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## OBSTETRICS

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# Third Trimester Reference Values of Amniotic Fluid Index in a Group of Healthy Nigerian Women in Jos, Nigeria

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### ABSTRACT

**Objectives:** To ascertain the normal values of amniotic fluid index in third trimester among Nigerian women with uncomplicated singleton pregnancies in Jos, Nigeria.

**Materials and Methods:** This was a prospective cross-sectional study among 500 healthy pregnant women. Fifty women each were recruited at two-weekly interval from 28-36 weeks' gestation and then weekly up to 41 weeks' gestation. The uterine cavity was divided into four quadrants and using real-time ultrasonography, the vertical diameter of the largest pool of amniotic fluid was measured and summation of the values gave the amniotic fluid index (AFI). Mean, ranges, 5<sup>th</sup>, 10<sup>th</sup>, 50<sup>th</sup>, 90<sup>th</sup> and 95<sup>th</sup> percentiles for each gestational age were calculated using SPSS version 20 (IBM, Armonk, NY, USA).

**Results:** Mean AFI among the entire study population was 18.1±3.1 cm (range of 10.4-26.8 cm) while the mean AFI for preterm and term pregnancies were 18.5±2.6 cm and 17.8±3.5 cm respectively. The AFI reference range for the study population was 13.6-24.6 cm. Amniotic fluid volume was highest at 28 weeks, stabilized and plateau between 37-39 weeks and declined after 40 weeks' gestation. Using 5<sup>th</sup> and 95<sup>th</sup> percentile as lower and upper limits of normal, reference ranges for each gestational age was ascertained.

**Conclusion:** Third trimester reference ranges of AFI is established and this can be used as a guide for evaluation of amniotic fluid volume in this obstetric population.

**Keywords:** amniotic fluid index, pregnancy, reference ranges, Nigeria

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## Introduction

Antepartum fetal surveillance with the aim of detecting fetuses that are in distress or compromised by adverse obstetric factors so as to effect timely delivery is essential in preventing or reducing perinatal morbidity and mortality<sup>(1,2)</sup>. Assessment of amniotic fluid volume is an important component of modified biophysical profile, a useful method for assessment of fetal wellbeing<sup>(2,3)</sup>. Amniotic fluid surrounds the fetus throughout pregnancy providing nutrition, supporting and helping in the development of fetal lungs. Its volume is an important indicator of in-utero fetal wellbeing and this makes its quantification an important means of antenatal fetal assessment<sup>(4,5)</sup>. Amniotic fluid volume is largely determined by balance between fetal urine production and fluid resorption through fetal swallowing in the third trimester<sup>(2,4)</sup>.

Variations in amniotic fluid volumes may be a reflection of fetal compromise and are predictive of perinatal morbidity and mortality<sup>(1,4)</sup>. Extreme changes in amniotic volumes are often associated with poor pregnancy outcomes<sup>(1,2)</sup>. Some maternal and fetal medical conditions including diabetes mellitus, hypertensive disorders in pregnancy, placental insufficiency, intra-uterine growth restriction and fetal renal and gastro-intestinal anomalies<sup>(5-7)</sup> are associated with abnormalities in amniotic fluid volumes. Different methods are used for the assessment of amniotic fluid volume including palpation, amniocentesis with dye dilution and ultrasonography<sup>(7-9)</sup>. Ultrasound assessment of amniotic fluid especially changes in its volumes is an essential and integral component of pregnancy assessment in modern obstetric practice<sup>(4,7)</sup>.

This study was undertaken to establish the normal reference ranges of amniotic fluid volume in third trimester among a group of Nigerian women with uncomplicated singleton pregnancies because of the importance of amniotic fluid to the fetus and its volume as a marker of fetal wellbeing. This will enhance the detection of abnormalities in amniotic fluid volumes among high risk pregnancies leading

to timely interventions and thereby saving the fetuses from intra-uterine death.

## Materials and Methods

This was a prospective cross-sectional study of amniotic fluid volumes among 500 healthy pregnant women with singleton pregnancy between 28-41 weeks of gestation attending antenatal care at the Bingham University Teaching hospital, Jos between January and December 2017. Fifty pregnant women each were recruited consecutively at 2-weekly intervals at 28, 30, 32, 34, and 36 weeks' gestation and then weekly at term from 37, 38, 39, 40 and 41 weeks of gestation. Consent was obtained verbally. Inclusion criteria included consenting women with low risk pregnancy and reliable last menstrual period with dates correlating with ultrasound estimated gestational age done within the first half of pregnancy. Women with hypertensive disorders in pregnancy, pre-gestational or gestational diabetes mellitus, intrauterine growth restriction, fetal congenital abnormalities, preterm births as well as those with other medical or obstetric conditions were excluded from the study. Women at 42 weeks of gestation were also not included as we routinely induce labor for pregnancy beyond 41 weeks in our centre.

The amniotic fluid index of recruited women grouped according to gestational ages was assessed using portable Mindray(R) DP-2200 (Shenzhen Mindray Bio-medical Electronics Co Ltd, China 2010) ultrasound machine with a Curvilinear 3.5 MHz transducer. Each subject was scanned in supine position by the same sonographer to reduce inter-observer error using the method describes by Phelan et al<sup>(10)</sup>. The uterus was arbitrarily divided into four quadrants using the linea nigra as a vertical line and a transverse line at the level of the umbilicus. In each of these quadrants, the transducer was placed in sagittal plane perpendicular to patient's abdomen and maximum vertical depth of amniotic fluid was measured in centimeters after excluding presence of fetal parts or loops of

umbilical cord. The summation of the values from the four quadrants gave the amniotic fluid index (AFI).

Data was entered into and analyzed descriptively to ascertain the mean, standard deviation, and percentile values of AFI for each group at the various gestational age using SPSS version 20 (IBM, Armonk, NY, USA). Percentile values (5<sup>th</sup>, 50<sup>th</sup> and 95<sup>th</sup>) were plotted using Microsoft Excel 2010 (Microsoft, Redmond, WA, USA) for the selected gestational ages. Ethical clearance for the study was granted by the Human Research and Ethics Committee of Bingham University Teaching Hospital, Jos.

## Results

The mean age of the recruited women was 30.6 ±5.4 years with a range of 22-41 years. Ten percent of the women were primigravidae, 76.0% and 13.0% were of gravidity 2-4 and ≥ 5 respectively. Majority of the women (73.3%) were multiparous while 16.7% and 10.0% were primiparous and nulliparous respectively.

The mean late trimester AFI among the study population was 18.1±3.1 cm with a range of 10.4-26.8 cm. The mean AFI for preterm and term

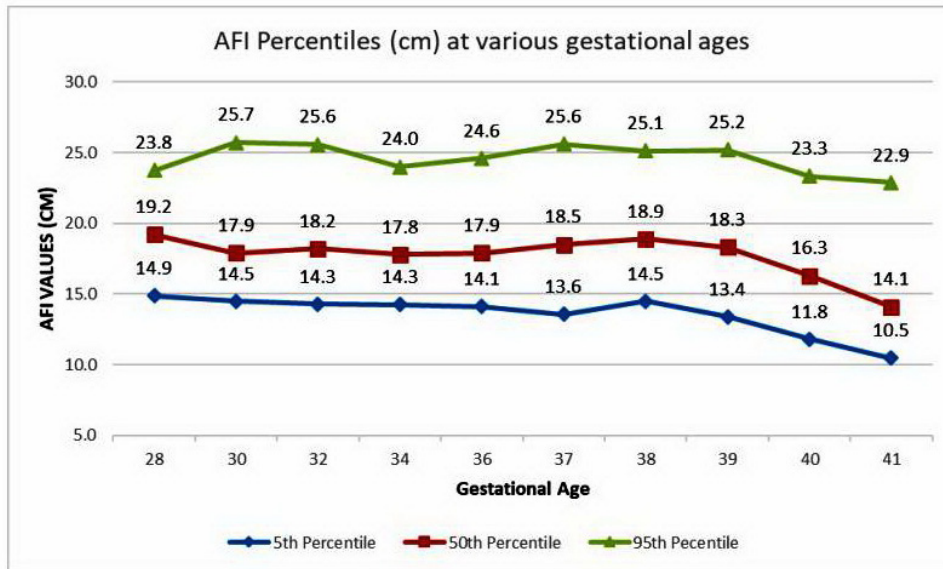
pregnancies were 18.5 ± 2.6 cm and 17.8 ± 3.5 cm respectively. The overall average normal range of AFI among the study population was 13.6-24.6 cm when the 5<sup>th</sup> and 95<sup>th</sup> percentiles were used as lower and upper limits respectively. Table 1 depicts the descriptive statistics of the AFI among the women. The 5<sup>th</sup>, 50<sup>th</sup>, and 95<sup>th</sup> percentiles ranged from 14.9, 19.2 and 23.8 cm respectively at 28 weeks gestation to 10.5, 14.1 and 22.9 cm respectively at 41 weeks gestation.

The trend of AFI in the study population showed that amniotic fluid volume was highest at 28 weeks of gestation and later stabilized and plateau between 37-39 weeks of gestation. Thereafter, there was decline in volumes with lowest volume noted at 41 weeks' gestation (Table 1). Between 28 and 40 weeks of gestation (12 weeks period), there was 10.4% decrease in mean AFI while the decline between 40 and 41 weeks (one week interval) of gestation was 8.7%. Fig 1 shows the pattern of decline in AFI with increasing gestational age. Table 2 shows the reference ranges (5<sup>th</sup> and 95<sup>th</sup> percentiles as lower and upper values respectively) of amniotic fluid index in late trimester in the study population.

**Table 1.** AFI parameters (cm) at various gestational ages; mean, standard deviation, percentile values.

Gestational age (weeks)	Mean	Standard deviation	5 <sup>th</sup> Percentile	10 <sup>th</sup> Percentile	50 <sup>th</sup> Percentile	90 <sup>th</sup> Percentile	95 <sup>th</sup> Percentile
28	19.3	2.4	14.9	15.9	19.2	22.6	23.8
30	18.5	2.8	14.5	14.9	17.9	22.0	25.7
32	18.9	3.1	14.3	14.8	18.2	24.4	25.6
34	17.9	2.6	14.3	14.9	17.8	22.3	24.0
36	17.9	2.3	14.1	14.5	17.7	21.6	24.6
37	18.8	3.4	13.6	14.4	18.5	24.1	25.6
38	18.4	3.1	14.5	15.2	18.9	24.3	25.1
39	18.6	3.6	13.4	14.2	18.3	24.2	25.2
40	17.3	3.4	11.8	13.0	16.3	22.2	23.3
41	15.8	3.8	10.5	10.6	14.1	21.5	22.9

AFI: amniotic fluid index



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**Fig. 1.** Graphical representation of AFI (cm) at 5<sup>th</sup>, 50<sup>th</sup> and 95<sup>th</sup> percentiles at various gestational ages.

**Table 2.** Reference ranges of AFI at various gestational ages among the study population.

Gestational age (weeks)	Reference Ranges (cm)	
	Lower range	Upper range
28	14.9	23.8
30	14.5	25.7
32	14.3	25.6
34	14.3	24.0
36	14.1	24.6
37	13.6	25.6
38	14.5	25.1
39	13.4	25.2
40	11.8	23.3
41	10.5	22.9

AFI: amniotic fluid index

## Discussion

Assessment of amniotic fluid volume is a very important modality for ascertaining fetal wellbeing. Hence the need to establish the normal values in any obstetric population as its abnormalities are associated

with adverse pregnancy outcomes. The mean AFI among our subjects was  $18.1 \pm 3.1$  cm with a range of 10.4-26.8 cm. This was slightly greater than mean values of  $14.07 \pm 3.34$  cm and  $13.85 \pm 3.61$  cm reported among pregnant women in Northeastern Thailand and

Southern Nigeria respectively<sup>(12,15)</sup>. This may be attributed to differences in obstetric populations, methodology and different gestational ages the women were recruited for the study as other researchers included women from 20 weeks of gestation in their studies. In our study, the mean AFI of 19.3 cm at 28 weeks gestation was highest, remain relatively stable up to 40 weeks gestation and then dropped to 15.8 cm at 41 weeks' gestation. However, there was no appreciable difference between the mean AFI for preterm and term gestations among our subjects. This trend in amniotic fluid volume among healthy pregnant women was also noted by other researchers elsewhere<sup>(6,12,13,15,16)</sup>. These similar trends are probably a reflection of normal physiological changes in amniotic fluid volumes in pregnant women irrespective of obstetric population, race and geographical location. Also, the physiological fall in amniotic fluid volume after 40 weeks' gestation as noted also in this study was probably ascribed to gradual reduction in fetal urine production as a result of decreasing fetal growth and placental function<sup>(17)</sup>. This trend was also noted among different obstetric populations by other researchers<sup>(6,10,12,15)</sup>.

Comparing the 50th percentile in this study with previous figures reported from different regions and

ethnic groups, our values were higher compared to values reported from Iranian, Thai, Nigerian (Igbo ethnic group) and Chinese obstetric populations<sup>(11-14)</sup> (Table 3). These findings suggested that racial and environmental factors may influence amniotic volume among pregnant women. Different normal ranges of AFI among healthy pregnant women have been reported by many researchers but reference values of 5.0-25.0 cm reported by Moore and Cayle as well as Magann EF et al have been widely used suggesting values < 5.0 cm and > 25.0 cm as oligohydramnios and polyhydramnios respectively<sup>(9,18)</sup>. The overall normal range of AFI among our subjects was 13.6- 24.6 cm when 5<sup>th</sup> and 95<sup>th</sup> percentiles are used as lower and upper limits of normal. Hence, values indicating oligohydramnios and polyhydramnios in our study were different from other studies<sup>(9, 12, 19 - 21)</sup>. This is a reflection of the fact that there are wide variations in reference standards for AFI in different obstetric populations, race and geographical locations. Establishment of normal reference values of AFI for a particular obstetric population cannot be over-emphasized as abnormalities in amniotic fluid volume especially oligohydramnios are associated with higher rate of caesarean deliveries due to fetal distress, meconium aspiration and poor perinatal outcomes<sup>(1,2,22,23)</sup>.

**Table 3.** Comparison of 50<sup>th</sup> percentile of the AFI with others from different ethnic groups.

Gestational age (weeks)	Present Study 2018	Birang SH 2008 <sup>(11)</sup>	Samakeenit B, et al 2015 <sup>(12)</sup>	Agwu EJ, et al 2016 <sup>(13)</sup>	Mongelli M, et al 1999 <sup>(14)</sup>
28	19.2	14.5	14.3	15.4	13.6
30	17.9	14.5	13.9	15.2	13.9
32	18.2	14.3	12.7	12.8	13.9
34	17.8	14.0	14.9	12.7	13.6
36	17.7	12.9	12.9	12.4	13.1
37	18.5	13.0	12.0	11.7	12.7
38	18.9	13.0	11.9	11.6	12.2
39	18.3	12.9	10.9	11.4	--
40	16.3	12.7	11.7	10.6	---
41	14.1	11.1	-	10.4	----

AFI: amniotic fluid index

Also from our results, there was appreciable decline in amniotic fluid index after 40 weeks of gestation (5<sup>th</sup> percentile was 10.5 cm at 41 weeks' gestation) compared to degrees of changes in AFI between earlier gestational ages. This remarkable change in AFI at 41 weeks of gestation was also noted by other researchers<sup>(11,12,21,24,25)</sup>. This suggests that the need for delivery of the fetus after 41 weeks' gestation is essential among our study population to reduce the risk of perinatal morbidity and mortality.

Limitations of this study included its cross-sectional nature instead of a longitudinal design as well as non-consideration of possible confounding variables such as maternal obesity in the study. Another limitation of the study was non recruitment of subjects at 29, 31, 33, and 35 weeks as the study was set out to determine AFI at even numbers gestational ages before term. However, the strengths of the study included its prospective nature and ultrasonographic scanning by the same sonographer thereby avoiding inter-observer bias.

## Conclusion

The normal reference values for AFI in this obstetric population are established and can be used as a guide for the diagnosis of oligohydramnios and polyhydramnios. Large multicentre study across different regions in Nigeria is recommended to estimate more accurate AFI reference values among pregnant Nigerian women.

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## Potential conflicts of interest

The authors declare no conflict of interest.

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