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Comparison of Mid arm circumference , Ponderal index and MAC/HC ratio to find the reliable parameter for identification of intrauterine growth restricted babies-CROSS SECTIONAL STUDY.

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ABSTRACT:

BACKGROUND:All over the world ,approximately 10-15%of all pregnancies are impacted by intrauterine growth restriction, resulting in babies who are twenty times more likely to experience neonatal deaths than those with normal birth weights. Despite numerous perinatal programs in our country, the incidence of low birth weight babies in India remains at around 30%.

AIM: 1.To study the anthropometric measurements of small for gestational age babies born between 28 weeks to 42 weeksof gestation and to determine if these anthropometric parameters has correlation and can be used as a screening toolfor detecting growth restricted babies, admitted in RL JalappaHospital.

MATERIALS AND METHODS:A cross sectional study of comparison of mid arm circumference , ponderal index and MAC/HC ratio to find the reliable parameter for identificationof intrauterine growth restricted babies in all SGA babies admitted in RL Jalappa Hospital,Tamaka,Karnataka,India.

RESULTS:A total of 254 SGA babies are included in thisstudy, out of which 133(52.36%) were female babies and121(47.64%) were male babies. Among the study population hypertension was the leading comorbidity causing SGA babies noted in 115(45.28%).The highest correlation among all measurements was observed between birth weight and midarm circumference.Mid arm circumference shows that it is a better predictor of SGA babies in our study as compared to other anthropometric parameters.

CONCLUSION:Measurement of mid arm circumference is easier, convenient and statistically superior to other anthropometrical parameters in detection of low birth weight newborn babies.

KEYWORDS:IUGR, mortality, anthropometry,neonates.

INTRODUCTION: Intrauterine growth restriction (IUGR), also known as fetal growth restriction, refers to the impaired growth velocity of a fetus while developing in the womb during the gestation period. This condition arises when the fetus fails to attain its full genetic growth potential due to a harmful environment during pregnancy, resulting in a decrease in fetal growth velocity. [1]. IUGR may result from maternal, placental or fetal origin [2]. Birth weight plays a significant role in determining foetal, neonatal, and post neonatal mortality rates, as well as infant and child morbidity[3]. India still has a high rate of low birth weight babies ,30% compared to affluent nations 5-7% rate.[4]. India has the highest incidence of low

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birth-weight (LBW) with nearly 8 million annually[5]. In India, the first month of life accounts for 50–60% of all baby mortality.Of them, over halfcould pass away in the first week following delivery, with thefirst 24 to 48 hours following delivery carrying the highest danger. LBW newborns account for more than 70% of prenatal mortality, 85% of neonatal deaths, and 30% of infantdeaths [6]. Over 80% of all neonatal deaths, in both the developed and developing countries, occur among the
LBW babies[7].

Henceforth, it becomes important to study the prevalence of SGA babies and need for early identification of SGA babies for treatment. The most accessible, globally applicable, affordable, non-invasive, and skill-free technique for determining body composition is anthropometry, which predicts survival, performance, and health while reflecting thestate of the human body's nutrition and overall health.
Therefore this study was conducted to measure the anthropometry of intrauterine growth restricted babies and tocompare the anthropometric measurements to find out the reliable parameters.

MATERIALS AND METHODS:
This is a cross sectional study conducted on SGA/IUGR babies delivered between 28 to 42 weeks of gestation admitted in department of pediatrics, RL Jalappa hospital kolar.
The study was proceeded after taking the institutionalethical clearance, with the certificate number being DMC/KLR/IEC/195/2022-23.
Study was done from september 2022 to august 2023 to compare parameters of mid arm circumference , ponderal index and MAC/HC ratio to find the reliable parameter for identification of intrauterine growth restricted babies .
Babies born between 28 weeks to 42 weeks gestation estimatedby using new ballard score.
The weight will be obtained with the naked baby in dorsal decubitus, soon after birth still in the delivery room, using an electronic balance. All measurement will be done after taking adequate precautions to prevent hypothermia at 24 to 48 hoursof life.
The mid-arm and head circumference will be measured withinthe first 48 hours of life, using a fiberglass non-expandable measuring tape.
The mid-arm circumference will be obtained from the left arm, at the midpoint between the acromion and olecranon, with the new-born in dorsal decubitus position with the arm lying laterally to the trunk and elbow flexed at an angle of 90º.
The head circumference will be measured with the new-born indorsal decubitus position with the measuring tape placed alongthe occipito-frontal circumference.
The ponderal index is calculated by using the followingformula: weight in grams X 100/length(cm^3).

Gestation was considered as outcome variable.

Length (Cms), head circumference (Cms), mid arm circumference (Cms), ponderal index, mode of delivery were considered as explanatory variable.

Gender, weight (kg), comorbidities etc, were considered as study relevant variable.

Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency and proportion for categorical variables. Data was also represented using appropriate diagrams like pie chat, bar chart, cluster bar chart, boxplot.
All quantitative variables were checked for normal distribution within each category of explanatory variable by using visual inspection of histograms and normality Q-Q plots.

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Shapiro- wilk test was also conducted to assess normal distribution. Shapiro wilk test p value of >0.05 was considered as normal distribution.

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For normally distributed quantitative parameters the mean values were compared across study groups using ANOVA (more than 2 groups (Term, Late preterm and Preterm)). For non-normally distributed Quantitative parameters, Medians and Interquartile range (IQR) were compared between study groups using Kruskal Wallis Test. (>2 groups).
For non-normally distributed association between quantitative explanatory and outcome variables was assessed by calculating spearman correlation coefficient and the data was represented in a scatter diagram.
Categorical outcomes were compared between study groups using Chi square test.
P value < 0.05 was considered statistically significant.Data was analysed by using coGuide software:

1. BDSS Corp. Released 2020. coGuide Statistics software,Version 1.0, India: BDSS corp.

RESULTS:

A total of 254 subjects were included in the final analysis.

Table 1: Descriptive analysis of gender of baby in thestudy population (N=254)

Gender of baby	Frequency	Percentage
Male	121	47.64%
Female	133	52.36%

Among the study population, 121 (47.64%) participants were male and remaining 133 (52.36%) participants were female. (Table 1 and Figure 1)

Figure 1: Pie Chart of Gender of baby

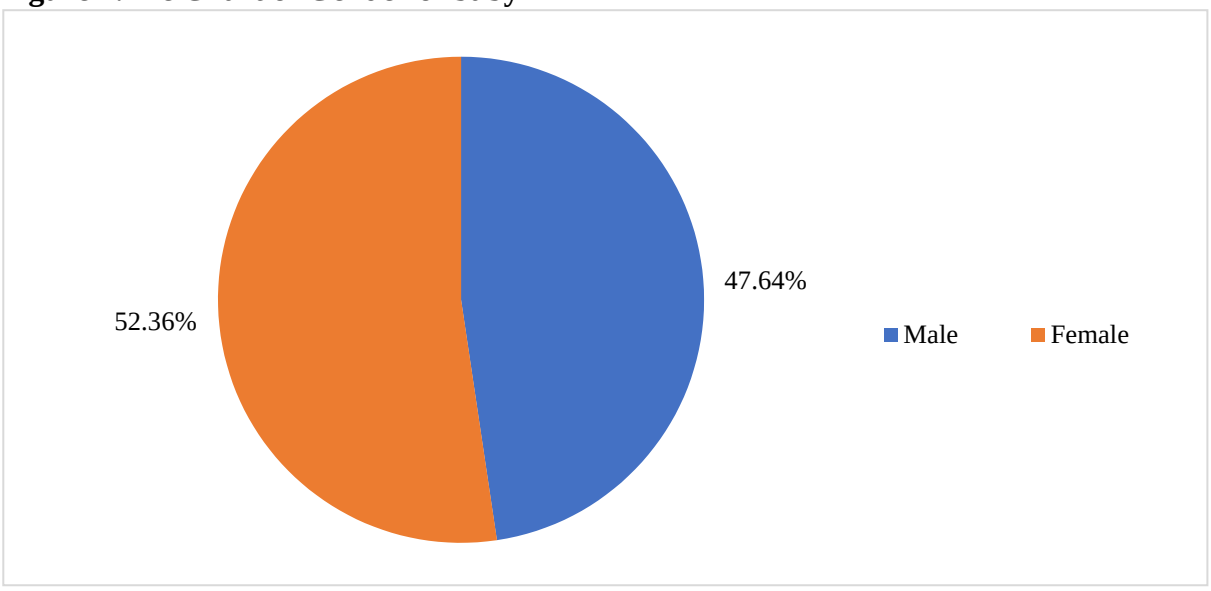

Table 2: Descriptive analysis of Weight (kg) in the study population(N=254).

Name	Mean ± S. D	Median	Minimum	Maximum	95% CI	
					Lower CI	Upper CI

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Weight (kg)	2.16±0.41	2.24	0.94	2.92	2.11	2.21

Table 3: Descriptive analysis of comorbidities

Comorbidities	Frequency	Percentage
Hypertension	115	45.28%
Gestational Diabetes	3	1.18%
Term Pregnancy	21	8.27%
Miscellaneous	31	12.20%
No Cause	84	33.07%

Miscellaneous:twin pregnancy,Rh negative pregnany,hypothyroid mother.

Figure 2: Bar chart of comorbidities

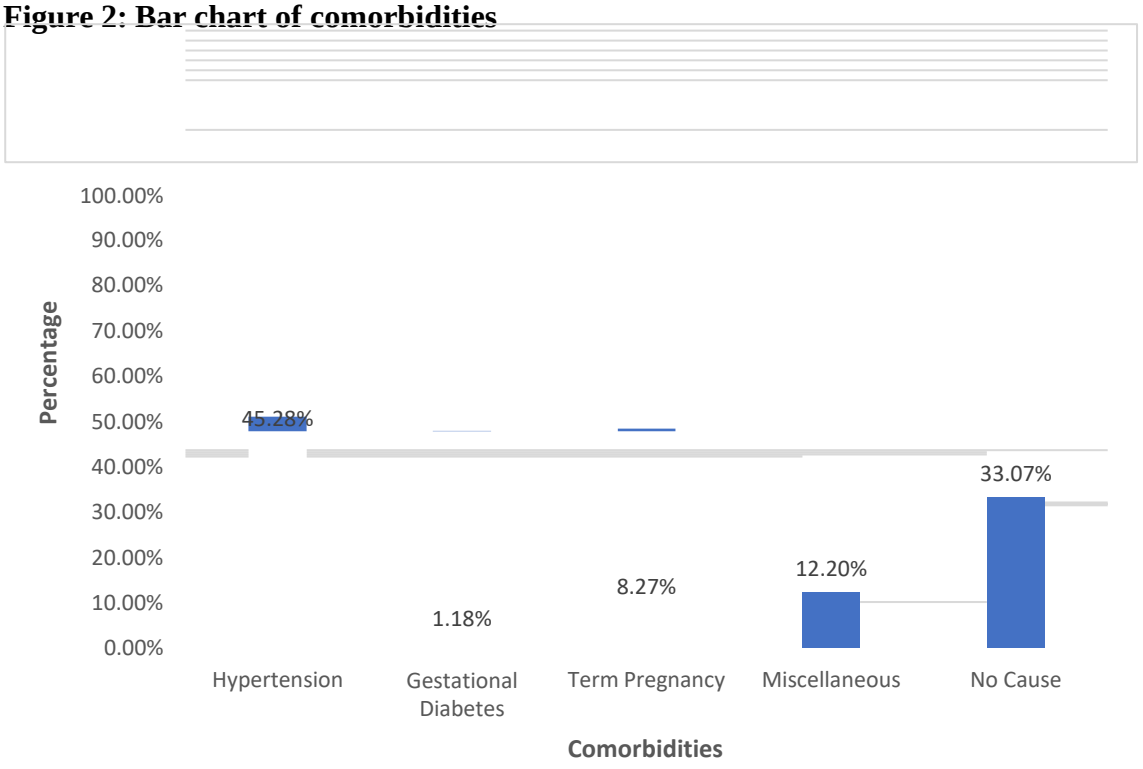

Table 4: Descriptive analysis of Mode of delivery

Mode of delivery	Frequency	Percentage
LSCS	164	64.57%
NVD	78	30.71%
Assisted Vaginal delivery	12	4.72%

In the study population, the Number of women with Mode of deliverywas LSCS in 164 (64.57%), NVD in 78 (30.71%) and Assisted Vaginal delivery in 12 (4.72%). (Table 4 & fig 3)

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Figure 3: Pie chart of mode of delivery

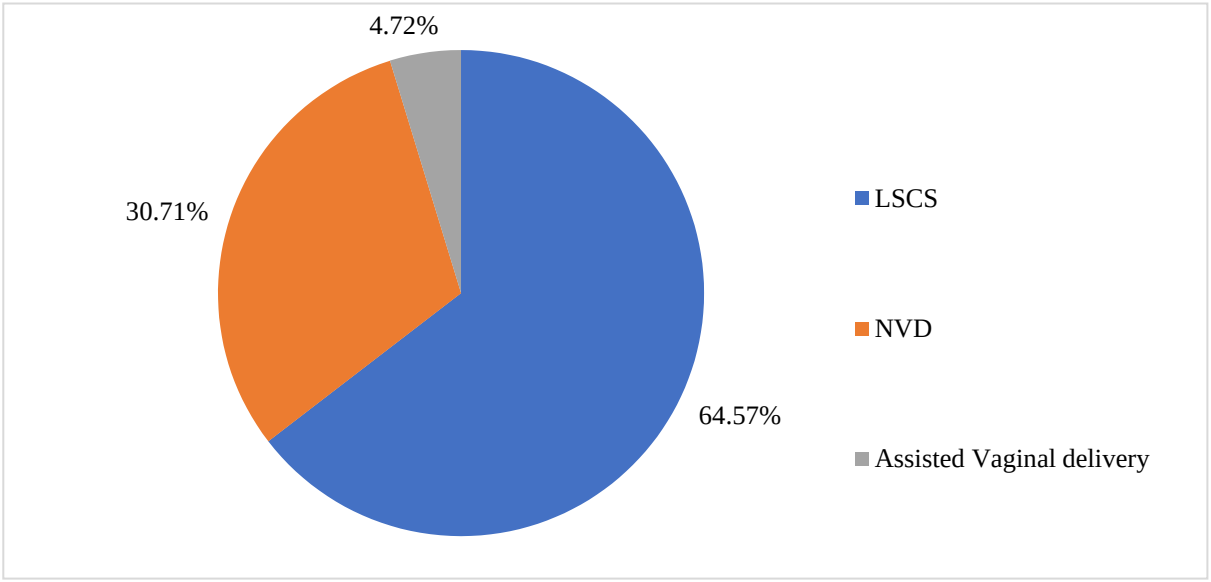

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Table 5: Descriptive analysis of Gestation

Gestation	Frequency	Percentage
Term	196	77.17%
Late preterm	47	18.50%
Preterm	11	4.33%

Figure 4: Bar chart of gestation

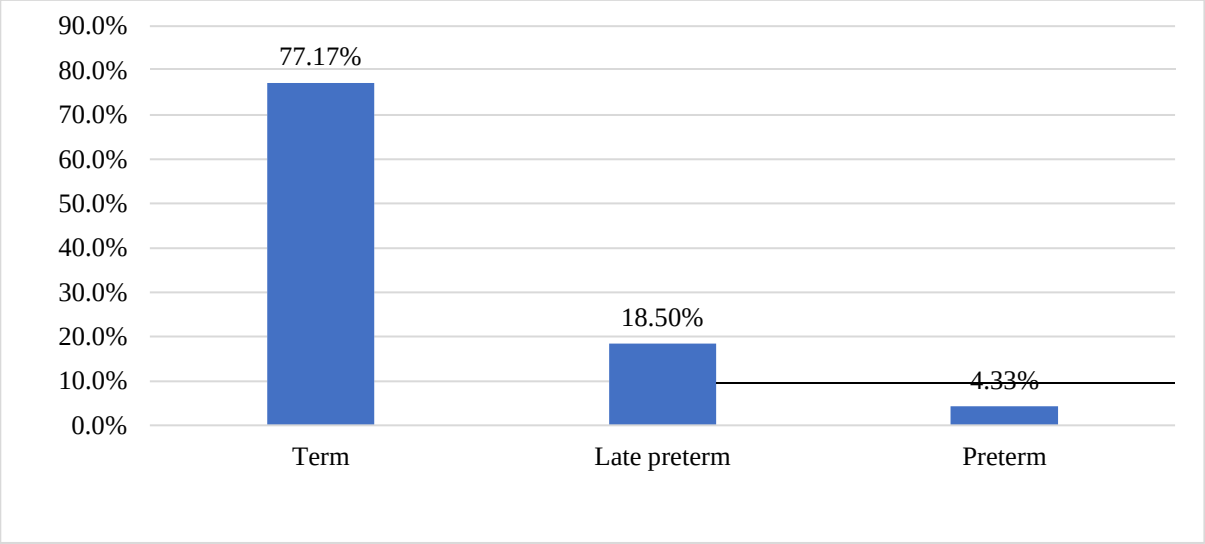

Table 6: Descriptive analysis of Length (Cms)

Name	Mean ± S. D	Median	Minimum	Maximum	95% CI	
					Lower CI	Upper CI
Length (Cms)	46.10±2.56	46.00	36.00	52.00	45.78	46.41

The mean Length (Cms) was 46.10±2.56 in the study population. Ranged between 36.00 cm to 52cm (95% CI 45.78to 46.41).

Table 7: Descriptive analysis of Head Circumference

Name	Mean ± S. D	Median	Minimum	Maximum	95% CI	
					Lower CI	Upper CI
Head Circumference (Cms)	33.01±1.49	33.00	26.00	37.00	32.82	33.19

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Table 8: Descriptive analysis of Mid Arm Circumference (Cms)

Name	Mean ± S. D	Median	Minimum	Maximum	95% CI	
					Lower CI	Upper CI
Mid Arm Circumference (Cms)	8.78±1.36	9.00	5.50	12.00	8.61	8.94

Table 9: Descriptive analysis of Mid Arm Circumference/HeadCircumference Ratio

Name	Mean ± S. D	Median	Minimum	Maximum	95% CI	
					Lower CI	Upper CI
Mid Arm Circumference/Head Circumference Ratio	0.26±0.03	0.26	0.19	0.34	0.26	0.26

Table 10: Descriptive analysis of Ponderal Index

Ponderal Index	Frequency	Percentage
Symmetrical IUGR	207	81.50%
Asymmetrical IUGR	47	18.50%

Figure 5: Bar chart of ponderal index

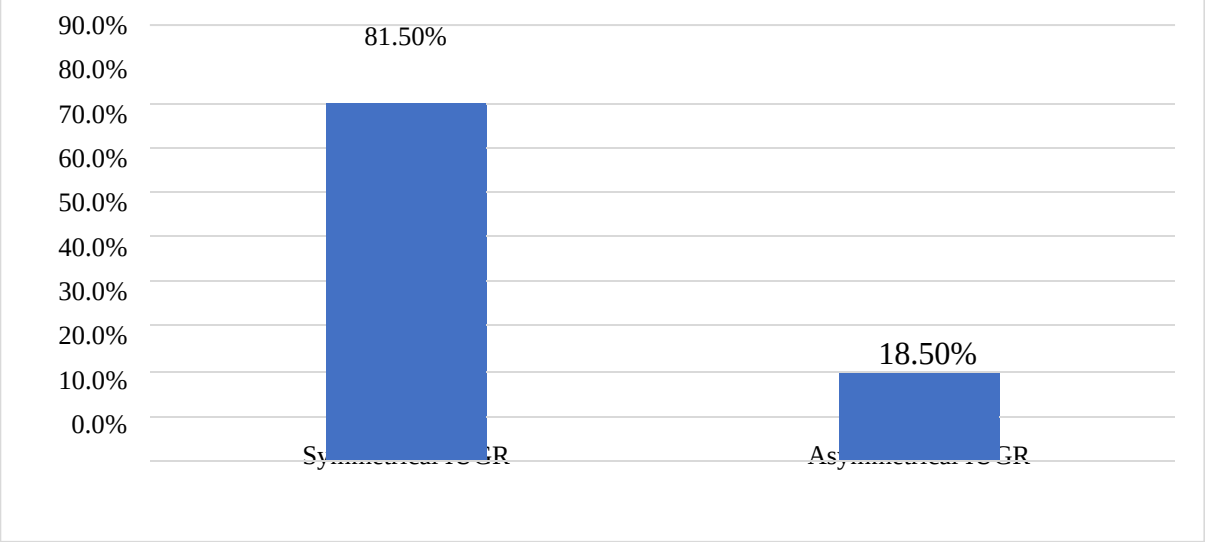

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Table 11: Comparison of Parameters with Gestation (N=254)

Parameter	Gestation			P Value
	Term (N=196)	Late preterm (N=47)	Preterm (N=11)	
	Mean ± SD	Mean ± SD	Mean ± SD	
Weight (Kg)	2.32 ± 0.26	1.71 ± 0.27	1.20 ± 0.20	<0.001*
Length (Cms)	47.00(46.0 to 48.0)	45.00(43.0 to 46.0)	38.50(37.5 to 41.0)	<0.001†
Head Circumference (Cms)	33.50(33.0 to 34.0)	32.00(31.0 to 33.0)	29.50(26.75 to 30.25)	<0.001†
Mid Arm Circumference (Cms)	9.00(8.0 to 10.0)	7.50(7.0 to 7.75)	6.00(6.0 to 7.0)	<0.001†
Mid Arm Circumference/Head Circumference Ratio	0.27(0.25 to 0.29)	0.22(0.21 to 0.24)	0.22(0.21 to 0.22)	<0.001†

*** =One way ANOVA Test P Value; †=Kruskal Wallis Test P Value**

dFigure 6: Error bar chart of Weight (Kg) with Gestation

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Figure 7: Boxplot of Length (Cms) with gestation

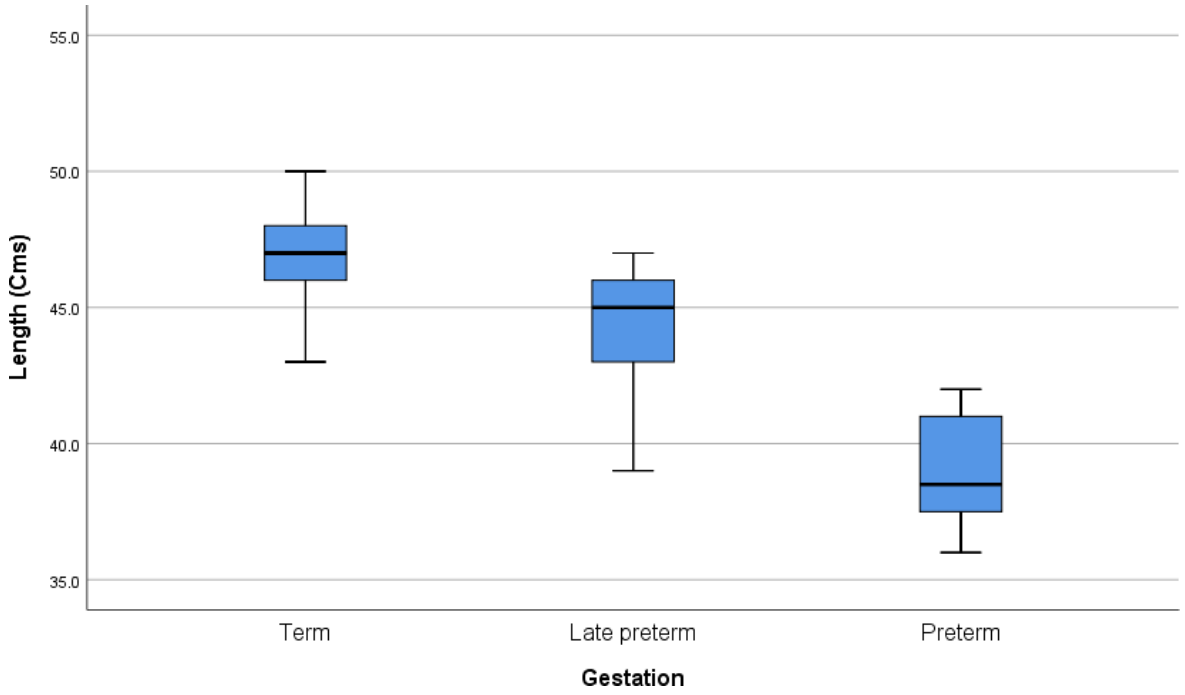

Figure 8: Boxplot of Head Circumference (Cms) with gestation

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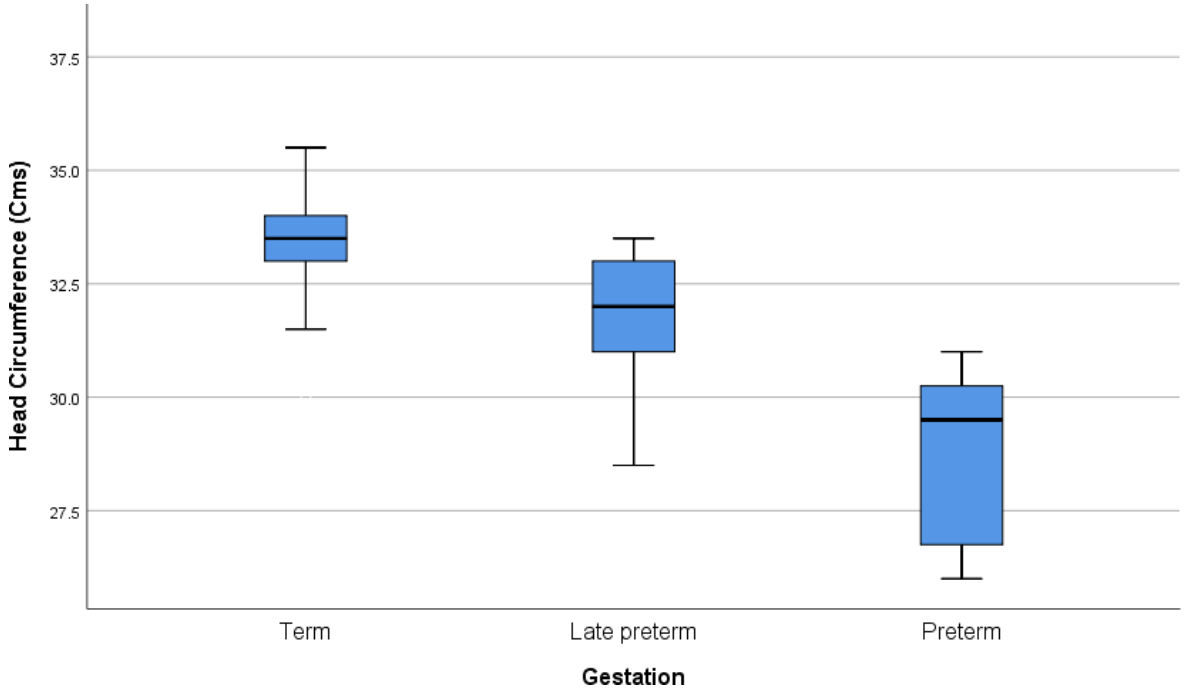

Figure 9: Boxplot of Mid Arm Circumference (Cms) with gestation

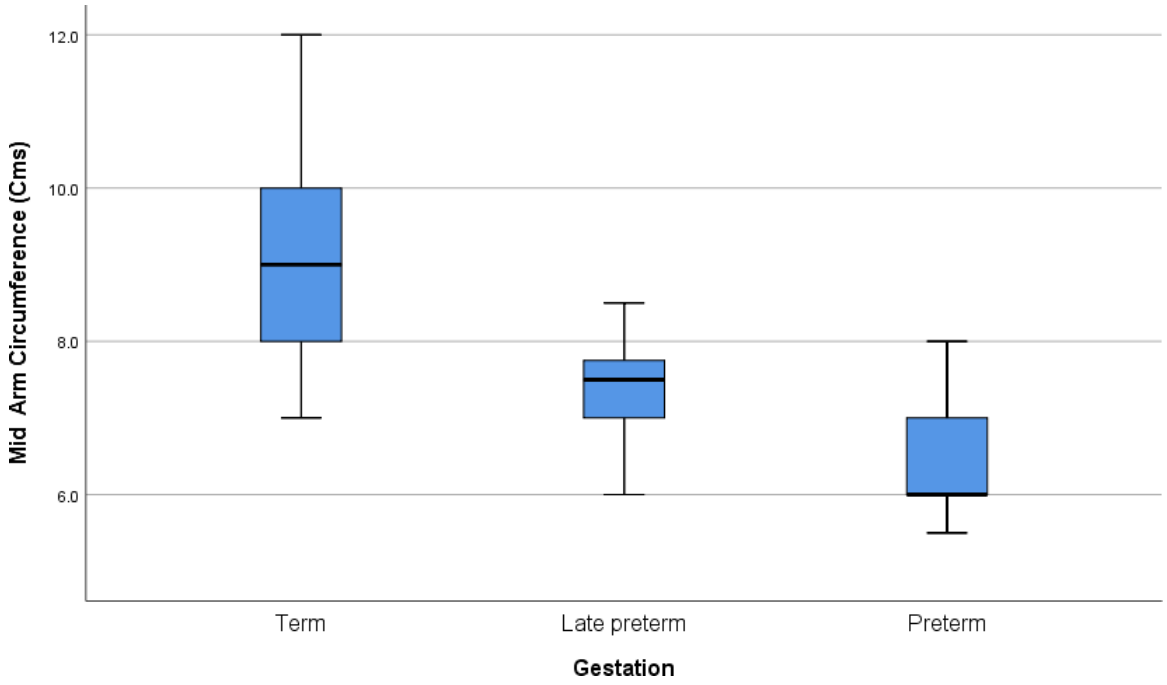

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Figure 10: Boxplot of Mid Arm Circumference/Head Circumference Ratiowith gestation

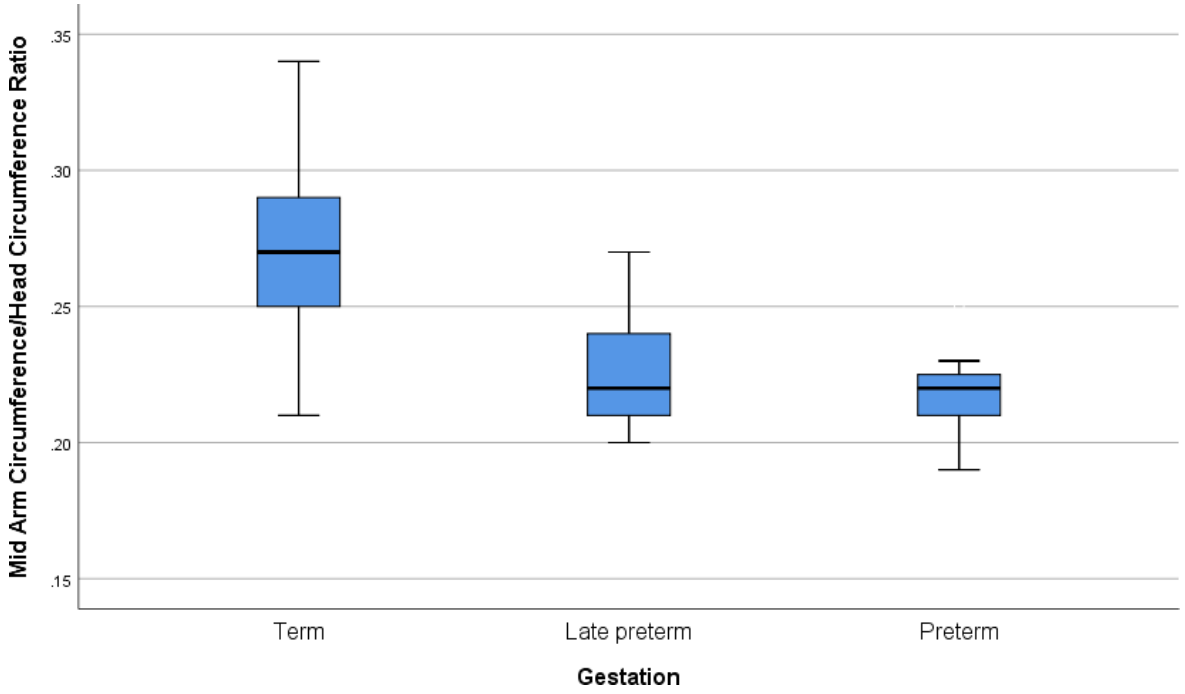

Table 12: Comparison of Ponderal Index with Gestation (N=254)

Ponderal Index	Gestation			Chi square value	P value
	Term (N=196)	Late preterm (N=47)	Preterm (N=11)		
Symmetrical IUGR	173 (88.27%)	26 (55.32%)	8 (72.73%)	27.87	<0.001
Asymmetrical IUGR	23 (11.73%)	21 (44.68%)	3 (27.27%)		

Figure 11: Cluster bar chart of comparison of ponderal index acrossgestation (N=254)

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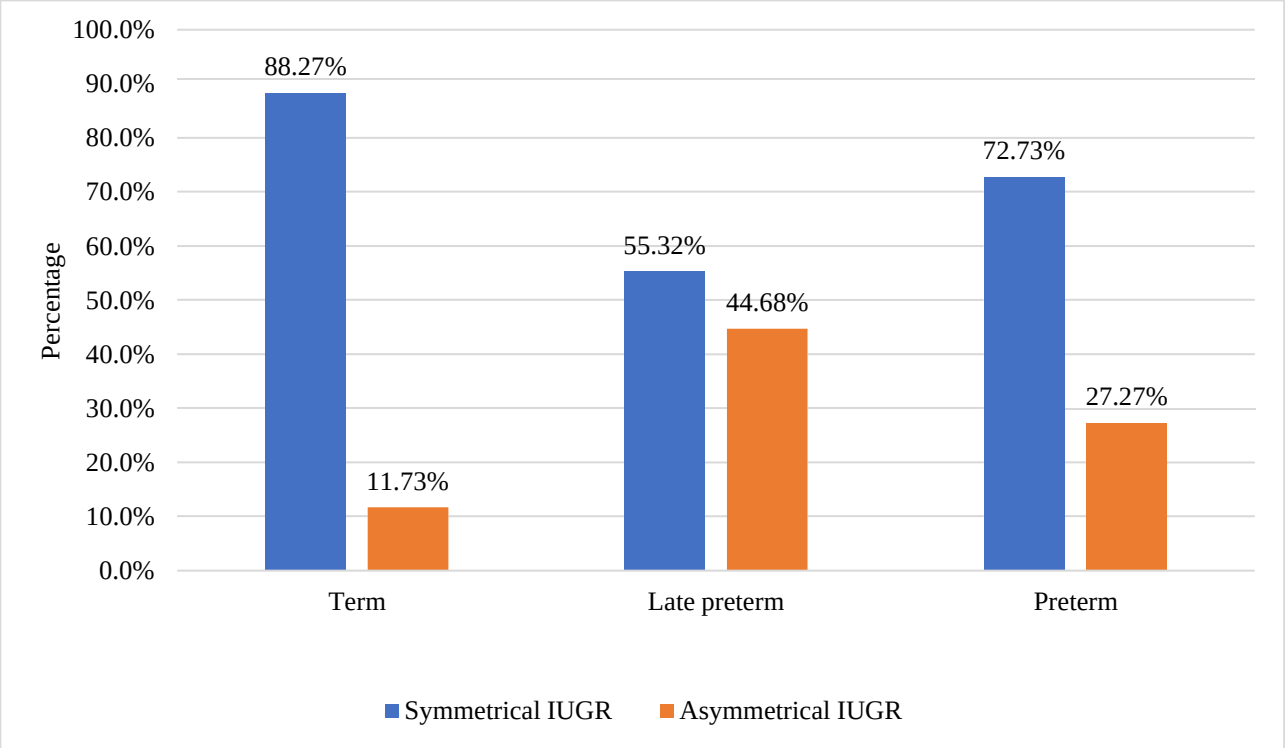

Table 13: correlation between parameters with gestation (weeks) in the study population (N=254)

Parameter	Gestation (weeks) rs Value(spearman)	P Value(spearman)
Weight (Kg)	0.75	<0.001
Length (Cms)	0.65	<0.001
Head Circumference (Cms)	0.73	<0.001
Mid Arm Circumference (Cms)	0.81	<0.001
Mid Arm Circumference/Head Circumference Ratio	0.70	<0.001

(<0.5 weak, 0.5 to 0.7 moderate, >0.7 strong, >0.9 very strong)

Figure 12: Scatter plot diagram of weight with gestation (weeks)

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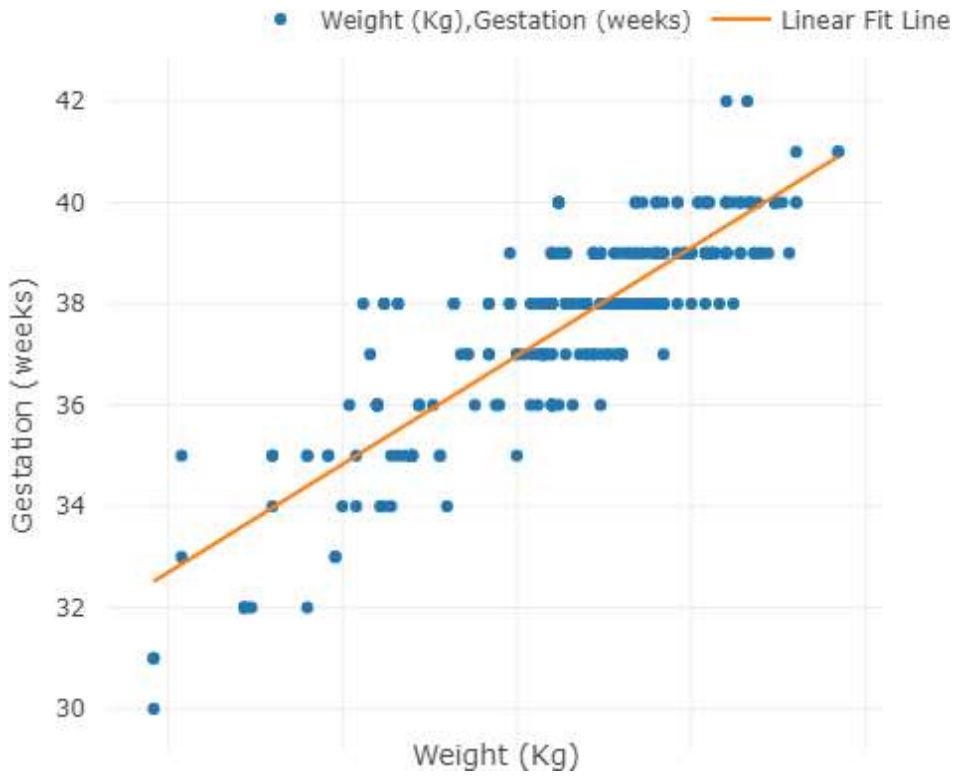

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Figure 13: Scatter plot diagram of length (cms) with gestation (weeks)

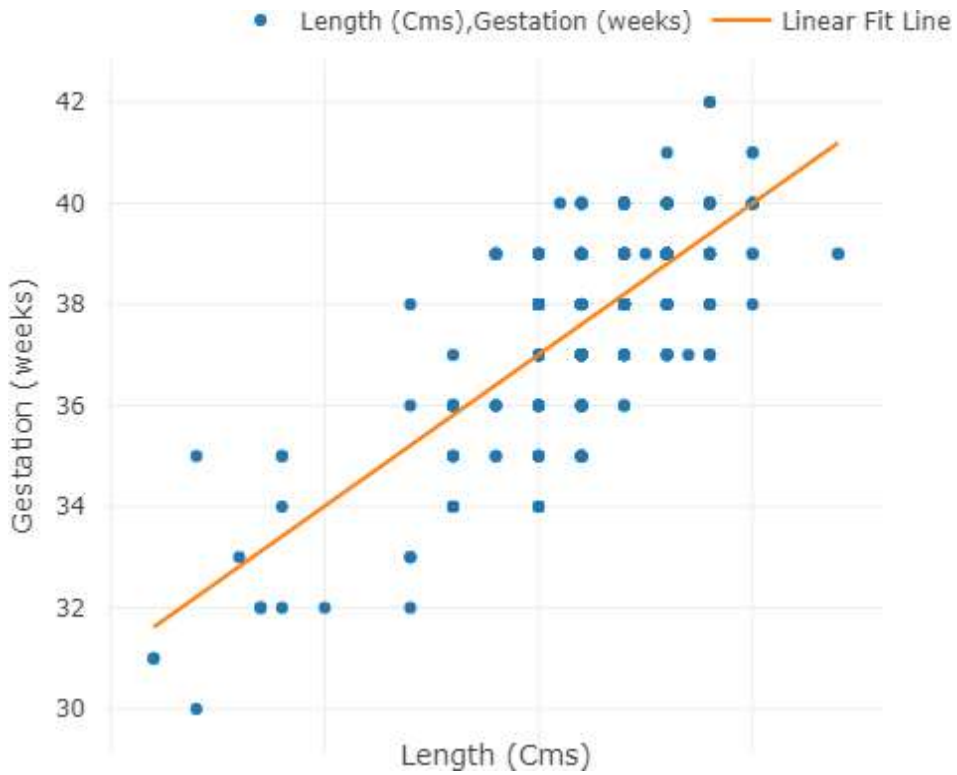

Figure 14: Scatter plot diagram of head circumference (cms) with gestation(weeks)

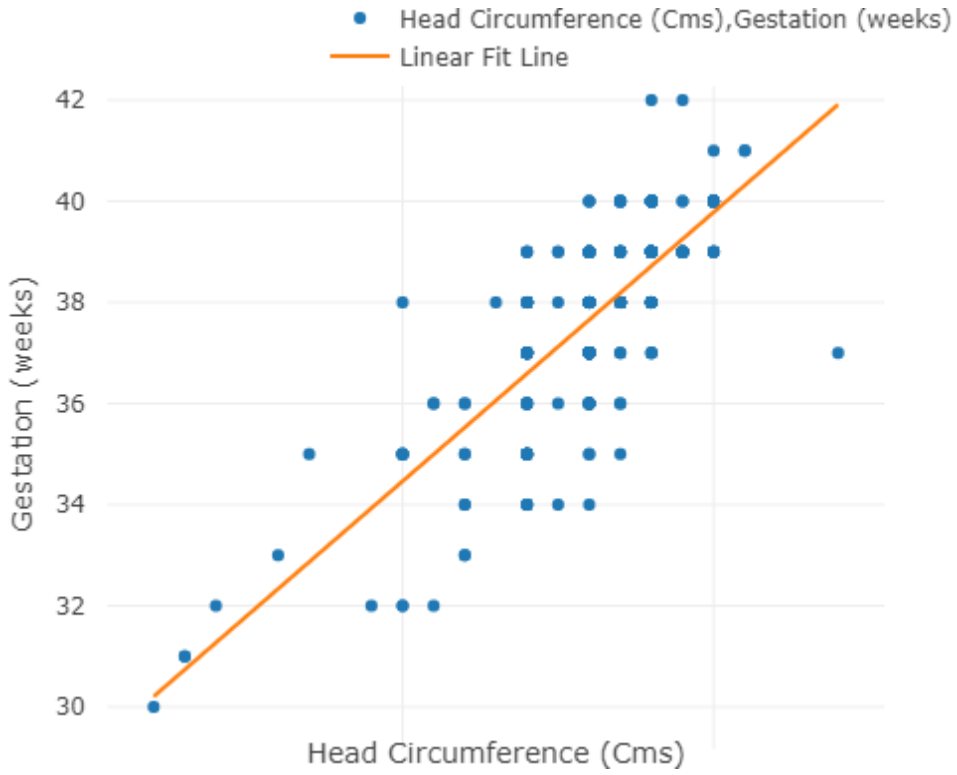

Figure 15: Scatter plot diagram of Mid Arm Circumference (cms) withgestation (weeks)

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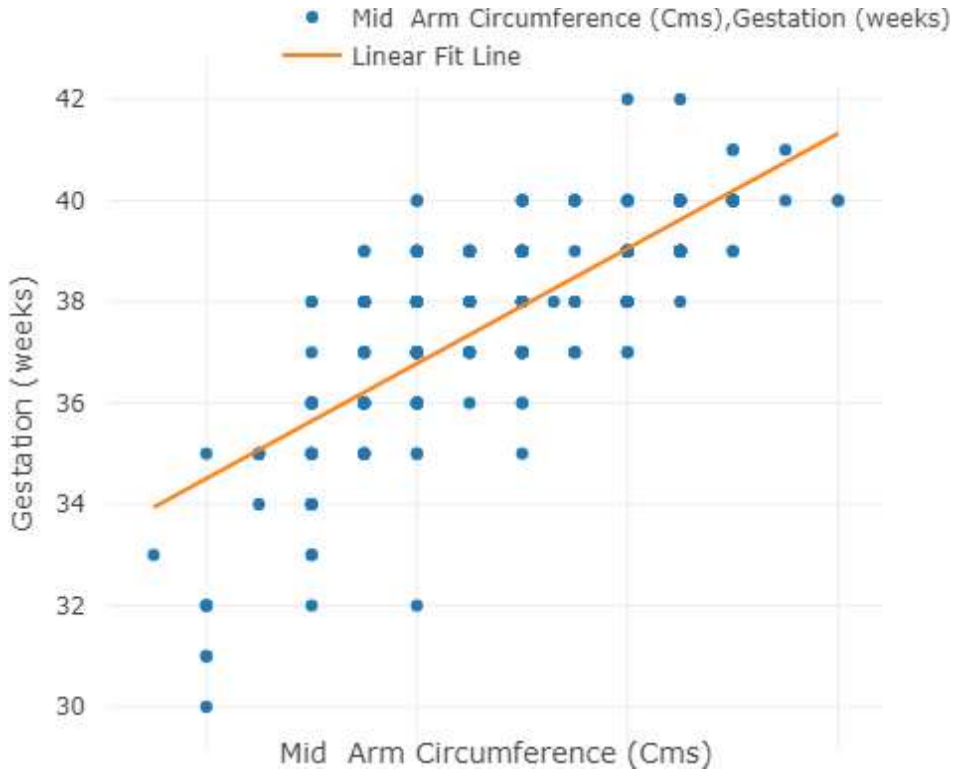
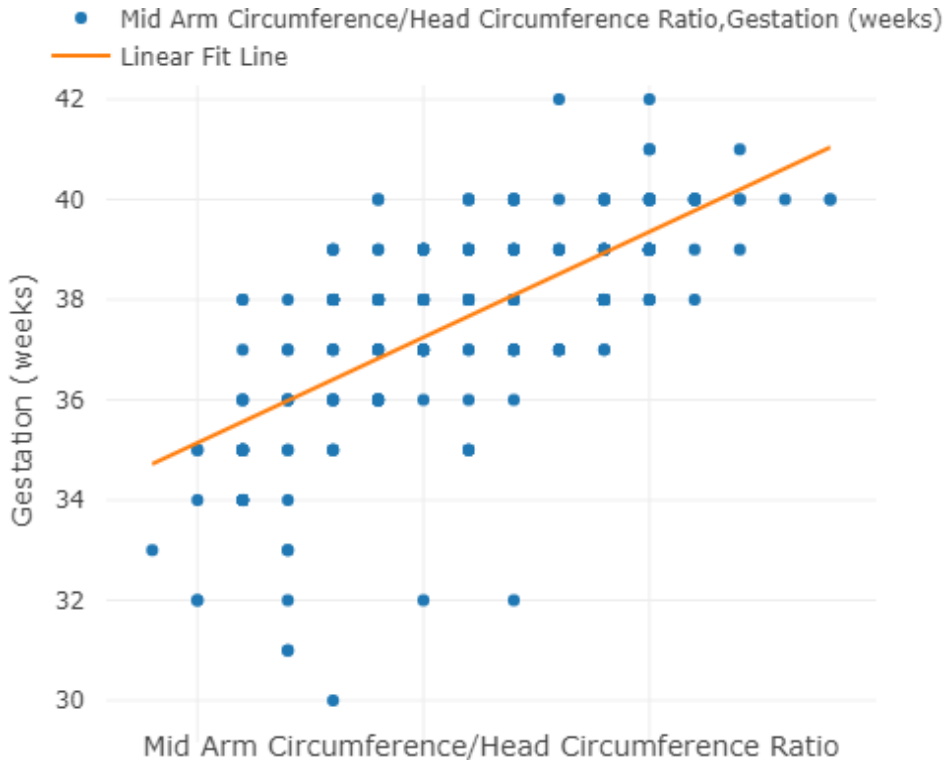


Figure 16: Scatter plot diagram of Mid Arm Circumference/Head Circumference Ratio with gestation (weeks)



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DISCUSSION: Low birth weight is a major public healthproblem in India, in contrast to what is observed in most developed and many developing countries of the world. Over half of newborns worldwide do not have their weightrecorded; in South Asia, the region with the highest rate oflow birth weight babies, two out of three babies are not weighed [9].
A study based on the National Family Health Survey (NFHS-2) showed that 70.1 percent of babies were not weighed within two days of birth, and of those weighed, 22.6 percent babies were below 2500 grams at the time of birth inIndia in 1999. In Manipur, India, percentage of

babies not weighed at birth was 69.4.[10].

As IUGR/SGA babies are more prone to morbidity and mortality, a number of studies have been done to diagnose atthe earliest to prevent the complications.
As mentioned below, many studies have been done on MACand head circumference parameters to compare correlation and reliability at diagnosing earliest.
In our study, other than the MAC and head circumfernce ,other anthropometric measures were compared and descriptive analysis of factors associated or leading to thecondition were studied.

- A prospective observational study conducted in the pediatric department of a tertiary care hospital Darbhanamedical college and Bihar hospital by shankar m et al. from October 2017 to may 2018 involving 250 new borns babies concluded that Mid arm circumference
  /head circumference has a good correlation with birth weight and can be used reliably to identify LBW babies.[3]
  A cross sectional study conducted in a private medical college in Puducherry by Shrivastava et al. over a periodof 2 years among 100 term neonates stated that mid armcircumference has the highest sensitivity and MAC/HC has the highest specificity .[4]
- A prospective cross sectional study done by Kambialdik T et al. on 324 neonates admitted to the pediatric ward ofRIMS hospital , Manipur, between september 2013 to September 2015 stated that mid arm circumference is a simple, quick and reliable indicator for predicting low birth weight babies which can be used by healthcare personnel when recording birth weight is not feasible.[5]
- In a cross sectional study done on 965 neonates by Neeluri R et al. in mamata general hospital, Khammam over a period of one year during october 2011 to september 2012 gave conclusion as measurement of midarm circumference is easier, convenient and statisticallysuperior to other anthropometric parameters in detection of low birth weight newborn babies.8
- A total of 254 subjects were included in the analysis, outof which 133(52.36%) were female babies and 121(47.64%) were male babies.
- Mothers attending the institution come from mainly middle and low socioeconomic status and from all castes.Thus the study population is the representativeneonatal population coming from the urban and ruralmiddle and low socioeconomic families.

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Among the study population, 115 (45.28%) people hadhypertension comorbidities, 3 (1.18%) people had gestational diabetes, 21 (8.27%) people had termpregnancy.
In term gestation, 173 (88.27%) participants were symmetrical IUGR in ponderal index and 23 (11.73%) wereasymmetrical IUGR. In late preterm gestation, 26 (55.32%)participants were symmetrical IUGR and 21 (44.68%) wereasymmetrical IUGR. In preterm gestation, 8 (72.73%) participants were symmetrical IUGR and 3 (27.27%) were asymmetrical IUGR.
There was strong positive correlation between mid arm circumference and gestation (weeks) with the correlationcoefficient r= 0.81 and where the association was statistically significant (P value<0.05).

LIMITATIONS:At hospital the measurements were done by asingle investigator which may not be the same at community level where multiple health workers are involved.

WHAT STUDY ADDS?
In the above mentioned studies, any one of the parameter wasevaluated for identification of IUGR babies. In our study 3 parameters were evaluated to find the most sensitive and reliable parameter for identidication of IUGR babies. This study also evaluates the most common etiology(maternal cause) leading to IUGR babies, therefore preventing it decreases the prevalence of IUGR babies and complications associated withit.

CONCLUSION:The current method of assigning babies to SGA, AGA, and LGA groups based solely on weight has aided in their overall treatment. However, the infant mortality rate has not decreased to the anticipated levels as a result of

this. This study's straightforward, methodical approach can beused as a routine and preferred method for identifying SGA babies, particularly in rural areas where social workers can use it to lessen the burden of perinatal and neonatal morbidityand mortality. It doesn't require complex calculations or sophisticated equipment.
This study concludes that measurement of mid arm circumference is statistically superior to other anthropometrical parameters in detection of low birth weightnewborn babies.
This study also shows the comorbidities leading to the condition(hypertension) ,so preventive health care changescan be done to prevent the condition .
As a result, it is an affordable technique that is accessible to alarge population and, when applied, can be a useful tool for delivering healthier infants to the community.
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