
115	28	Multi	32	79	290	280	61	31	Right
116	34	Multi	37	88	325	327	70	37	Left
117	29	Primi	39	92	340	345	73	39	Left
118	31	Multi	35	85	311	310	67	35	Right
119	33	Primi	36	87	320	318	68	35	Left
120	19	Primi	24	60	222	207	43	23	Left
121	22	Primi	38	90	332	335	72	39	Left
122	25	Primi	30	74	275	260	57	29	Left
123	29	Primi	33	81	298	290	63	33	Left
124	21	Primi	26	65	240	219	49	25	Right
125	23	Multi	29	72	265	248	55	29	Left

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
126	26	Primi	31	77	282	272	59	30	Left
127	19	Primi	24	60	222	207	43	25	Left
128	24	Primi	30	74	275	260	57	30	Left
129	28	Primi	32	79	290	280	61	31	Left
130	34	Multi	37	88	325	327	70	37	Right
131	22	Primi	37	88	325	327	70	37	Right
132	29	Multi	39	92	340	345	73	40	Right
133	31	Multi	35	85	311	310	67	36	Left
134	23	Primi	38	90	332	335	72	38	Right
135	25	Multi	24	60	222	207	43	22	Right
136	29	Primi	33	81	298	290	63	33	Right
137	29	Primi	32	79	290	280	61	31	Right
138	21	Multi	26	65	240	219	49	26	Left
139	23	Primi	28	70	258	240	53	29	Right
140	26	Primi	31	77	282	272	59	30	Right
141	19	Multi	24	60	222	207	43	23	Right
142	24	Primi	29	72	265	248	55	30	Right
143	28	Multi	32	79	290	280	61	31	Right
144	34	Multi	37	88	325	327	70	37	Left
145	29	Primi	39	92	340	345	73	39	Left
146	31	Multi	35	85	311	310	67	35	Right
147	33	Primi	36	87	320	318	68	35	Left
148	22	Primi	38	90	332	335	72	39	Left
149	25	Primi	30	74	275	260	57	29	Left
150	29	Multi	33	81	298	290	63	33	Left

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
151	32	Multi	24	60	222	207	43	22	Left
152	21	Primi	26	65	240	219	49	25	Right
153	24	Primi	29	72	265	248	55	28	Left
154	26	Primi	31	77	282	272	59	30	Left
155	19	Primi	24	60	222	207	43	25	Left
156	25	Primi	30	74	275	260	57	31	Left
157	28	Primi	32	79	290	280	61	31	Left
158	34	Multi	37	88	325	327	70	37	Right
159	22	Primi	37	88	325	327	70	37	Right
160	29	Multi	39	92	340	345	73	40	Right
161	31	Multi	35	85	311	310	67	36	Left
162	23	Primi	38	90	332	335	72	38	Right
163	26	Multi	24	60	222	207	43	22	Right
164	29	Primi	33	81	298	290	63	32	Right
165	29	Primi	32	79	290	280	61	31	Right
166	21	Multi	26	65	240	219	49	26	Left
167	23	Primi	28	70	258	240	53	29	Right
168	26	Primi	31	77	282	272	59	30	Right
169	19	Multi	24	60	222	207	43	23	Right
170	24	Primi	29	72	265	248	55	30	Right
171	28	Multi	32	79	290	280	61	31	Right
172	34	Multi	37	88	325	327	70	37	Left
173	22	Primi	37	88	325	327	70	38	Left
174	29	Primi	39	92	340	345	73	39	Left
175	31	Multi	35	85	311	310	67	36	Right

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
176	22	Primi	38	90	332	335	72	39	Left
177	25	Primi	30	74	275	260	57	29	Left
178	29	Multi	33	81	298	290	63	33	Left
179	31	Multi	24	60	222	207	43	22	Left
180	21	Primi	26	65	240	219	49	25	Right
181	24	Primi	29	72	265	248	55	28	Left
182	26	Primi	31	77	282	272	59	30	Left
183	19	Primi	24	60	222	207	43	25	Left
184	25	Primi	30	74	275	260	57	31	Left
185	28	Primi	32	79	290	280	61	33	Left
186	34	Multi	37	88	325	327	70	37	Right
187	22	Primi	37	88	325	327	70	37	Right
188	29	Multi	39	92	340	345	73	40	Right
189	31	Multi	35	85	311	310	67	36	Left
190	23	Primi	38	90	332	335	72	38	Right
191	25	Multi	24	60	222	207	43	22	Right
192	29	Primi	33	81	298	290	63	32	Right
193	29	Primi	32	79	290	280	61	31	Right
194	21	Multi	26	65	240	219	49	25	Left
195	23	Primi	28	70	258	240	53	29	Right
196	26	Primi	31	77	282	272	59	30	Right
197	19	Primi	24	60	222	207	43	23	Right
198	24	Primi	29	72	265	248	55	30	Right
199	28	Multi	32	79	290	280	61	31	Right
200	34	Multi	37	88	325	327	70	37	Left

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
201	22	Primi	37	88	325	327	70	38	Left
202	29	Primi	39	92	340	345	73	39	Left
203	31	Multi	35	85	311	310	67	36	Right
204	19	Primi	38	90	332	335	72	38	Left
205	25	Primi	30	74	275	260	57	29	Left
206	29	Multi	33	81	298	290	63	33	Left
207	30	Multi	24	60	222	207	43	22	Left
208	21	Primi	26	65	240	219	49	25	Right
209	24	Primi	29	72	265	248	55	28	Left
210	26	Primi	31	77	282	272	59	30	Left
211	19	Primi	24	60	222	207	43	25	Left
212	25	Primi	30	74	275	260	57	31	Left
213	28	Primi	32	79	290	280	61	33	Left
214	31	Multi	39	92	340	345	73	39	Right
215	22	Primi	37	88	325	327	70	37	Right
216	29	Multi	39	92	340	345	73	40	Right
217	31	Multi	35	85	311	310	67	36	Left
218	19	Multi	24	60	222	207	43	22	Right
219	23	Primi	38	90	332	335	72	38	Right
220	29	Primi	33	81	298	290	63	32	Right
221	29	Primi	32	79	290	280	61	31	Right
222	21	Multi	26	65	240	219	49	25	Left
223	23	Primi	28	70	258	240	53	29	Right
224	26	Primi	31	77	282	272	59	30	Right
225	19	Primi	24	60	222	207	43	23	Right

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
226	24	Primi	29	72	265	248	55	30	Right
227	28	Multi	32	79	290	280	61	31	Right
228	34	Multi	37	88	325	327	70	37	Left
229	22	Primi	37	88	325	327	70	38	Left
230	29	Primi	39	92	340	345	73	39	Left
231	31	Multi	35	85	311	310	67	36	Right
232	19	Primi	38	90	332	335	72	38	Left
233	25	Multi	30	74	275	260	57	29	Left
234	26	Primi	24	60	222	207	43	22	Left
235	29	Multi	33	81	298	290	63	33	Left
236	21	Primi	26	65	240	219	49	25	Right
237	24	Primi	29	72	265	248	55	28	Left
238	26	Primi	31	77	282	272	59	32	Left
239	19	Primi	24	60	222	207	43	25	Left
240	26	Primi	31	77	282	272	59	30	Left
241	27	Primi	32	79	290	280	61	33	Left
242	31	Multi	39	92	340	345	73	39	Right
243	22	Primi	37	88	325	327	70	37	Right
244	29	Multi	39	92	340	345	73	38	Right
245	31	Multi	35	85	311	310	67	36	Left
246	19	Multi	24	60	222	207	43	22	Right
247	23	Primi	38	90	332	335	72	38	Right
248	25	Multi	30	74	275	260	57	30	Right
249	29	Primi	33	81	298	290	63	32	Right
250	21	Multi	26	65	240	219	49	25	Left

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
251	23	Primi	28	70	258	240	53	29	Right
252	26	Primi	31	77	282	272	59	30	Right
253	19	Primi	24	60	222	207	43	23	Right
254	24	Primi	30	74	275	260	57	30	Right
255	28	Multi	32	79	290	280	61	31	Right
256	34	Multi	37	88	325	327	70	37	Left
257	22	Primi	37	88	325	327	70	38	Left
258	29	Multi	39	92	340	345	73	40	Left
259	31	Multi	35	85	311	310	67	36	Right
260	19	Primi	38	90	332	335	72	38	Left
261	25	Multi	30	74	275	260	57	29	Left
262	25	Primi	24	60	222	207	43	22	Left
263	29	Multi	33	81	298	290	63	33	Left
264	21	Primi	26	65	240	219	49	25	Right
265	24	Primi	29	72	265	248	55	28	Left
266	26	Primi	31	77	282	272	59	32	Left
267	19	Primi	24	60	222	207	43	25	Left
268	26	Primi	31	77	282	272	59	30	Left
269	27	Primi	32	79	290	280	61	33	Left
270	31	Multi	39	92	340	345	73	39	Right
271	19	Primi	40	95	345	355	75	40	Right
272	22	Primi	37	88	325	327	70	37	Right
273	31	Multi	35	85	311	310	67	36	Left
274	19	Multi	24	60	222	207	43	22	Right
275	23	Primi	38	90	332	335	72	38	Right

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
276	25	Primi	30	74	275	260	57	30	Right
277	29	Primi	33	81	298	290	63	32	Right
278	21	Multi	26	65	240	219	49	25	Left
279	23	Primi	28	70	258	240	53	29	Right
280	26	Primi	31	77	282	272	59	30	Right
281	19	Primi	24	60	222	207	43	23	Right
282	25	Primi	30	74	275	260	57	31	Right
283	28	Primi	32	79	290	280	61	31	Right
284	31	Multi	39	92	340	345	73	39	Left
285	22	Primi	37	88	325	327	70	38	Left
286	29	Multi	39	92	340	345	73	40	Left
287	31	Multi	35	85	311	310	67	36	Right
288	19	Primi	38	90	332	335	72	38	Left
289	25	Multi	30	74	275	260	57	29	Left
290	26	Primi	24	60	222	207	43	22	Left
291	29	Multi	33	81	298	290	63	33	Left
292	21	Primi	26	65	240	219	49	25	Right
293	24	Primi	29	72	265	248	55	28	Left
294	26	Primi	31	77	282	272	59	32	Left
295	19	Primi	24	60	222	207	43	25	Left
296	26	Primi	31	77	282	272	59	30	Left
297	27	Primi	32	79	290	280	61	33	Left
298	31	Multi	39	92	340	345	73	39	Right
299	19	Primi	40	95	345	355	75	39	Right
300	22	Primi	37	88	325	327	70	37	Right

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
301	31	Multi	35	85	311	310	67	36	Left
302	20	Multi	24	60	222	207	43	22	Right
303	23	Primi	38	90	332	335	72	38	Right
304	25	Multi	30	74	275	260	57	29	Right
305	29	Primi	33	81	298	290	63	34	Right
306	21	Multi	26	65	240	219	49	25	Left
307	23	Primi	28	70	258	240	53	29	Right
308	26	Primi	31	77	282	272	59	30	Right
309	19	Primi	24	60	222	207	43	23	Right
310	25	Primi	30	74	275	260	57	31	Right
311	28	Primi	32	79	290	280	61	33	Right
312	31	Primi	39	92	340	345	73	39	Left
313	23	Primi	37	88	325	327	70	38	Left
314	29	Multi	39	92	340	345	73	40	Left
315	31	Multi	35	85	311	310	67	36	Right
316	19	Primi	38	90	332	335	72	38	Left
317	25	Multi	30	74	275	260	57	29	Left
318	27	Multi	24	60	222	207	43	22	Left
319	29	Multi	33	81	298	290	63	33	Left
320	21	Primi	26	65	240	219	49	25	Right
321	24	Primi	29	72	265	248	55	28	Left
322	26	Primi	31	77	282	272	59	32	Left
323	19	Multi	24	60	222	207	43	25	Left
324	26	Primi	31	77	282	272	59	30	Left
325	27	Primi	32	79	290	280	61	33	Left

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
326	31	Multi	39	92	340	345	73	39	Right
327	19	Primi	40	95	345	355	75	39	Right
328	22	Primi	37	88	325	327	70	37	Right
329	31	Multi	35	85	311	310	67	34	Left
330	20	Multi	24	60	222	207	43	24	Right
331	23	Primi	38	90	332	335	72	38	Right
332	25	Multi	30	74	275	260	57	29	Right
333	29	Primi	33	81	298	290	63	34	Right
334	21	Multi	26	65	240	219	49	25	Left
335	23	Primi	28	70	258	240	53	29	Right
336	26	Primi	31	77	282	272	59	32	Right
337	19	Primi	24	60	222	207	43	23	Right
338	25	Primi	30	74	275	260	57	31	Right
339	28	Primi	32	79	290	280	61	33	Right
340	31	Multi	39	92	340	345	73	39	Left
341	19	Primi	40	95	345	355	75	40	Left
342	23	Primi	37	88	325	327	70	38	Left
343	31	Multi	35	85	311	310	67	36	Right
344	19	Primi	38	90	332	335	72	38	Left
345	25	Multi	30	74	275	260	57	29	Left
346	28	Multi	24	60	222	207	43	22	Left
347	29	Multi	33	81	298	290	63	33	Left
348	21	Primi	26	65	240	219	49	25	Right
349	24	Primi	29	72	265	248	55	28	Left
350	26	Primi	31	77	282	272	59	32	Left

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
351	19	Multi	24	60	222	207	43	25	Left
352	26	Primi	31	77	282	272	59	30	Left
353	27	Primi	32	79	290	280	61	33	Left
354	31	Multi	39	92	340	345	73	39	Right
355	19	Primi	40	95	345	355	75	39	Right
356	22	Primi	37	88	325	327	70	37	Right
357	31	Multi	35	85	311	310	67	34	Left
358	19	Multi	24	60	222	207	43	24	Right
359	23	Primi	38	90	332	335	72	38	Right
360	25	Multi	30	74	275	260	57	29	Right
361	29	Primi	33	81	298	290	63	34	Right
362	21	Multi	26	65	240	219	49	25	Left
363	23	Primi	28	70	258	240	53	29	Right
364	26	Primi	31	77	282	272	59	32	Right
365	19	Primi	24	60	222	207	43	23	Right
366	25	Primi	30	74	275	260	57	31	Right
367	28	Primi	32	79	290	280	61	33	Right
368	31	Multi	39	92	340	345	73	39	Left
369	19	Primi	40	95	345	355	75	40	Left
370	23	Primi	37	88	325	327	70	38	Left
371	31	Multi	35	85	311	310	67	36	Right
372	19	Primi	38	90	332	335	72	38	Left
373	21	Multi	24	60	222	207	43	24	Left
374	25	Multi	30	74	275	260	57	29	Left
375	29	Multi	33	81	298	290	63	33	Left

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
376	22	Primi	26	65	240	219	49	25	Right
377	24	Primi	29	72	265	248	55	28	Left
378	27	Primi	31	77	282	272	59	32	Left
379	19	Multi	24	60	222	207	43	25	Left
380	26	Primi	31	77	282	272	59	30	Left
381	31	Multi	39	92	340	345	73	39	Right
382	19	Primi	40	95	345	355	75	40	Right
383	22	Primi	37	88	325	327	70	36	Right
384	31	Multi	35	85	311	310	67	34	Left
385	23	Primi	38	90	332	335	72	38	Right
386	25	Multi	30	74	275	260	57	29	Right
387	29	Primi	33	81	298	290	63	34	Right
388	21	Multi	26	65	240	219	49	25	Left
389	23	Primi	28	70	258	240	53	29	Right
390	26	Primi	31	77	282	272	59	32	Right
391	19	Primi	24	60	222	207	43	23	Right
392	25	Primi	30	74	275	260	57	31	Right
393	31	Multi	39	92	340	345	73	39	Left
394	19	Primi	40	95	345	355	75	40	Left
395	23	Primi	37	88	325	327	70	38	Left
396	31	Multi	35	85	311	310	67	36	Right
397	19	Primi	38	90	332	335	72	38	Left
398	25	Multi	30	74	275	260	57	29	Left
399	30	Multi	34	83	305	301	65	34	Left
400	22	Primi	26	65	240	219	49	27	Right

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
401	24	Primi	29	72	265	248	55	28	Left
402	27	Primi	31	77	282	272	59	32	Left
403	19	Multi	24	60	222	207	43	25	Left
404	26	Primi	31	77	282	272	59	30	Left
405	31	Multi	39	92	340	345	73	39	Right
406	19	Primi	40	95	345	355	75	40	Right
407	22	Primi	37	88	325	327	70	36	Right
408	31	Multi	35	85	311	310	67	34	Left
409	23	Primi	38	90	332	335	72	38	Right
410	25	Multi	30	74	275	260	57	29	Right
411	29	Primi	33	81	298	290	63	34	Right
412	22	Primi	26	65	240	219	49	27	Left
413	23	Multi	29	72	265	248	55	29	Right
414	26	Primi	31	77	282	272	59	32	Right
415	19	Primi	24	60	222	207	43	23	Right
416	25	Primi	30	74	275	260	57	31	Right
417	33	Multi	39	92	340	345	73	38	Left
418	22	Primi	40	95	345	355	75	40	Left
419	23	Primi	37	88	325	327	70	38	Left
420	31	Multi	35	85	311	310	67	36	Right
421	19	Primi	38	90	332	335	72	38	Left
422	25	Multi	30	74	275	260	57	29	Left
423	30	Multi	34	83	305	301	65	34	Left
424	22	Primi	26	65	240	219	49	27	Right
425	24	Primi	29	72	265	248	55	28	Left

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
426	27	Primi	31	77	282	272	59	32	Left
427	19	Multi	24	60	222	207	43	25	Left
428	26	Primi	31	77	282	272	59	30	Left
429	31	Multi	39	92	340	345	73	39	Right
430	22	Primi	37	88	325	327	70	36	Right
431	22	Primi	40	95	345	355	75	40	Right
432	31	Multi	35	85	311	310	67	34	Left
433	23	Primi	38	90	332	335	72	38	Right
434	25	Multi	30	74	275	260	57	29	Right
435	29	Primi	33	81	298	290	63	34	Right
436	22	Primi	26	65	240	219	49	27	Left
437	23	Multi	29	72	265	248	55	29	Right
438	26	Primi	31	77	282	272	59	32	Right
439	19	Multi	24	60	222	207	43	25	Right
440	25	Primi	30	74	275	260	57	31	Right
441	33	Multi	39	92	340	345	73	38	Left
442	22	Primi	40	95	345	355	75	40	Left
443	23	Primi	37	88	325	327	70	38	Left
444	31	Multi	35	85	311	310	67	36	Right
445	19	Primi	38	90	332	335	72	38	Left
446	25	Multi	30	74	275	260	57	29	Left
447	30	Multi	34	83	305	301	65	34	Left
448	22	Primi	26	65	240	219	49	27	Right
449	24	Primi	29	72	265	248	55	28	Left
450	27	Primi	31	77	282	272	59	32	Left

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
451	20	Multi	25	62	230	209	46	25	Left
452	26	Primi	31	77	282	272	59	30	Left
453	31	Multi	39	92	340	345	73	39	Right
454	22	Primi	37	88	325	327	70	36	Right
455	22	Primi	40	95	345	355	75	40	Right
456	31	Multi	35	85	311	310	67	34	Left
457	23	Primi	38	90	332	335	72	38	Right
458	25	Multi	30	74	275	260	57	31	Right
459	29	Primi	33	81	298	290	63	34	Right
460	22	Primi	26	65	240	219	49	27	Left
461	23	Multi	29	72	265	248	55	29	Right
462	26	Primi	31	77	282	272	59	32	Right
463	19	Multi	24	60	222	207	43	25	Right
464	25	Primi	30	74	275	260	57	31	Right
465	33	Multi	39	92	340	345	73	38	Left
466	22	Primi	40	95	345	355	75	40	Left
467	23	Primi	38	90	332	335	72	38	Left
468	31	Multi	35	85	311	310	67	34	Right
469	23	Primi	38	90	332	335	72	38	Left
470	25	Multi	30	74	275	260	57	29	Left
471	30	Multi	34	83	305	301	65	34	Left
472	22	Primi	26	65	240	219	49	27	Right
473	24	Primi	29	72	265	248	55	28	Left
474	27	Primi	31	77	282	272	59	32	Left
475	20	Multi	25	62	230	209	46	25	Left

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
476	26	Primi	31	77	282	272	59	30	Left
477	31	Multi	39	92	340	345	73	39	Right
478	22	Primi	37	88	325	327	70	36	Right
479	22	Primi	40	95	345	355	75	40	Right
480	31	Multi	36	87	320	318	68	36	Left
481	23	Primi	38	90	332	335	72	38	Right
482	25	Multi	31	77	282	272	59	31	Right
483	29	Primi	33	81	298	290	63	34	Right
484	22	Primi	26	65	240	219	49	27	Left
485	23	Multi	29	72	265	248	55	29	Right
486	27	Primi	32	79	290	280	61	32	Right
487	19	Multi	24	60	222	207	43	25	Right
488	25	Primi	30	74	275	260	57	31	Right
489	33	Multi	39	92	340	345	73	38	Left
490	22	Primi	40	95	345	355	75	40	Left
491	23	Primi	38	90	332	335	72	37	Left
492	31	Multi	35	85	311	310	67	34	Right
493	23	Primi	38	90	332	335	72	38	Left
494	25	Multi	31	77	282	272	59	31	Left
495	30	Multi	34	83	305	301	65	34	Left
496	22	Primi	26	65	240	219	49	27	Right
497	24	Primi	29	72	265	248	55	30	Left
498	27	Primi	31	77	282	272	59	32	Left
499	20	Multi	25	62	230	209	46	25	Left
500	26	Primi	31	77	282	272	59	30	Left

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
501	33	Multi	39	92	340	345	73	38	Right
502	22	Primi	37	88	325	327	70	36	Right
503	22	Primi	40	95	345	355	75	40	Right
504	31	Multi	36	87	320	318	68	36	Left
505	25	Multi	31	77	282	272	59	31	Right
506	29	Primi	39	92	340	345	73	39	Right
507	30	Multi	34	83	305	301	65	34	Right
508	22	Primi	26	65	240	219	49	27	Left
509	23	Multi	29	72	265	248	55	29	Right
510	27	Primi	32	79	290	280	61	32	Right
511	19	Multi	24	60	222	207	43	25	Right
512	25	Primi	30	74	275	260	57	31	Right
513	33	Multi	40	95	345	355	75	40	Left
514	22	Primi	40	95	345	355	75	40	Left
515	23	Primi	38	90	332	335	72	37	Left
516	31	Multi	35	85	311	310	67	34	Right
517	23	Primi	38	90	332	335	72	38	Left
518	25	Multi	31	77	282	272	59	31	Left
519	30	Multi	34	83	305	301	65	34	Left
520	22	Primi	26	65	240	219	49	27	Right
521	24	Primi	29	72	265	248	55	30	Left
522	27	Primi	31	77	282	272	59	32	Left
523	20	Multi	25	62	230	209	46	26	Left
524	26	Primi	31	77	282	272	59	30	Left
525	33	Multi	39	92	340	345	73	38	Right

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
526	22	Primi	37	88	325	327	70	36	Right
527	22	Primi	40	95	345	355	75	40	Right
528	31	Multi	36	87	320	318	68	36	Left
529	25	Multi	31	77	282	272	59	31	Right
530	29	Primi	39	92	340	345	73	39	Right
531	30	Multi	34	83	305	301	65	34	Right
532	22	Primi	27	67	250	230	51	27	Left
533	24	Multi	29	72	265	248	55	29	Right
534	27	Primi	32	79	290	280	61	32	Right
535	19	Multi	24	60	222	207	43	25	Right
536	25	Primi	30	74	275	260	57	31	Right
537	33	Multi	40	95	345	355	75	40	Left
538	22	Primi	40	95	345	355	75	40	Left
539	23	Primi	38	90	332	335	72	37	Left
540	31	Multi	35	85	311	310	67	34	Right
541	23	Primi	39	92	340	345	73	39	Left
542	25	Multi	31	77	282	272	59	31	Left
543	30	Multi	34	83	305	301	65	34	Left
544	22	Primi	26	65	240	219	49	27	Right
545	24	Primi	29	72	265	248	55	30	Left
546	27	Primi	32	79	290	280	61	32	Left
547	20	Multi	25	62	230	209	46	26	Left
548	26	Primi	31	77	282	272	59	30	Left
549	33	Primi	40	95	345	355	75	40	Right
550	19	Primi	38	90	332	335	72	38	Right

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
551	22	Primi	40	95	345	355	75	40	Right
552	31	Multi	36	87	320	318	68	36	Left
553	25	Multi	31	77	282	272	59	31	Right
554	29	Primi	39	92	340	345	73	39	Right
555	30	Multi	34	83	305	301	65	34	Right
556	22	Primi	27	67	250	230	51	27	Left
557	24	Multi	29	72	265	248	55	29	Right
558	27	Primi	32	79	290	280	61	32	Right
559	19	Multi	24	60	222	207	43	25	Right
560	25	Primi	30	74	275	260	57	31	Right
561	33	Multi	40	95	345	355	75	40	Left
562	22	Primi	40	95	345	355	75	40	Left
563	23	Primi	38	90	332	335	72	37	Left
564	31	Multi	35	85	311	310	67	34	Right
565	23	Primi	39	92	340	345	73	39	Left
566	25	Multi	31	77	282	272	59	31	Left
567	30	Multi	34	83	305	301	65	34	Left
568	22	Primi	26	65	240	219	49	27	Right
569	24	Primi	29	72	265	248	55	30	Left
570	27	Primi	32	79	290	280	61	32	Left
571	20	Multi	25	62	230	209	46	26	Left
572	26	Primi	31	77	282	272	59	30	Left
573	33	Primi	40	95	345	355	75	40	Right
574	19	Primi	38	90	332	335	72	38	Right
575	22	Primi	40	95	345	355	75	40	Right

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
576	31	Multi	36	87	320	318	68	36	Left
577	25	Multi	31	77	282	272	59	31	Right
578	29	Primi	39	92	340	345	73	39	Right
579	30	Multi	34	83	305	301	65	34	Right
580	22	Primi	27	67	250	230	51	27	Left
581	24	Multi	29	72	265	248	55	29	Right
582	27	Primi	32	79	290	280	61	32	Right
583	19	Multi	24	60	222	207	43	25	Right
584	25	Primi	30	74	275	260	57	31	Right
585	33	Multi	40	95	345	355	75	40	Left
586	22	Primi	40	95	345	355	75	40	Left
587	23	Primi	38	90	332	335	72	37	Left
588	31	Multi	35	85	311	310	67	34	Right
589	23	Primi	39	92	340	345	73	39	Left
590	25	Multi	31	77	282	272	59	31	Left
591	30	Multi	34	83	305	301	65	33	Left
592	22	Primi	26	65	240	219	49	27	Right
593	24	Primi	29	72	265	248	55	30	Left
594	27	Primi	32	79	290	280	61	32	Left
595	20	Multi	25	62	230	209	46	26	Left
596	26	Primi	31	77	282	272	59	30	Left
597	33	Primi	40	95	345	355	75	40	Right
598	19	Primi	38	90	332	335	72	38	Right
599	22	Primi	40	95	345	355	75	40	Right
600	31	Multi	36	87	320	318	68	36	Left

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
601	25	Multi	31	77	282	272	59	31	Right
602	29	Primi	39	92	340	345	73	39	Right
603	30	Multi	34	83	305	301	65	34	Right
604	22	Primi	27	67	250	230	51	27	Left
605	24	Multi	29	72	265	248	55	28	Right
606	27	Primi	32	79	290	280	61	32	Right
607	20	Multi	24	60	222	207	43	25	Right
608	25	Primi	30	74	275	260	57	31	Right
609	33	Primi	40	95	345	355	75	40	Left
610	22	Primi	38	90	332	335	72	37	Left
611	22	Primi	40	95	345	355	75	40	Left
612	31	Multi	35	85	311	310	67	34	Right
613	23	Primi	39	92	340	345	73	39	Left
614	25	Multi	31	77	282	272	59	31	Left
615	30	Multi	34	83	305	301	65	33	Left
616	22	Primi	26	65	240	219	49	27	Right
617	24	Primi	29	72	265	248	55	30	Left
618	27	Primi	32	79	290	280	61	32	Left
619	20	Multi	25	62	230	209	46	26	Left
620	26	Primi	31	77	282	272	59	30	Left
621	33	Primi	40	95	345	355	75	40	Right
622	19	Primi	38	90	332	335	72	38	Right
623	22	Primi	40	95	345	355	75	40	Right
624	31	Multi	36	87	320	318	68	36	Left
625	25	Multi	31	77	282	272	59	31	Right

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
626	29	Primi	39	92	340	345	73	39	Right
627	30	Multi	34	83	305	301	65	34	Right
628	22	Primi	27	67	250	230	51	26	Left
629	24	Multi	29	72	265	248	55	28	Right
630	27	Primi	32	79	290	280	61	32	Right
631	20	Multi	24	60	222	207	43	25	Right
632	25	Primi	30	74	275	260	57	31	Right
633	33	Primi	40	95	345	355	75	40	Left
634	22	Primi	38	90	332	335	72	37	Left
635	22	Primi	40	95	345	355	75	40	Left
636	31	Multi	36	87	320	318	68	36	Right
637	23	Primi	39	92	340	345	73	39	Left
638	27	Multi	32	79	290	280	61	32	Left
639	30	Multi	34	83	305	301	65	33	Left
640	22	Primi	26	65	240	219	49	27	Right
641	24	Primi	29	72	265	248	55	30	Left
642	27	Primi	32	79	290	280	61	32	Left
643	20	Multi	25	62	230	209	46	26	Left
644	26	Primi	31	77	282	272	59	30	Left
645	33	Primi	40	95	345	355	75	40	Left
646	19	Primi	38	90	332	335	72	38	Right
647	22	Primi	40	95	345	355	75	40	Right
648	31	Multi	36	87	320	318	68	36	Left
649	25	Multi	31	77	282	272	59	30	Right
650	29	Primi	39	92	340	345	73	39	Right

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
651	30	Multi	34	83	305	301	65	34	Right
652	22	Primi	27	67	250	230	51	26	Left
653	24	Primi	29	72	265	248	55	28	Right
654	27	Primi	32	79	290	280	61	32	Right
655	20	Multi	24	60	222	207	43	25	Right
656	25	Primi	30	74	275	260	57	31	Right
657	33	Primi	40	95	345	355	75	40	Left
658	22	Primi	38	90	332	335	72	37	Left
659	22	Primi	40	95	345	355	75	40	Left
660	31	Multi	36	87	320	318	68	36	Right
661	27	Multi	32	79	290	280	61	32	Left
662	30	Multi	34	83	305	301	65	33	Left
663	24	Primi	29	72	265	248	55	30	Left
664	25	Primi	27	67	250	230	51	27	Right
665	27	Primi	32	79	290	280	61	32	Left
666	20	Multi	25	62	230	209	46	26	Left
667	33	Primi	40	95	345	355	75	40	Left
668	19	Primi	38	90	332	335	72	38	Right
669	22	Primi	40	95	345	355	75	40	Right
670	31	Multi	36	87	320	318	68	36	Left
671	27	Multi	32	79	290	280	61	32	Right
672	30	Multi	34	83	305	301	65	34	Right
673	22	Primi	27	67	250	230	51	26	Left
674	24	Primi	29	72	265	248	55	28	Right
675	27	Primi	32	79	290	280	61	32	Right

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
676	20	Multi	24	60	222	207	43	25	Right
677	33	Primi	40	95	345	355	75	40	Left
678	22	Primi	38	90	332	335	72	38	Left
679	31	Multi	36	87	320	318	68	36	Right
680	34	Multi	37	88	325	327	70	37	Left
681	27	Multi	32	79	290	280	61	32	Left
682	30	Multi	34	83	305	301	65	33	Left
683	22	Primi	27	67	250	230	51	26	Right
684	24	Primi	29	72	265	248	55	30	Left
685	25	Primi	30	74	275	260	57	30	Left
686	20	Multi	25	62	230	209	46	26	Left
687	33	Primi	40	95	345	355	75	40	Left
688	23	Primi	38	90	332	335	72	38	Right
689	31	Multi	36	87	320	318	68	36	Left
690	33	Multi	37	88	325	327	70	37	Right
691	27	Multi	32	79	290	280	61	33	Right
692	30	Multi	34	83	305	301	65	34	Right
693	22	Primi	27	67	250	230	51	26	Left
694	29	Primi	32	79	290	280	61	31	Right
695	20	Multi	25	62	230	209	46	26	Right
696	22	Primi	40	95	345	355	75	40	Left
697	32	Multi	36	87	320	318	68	36	Right
698	34	Multi	37	88	325	327	70	37	Left
699	27	Multi	32	79	290	280	61	31	Left
700	30	Multi	34	83	305	301	65	33	Left

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
701	22	Primi	27	67	250	230	51	26	Right
702	25	Primi	30	74	275	260	57	30	Left
703	20	Multi	25	62	230	209	46	26	Left
704	33	Multi	37	88	325	327	70	37	Left
705	31	Multi	36	87	320	318	68	36	Left
706	34	Multi	37	88	325	327	70	37	Right
707	27	Multi	32	79	290	280	61	33	Right
708	30	Multi	34	83	305	301	65	34	Right
709	22	Primi	27	67	250	230	51	26	Left
710	29	Primi	32	79	290	280	61	31	Right
711	20	Multi	25	62	230	209	46	26	Right
712	33	Multi	37	88	325	327	70	37	Left
713	32	Multi	36	87	320	318	68	36	Right
714	34	Multi	37	88	325	327	70	37	Left
715	27	Multi	32	79	290	280	61	33	Left
716	30	Multi	34	83	305	301	65	33	Left
717	22	Primi	27	67	250	230	51	26	Right
718	25	Primi	30	74	275	260	57	30	Left
719	20	Multi	25	62	230	209	46	26	Left
720	27	Multi	32	79	290	280	61	33	Right
721	32	Multi	36	87	320	318	68	36	Left
722	34	Multi	37	88	325	327	70	37	Right
723	27	Multi	32	79	290	280	61	33	Left
724	30	Multi	34	83	305	301	65	34	Right
725	22	Primi	27	67	250	230	51	26	Left

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
726	29	Primi	32	79	290	280	61	31	Right
727	20	Multi	26	65	240	219	49	27	Right
728	27	Multi	32	79	290	280	61	33	Right
729	32	Multi	36	87	320	318	68	36	Right
730	27	Multi	32	79	290	280	61	33	Left
731	30	Multi	34	83	305	301	65	33	Left
732	22	Primi	27	67	250	230	51	28	Right
733	20	Multi	25	62	230	209	46	26	Left
734	27	Multi	32	79	290	280	61	33	Right
735	32	Multi	36	87	320	318	68	36	Left
736	27	Multi	32	79	290	280	61	33	Left
737	30	Multi	34	83	305	301	65	34	Right
738	22	Primi	27	67	250	230	51	26	Left
739	20	Multi	26	65	240	219	49	27	Right
740	27	Multi	32	79	290	280	61	33	Right
741	32	Multi	36	87	320	318	68	36	Right
742	27	Multi	32	79	290	280	61	33	Left
743	30	Multi	34	83	305	301	65	33	Left
744	22	Primi	27	67	250	230	51	28	Right
745	20	Multi	25	62	230	209	46	26	Left
746	28	Primi	32	79	290	280	61	33	Right
747	32	Multi	36	87	320	318	68	36	Left
748	27	Primi	32	79	290	280	61	33	Left
749	30	Multi	34	83	305	301	65	34	Right
750	22	Primi	27	67	250	230	51	26	Left

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
751	20	Multi	26	65	240	219	49	27	Right
752	32	Multi	36	87	320	318	68	36	Right
753	30	Multi	34	83	305	301	65	33	Left
754	22	Primi	27	67	250	230	51	28	Right
755	20	Multi	25	62	230	209	46	26	Left
756	32	Multi	36	87	320	318	68	36	Left
757	30	Multi	34	83	305	301	65	34	Right
758	22	Primi	27	67	250	230	51	26	Left
759	20	Multi	26	65	240	219	49	27	Right
760	32	Multi	36	87	320	318	68	36	Right
761	30	Multi	34	83	305	301	65	33	Left
762	22	Primi	27	67	250	230	51	28	Right
763	20	Primi	25	62	230	209	46	26	Left
764	32	Multi	36	87	320	318	68	36	Left
765	30	Multi	34	83	305	301	65	34	Right
766	22	Multi	28	70	258	240	53	28	Left
767	25	Multi	26	65	240	219	49	27	Right
768	32	Multi	36	87	320	318	68	36	Right
769	30	Multi	34	83	305	301	65	35	Left
770	22	Primi	27	67	250	230	51	28	Right
771	20	Primi	25	62	230	209	46	26	Left
772	32	Multi	36	87	320	318	68	36	Left
773	30	Multi	34	83	305	301	65	34	Right
774	22	Multi	28	70	258	240	53	28	Left
775	20	Multi	25	62	230	209	46	26	Right

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
776	32	Multi	36	87	320	318	68	36	Right
777	30	Multi	34	83	305	301	65	35	Left
778	22	Primi	27	67	250	230	51	28	Right
779	20	Primi	25	62	230	209	46	26	Left
780	32	Multi	36	87	320	318	68	36	Left
781	30	Multi	34	83	305	301	65	35	Right
782	22	Multi	28	70	258	240	53	28	Left
783	20	Multi	25	62	230	209	46	26	Right
784	32	Multi	36	87	320	318	68	36	Right
785	30	Multi	34	83	305	301	65	35	Left
786	22	Primi	27	67	250	230	51	28	Right
787	20	Primi	25	62	230	209	46	26	Left
788	32	Multi	36	87	320	318	68	37	Left
789	30	Multi	34	83	305	301	65	35	Right
790	22	Multi	28	70	258	240	53	28	Left
791	20	Primi	25	62	230	209	46	24	Right
792	32	Multi	36	87	320	318	68	36	Right
793	30	Multi	34	83	305	301	65	35	Left
794	22	Primi	27	67	250	230	51	28	Right
795	20	Primi	25	62	230	209	46	26	Left
796	32	Multi	36	87	320	318	68	37	Left
797	30	Multi	34	83	305	301	65	35	Right
798	22	Multi	28	70	258	240	53	28	Left
799	20	Primi	25	62	230	209	46	24	Right
800	32	Multi	36	87	320	318	68	36	Right

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
801	30	Multi	34	83	305	301	65	35	Left
802	22	Primi	27	67	250	230	51	28	Right
803	20	Primi	25	62	230	209	46	26	Left
804	32	Multi	36	87	320	318	68	37	Left
805	30	Multi	34	83	305	301	65	35	Right
806	23	Multi	28	70	258	240	53	28	Left
807	20	Primi	25	62	230	209	46	24	Right
808	32	Multi	36	87	320	318	68	37	Right
809	30	Multi	34	83	305	301	65	35	Left
810	22	Primi	27	67	250	230	51	28	Right
811	20	Primi	25	62	230	209	46	26	Left
812	32	Multi	36	87	320	318	68	37	Left
813	30	Multi	34	83	305	301	65	35	Right
814	23	Multi	28	70	258	240	53	28	Left
815	20	Primi	25	62	230	209	46	24	Right
816	32	Multi	36	87	320	318	68	37	Right
817	30	Multi	34	83	305	301	65	35	Left
818	22	Primi	27	67	250	230	51	28	Right
819	20	Primi	25	62	230	209	46	26	Left
820	32	Multi	36	87	320	318	68	37	Left
821	30	Multi	34	83	305	301	65	35	Right
822	23	Multi	28	70	258	240	53	28	Left
823	20	Primi	25	62	230	209	46	24	Right
824	32	Multi	36	87	320	318	68	37	Right
825	30	Multi	34	83	305	301	65	35	Left

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
826	22	Primi	27	67	250	230	51	28	Right
827	20	Primi	25	62	230	209	46	26	Left
828	32	Multi	36	87	320	318	68	37	Left
829	30	Multi	34	83	305	301	65	35	Right
830	23	Multi	28	70	258	240	53	27	Left
831	20	Primi	25	62	230	209	46	24	Right
832	32	Multi	36	87	320	318	68	37	Right
833	30	Multi	35	85	311	310	67	35	Left
834	22	Primi	27	67	250	230	51	28	Right
835	20	Primi	25	62	230	209	46	26	Left
836	32	Multi	36	87	320	318	68	37	Left
837	30	Multi	34	83	305	301	65	35	Right
838	23	Multi	28	70	258	240	53	27	Left
839	21	Primi	25	62	230	209	46	24	Right
840	32	Multi	36	87	320	318	68	37	Right
841	30	Multi	35	85	311	310	67	35	Left
842	22	Primi	27	67	250	230	51	28	Right
843	20	Primi	25	62	230	209	46	26	Left
844	32	Multi	36	87	320	318	68	37	Left
845	30	Multi	34	83	305	301	65	35	Right
846	23	Multi	28	70	258	240	53	27	Left
847	21	Primi	25	62	230	209	46	24	Right
848	32	Multi	36	87	320	318	68	37	Right
849	30	Multi	35	85	311	310	67	35	Left
850	22	Multi	27	67	250	230	51	28	Right

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
851	20	Primi	25	62	230	209	46	26	Left
852	32	Multi	36	87	320	318	68	37	Left
853	30	Multi	34	83	305	301	65	35	Right
854	23	Primi	28	70	258	240	53	27	Left
855	21	Primi	25	62	230	209	46	24	Right
856	32	Multi	36	87	320	318	68	37	Right
857	30	Multi	35	85	311	310	67	35	Left
858	22	Multi	27	67	250	230	51	28	Right
859	20	Primi	25	62	230	209	46	26	Left
860	32	Multi	36	87	320	318	68	37	Left
861	31	Multi	35	85	311	310	67	35	Right
862	23	Primi	28	70	258	240	53	27	Left
863	21	Primi	25	62	230	209	46	24	Right
864	32	Multi	36	87	320	318	68	37	Right
865	30	Multi	35	85	311	310	67	35	Left
866	22	Multi	27	67	250	230	51	28	Right
867	20	Primi	25	62	230	209	46	26	Left
868	32	Multi	36	87	320	318	68	37	Left
869	31	Multi	35	85	311	310	67	35	Right
870	23	Primi	28	70	258	240	53	29	Left
871	21	Primi	25	62	230	209	46	24	Right
872	32	Multi	36	87	320	318	68	37	Right
873	30	Multi	35	85	311	310	67	35	Left
874	22	Multi	27	67	250	230	51	28	Right
875	21	Primi	25	62	230	209	46	24	Left

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
876	32	Multi	36	87	320	318	68	37	Left
877	31	Multi	35	85	311	310	67	35	Right
878	23	Primi	28	70	258	240	53	29	Left
879	21	Primi	25	62	230	209	46	24	Right
880	32	Multi	36	87	320	318	68	37	Right
881	30	Multi	35	85	311	310	67	35	Left
882	22	Multi	27	67	250	230	51	28	Right
883	21	Primi	25	62	230	209	46	24	Left
884	32	Multi	36	87	320	318	68	37	Left
885	31	Multi	35	85	311	310	67	35	Right
886	23	Primi	28	70	258	240	53	29	Left
887	21	Primi	25	62	230	209	46	24	Right
888	32	Multi	36	87	320	318	68	37	Right
889	30	Multi	35	85	311	310	67	35	Left
890	22	Multi	27	67	250	230	51	28	Right
891	21	Primi	25	62	230	209	46	24	Left
892	32	Multi	36	87	320	318	68	37	Left
893	31	Multi	35	85	311	310	67	35	Right
894	23	Primi	28	70	258	240	53	29	Left
895	21	Primi	25	62	230	209	46	24	Right
896	32	Multi	36	87	320	318	68	37	Right
897	30	Multi	35	85	311	310	67	35	Left
898	22	Multi	27	67	250	230	51	28	Right
899	21	Primi	25	62	230	209	46	24	Left
900	33	Multi	36	87	320	318	68	35	Left

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
901	31	Multi	35	85	311	310	67	35	Right
902	23	Primi	28	70	258	240	53	29	Left
903	21	Multi	26	65	240	219	49	25	Right
904	33	Multi	36	87	320	318	68	37	Right
905	30	Multi	35	85	311	310	67	35	Left
906	22	Multi	27	67	250	230	51	28	Right
907	21	Primi	25	62	230	209	46	24	Left
908	33	Primi	36	87	320	318	68	35	Left
909	31	Multi	35	85	311	310	67	35	Right
910	23	Primi	28	70	258	240	53	29	Left
911	21	Multi	26	65	240	219	49	25	Right
912	33	Multi	36	87	320	318	68	35	Right
913	30	Multi	35	85	311	310	67	35	Left
914	22	Multi	27	67	250	230	51	28	Right
915	21	Primi	25	62	230	209	46	24	Left
916	33	Primi	36	87	320	318	68	35	Left
917	31	Multi	35	85	311	310	67	35	Right
918	23	Primi	28	70	258	240	53	29	Left
919	21	Multi	26	65	240	219	49	25	Right
920	33	Multi	36	87	320	318	68	35	Right
921	30	Multi	35	85	311	310	67	35	Left
922	23	Primi	28	70	258	240	53	27	Right
923	21	Primi	25	62	230	209	46	24	Left
924	33	Primi	36	87	320	318	68	35	Left
925	31	Multi	35	85	311	310	67	35	Right

GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida

Sl No	Age (year)	Gravida	GA as per CRL(weeks)	Sonographic fetal biometric parameters for gestational age determination				Fetal Kidney Length	
				BPD (mm)	HC (mm)	AC (mm)	FL (mm)	FKL (mm)	Imaged kidney
926	23	Primi	28	70	258	240	53	29	Left
927	21	Multi	26	65	240	219	49	25	Right
928	33	Multi	36	87	320	318	68	35	Right
929	30	Multi	35	85	311	310	67	35	Left
930	23	Primi	28	70	258	240	53	27	Right
931	21	Primi	25	62	230	209	46	24	Left
932	33	Primi	36	87	320	318	68	35	Left
933	31	Multi	35	85	311	310	67	35	Right
934	23	Primi	28	70	258	240	53	29	Left
935	21	Multi	26	65	240	219	49	25	Right
936	33	Multi	36	87	320	318	68	35	Right
937	31	Multi	35	85	311	310	67	36	Left
938	23	Primi	28	70	258	240	53	27	Right
939	21	Primi	25	62	230	209	46	24	Left



GA=Gestational Age; CRL= Crown Rump Length; BPD= Biparietal diameter; HC= Head circumference; AC= Abdominal circumference; FL= Femoral length; FKL = Fetal Kidney Length; Primi= Primi Gravida; Multi= Multi Gravida