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Anaemia in pregnant women of Hyderabad (Telangana): prevalence, severity, associated risk factors and neonatal outcome

Dr M.V.Surekha[1], Dr G.Sravanthi[2], Dr Putcha Uday Kumar[1], Dr.N.Balakrishna[1], Dr Siddu Anita[2].
[1](Pathology & Microbiology Division, National Institute of Nutrition, India)
[2](Department of Obstetrics and Gynaecology, Gandhi Medical college and Hospital, India)
Corresponding Author: Dr Siddu Anita

Abstract
Background and purpose of the study:
Anemia is a significant public health problem in India with a high morbidity and mortality, particularly in pregnant women and also adversely affecting fetal development and thus neonatal outcome. Different studies in South India have depicted different prevalent rates for anaemia.
The aim of this study was, to determine the prevalence of anemia and assess its associated factors among pregnant women attending antenatal care (ANC) at Gandhi Hospital in Hyderabad, South India.
Methods*:*
This cross-sectional study involving 200 pregnant women was conducted from August 2017- January 2018. Socio-demographic, medical and obstetric data of mothers were collected using a structured questionnaire along with background information like education, occupation, monthly family income and community.
Subject's body mass index /BMI, obstetric score, number of antenatal visits, hemoglobin levels and perinatal parameters like placental and birth weight were recorded.
Results:
Overall prevalence of anemia was 58.8%, of which 60.35% was moderate anemia.
71.5% women were 18-25 years of age with 66% having a BMI >23. Majority of anaemic women were illiterate, with family income between Rs 5000-10,000, were un-employed with higher parity. Bivariate and multivariate analyses showed that pallor was most strongly associated with anaemia. Children born of anaemic mothers had lower birth weight, head and mid-arm circumference, crown-rump length and skin fold thickness.
Conclusion*: This study showed a high prevalence of anemia among the pregnant women, with a sizable proportion having moderate anemia and children born of anaemic mothers having lower birth weight, head and mid-arm circumference, crown-rump length and skin fold thickness.*
Keywords: *Anemia, anthropometric data, associated factors, neonates, pregnant women.*

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I. Introduction

Anaemia, defined as low blood haemoglobin (Hb) concentration, has been shown to be a public health problem that affects low, middle and high-income countries and has significant adverse health consequences [1,2]. According to WHO, globally 38.2% pregnant women are affected by anaemia [3]. National Family Health Survey 2015-16, reports that 50.3% of pregnant women in India and 57% in Telangana are anaemic.

Anaemia in pregnancy, is associated with low birth weight and increased risk of maternal and perinatal mortality [4].The many factors that contribute to anemia during pregnancy vary greatly depending on dietary practice, geographical location, and weather or season [5]. Any strategy implemented to prevent or treat anaemia should be tailored to local conditions, taking into account the specific etiology and prevalence of anaemia in a given setting and population group. Therefore, this study was aimed at determining prevalence of anemia and assessing associated risk factors among pregnant women attending antenatal care (ANC) at Gandhi Hospital, Hyderabad and also to determine the relationship between maternal anaemia and neonatal anthropometric characteristics.

II. Materials and methods

The present study was carried out in 200 pregnant women, in their third trimester of pregnancy, reporting to Gandhi Government Medical Hospital, Hyderabad, South India, for delivery, between August 2017 and January 2018. Ethical committee clearance of National Institute of Nutrition (NIN) and Gandhi Hospital were obtained before start of the study.

2.1Study design and study population

This was a cross-sectional study in which women in 3rd trimester of pregnancy were enrolled. Gandhi Hospital is a tertiary care level hospital catering to the needs of population of Hyderabad which is capital city of the southern state of Telangana and its surrounding districts. Anemia in pregnancy was defined as Hb <11 g/dl according to WHO and mild, moderate and severe grades of anemia as Hb measurements between 10-10.9 g/dl, 7-9.9 g/dl and < 7 g/dl, respectively [6]. Accordingly in our study women with Hb levels < 11 g/dl were taken as cases while those with Hb >11g/dl were taken as controls. Pregnant women of age 18 years and above, with singleton pregnancy and in third trimester of pregnancy were included while those with hemolytic anaemia, hypertension, diabetes mellitus, human immunodeficiency virus , hepatitis C virus ,hepatitis B surface antigen positivity and twin pregnancies were excluded from our study.

2.2 Sample size estimation

Sample size was estimated using the general formula for single population proportion, with the following assumptions: anemia prevalence of 50.3% and using 95% confidence level and 5% marginal error. This gave us a total of 196; hence, all pregnant women visiting O&G department from August 2017- January 2018 were included consecutively.

2.3 Study variables

The dependent variable of this study was 'anemia'. The independent variables were socio-economic and demographic characteristics, obstetric factors and maternal health conditions like hypertension, palpitation, dyspnoea, weakness, angina, koilonychia, jaundice and pedal oedema.

2.4 Data and sample collection

Data on socio-demographic, obstetric and medical history of pregnant women were obtained using a questionnaire. All subjects who agreed to participate in the study were explained about the study. Informed consent was obtained from all the participants included in the study. Weight and height were measured for computing body mass index (BMI). Hb estimation was done at the time of admission for delivery. About of 2ml of venous blood was collected in Vacutainer tubes (2ml) containing K3EDTA (Becton Dickinson Vacutainer System, USA), transported immediately to Pathology lab of NIN, in thermally insulated boxes containing ice packs. The blood was analyzed in ADVIA 120 automatic hematology analyzer system (Siemens) for Hb estimation.

Socio-demographic data collected included maternal age, residency, education, monthly family income, occupation and community.

Maternal anthropometric, obstetric and medical data collected included height, weight, BMI, gravida, parity, history of still births, induced and spontaneous abortions, pregnancy induced hypertension or diabetes, bleeding disorders, number of antenatal visits, previous place of delivery, tetanus toxoid injections, weakness, dysponea, palpitation, chest pain, palor, koilonychia and pedal oedema.

Anthropometric measurements of neonates included birth weight, crown-rump length, skin fold thickness, chest and mid-arm circumference and were done for assessing fetal growth.

Weight and length/height measurements followed a standard protocol [7]. Mother's body weight was taken using a calibrated digital weighing scale to the nearest 0·1 kg (Seca, Birmingham, UK) while height was measured using a portable stadiometer to the nearest 0·1 cm (Galaxy Scientific, New Delhi, India). Infant's weight was measured by using a Salter spring balance (CMS Weighing Equipment Ltd, UK) to nearest 20 grams while crown-rump length was measured to nearest 0·1 cm using an infantometer [7]. Head circumference was measured by placing a tape over occipital protuberance at the back and just over suprorbital ridge and glabella in the front while chest circumference was measured at the level of nipples. The mid-arm circumference was measured using a steel tape over left upper arm at a point between acromion and olecrenon. Skinfold thickness was measured with a Herpenden's caliper.

2.5Statistical analysis

Statistical analysis was performed using SPSS for windows version 19. Descriptive statistics like mean and SD values were calculated for quantitative variables and proportions were calculated for qualitative variables. Associations were assessed for qualitative variables between the two studies groups - anaemiac and non-anaemic groups and maternal variables by chi-square test. ''t'' was used for comparison of means of quantitative variables and Mann Whitney U test was used when normality assumption was violated for maternal and neonatal anthropometric measurements. Relationships were analyzed for maternal Hb levels and pregnancy outcome by Pearson's correlation. A probability value of $p<0.05$ was considered as statistically significant.

To study the risk estimates with 95% confidence interval, logistic regression was performed with adjusted socio-economic variables like age, education, occupation, family income of the study group.

III. Results

A total of 200 women were recruited among which total number of anaemic women was 58.8%. (Fig.1).

Figure 1: shows the distribution of subjects based on their hemoglobin levels

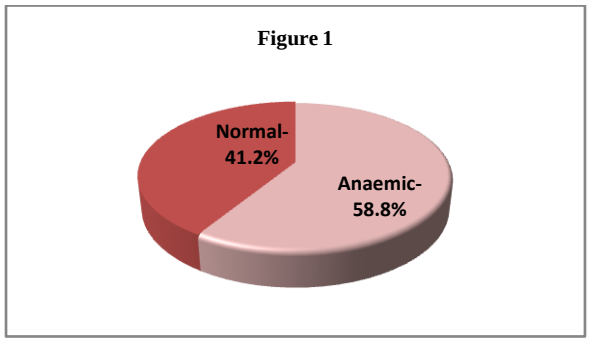


Fig.2 shows that among anaemic women, 60.35% had moderate anaemia, 27.65% mild anaemia and 12% severe anaemia.

Figure 2 showing distribution of grades of anaemia

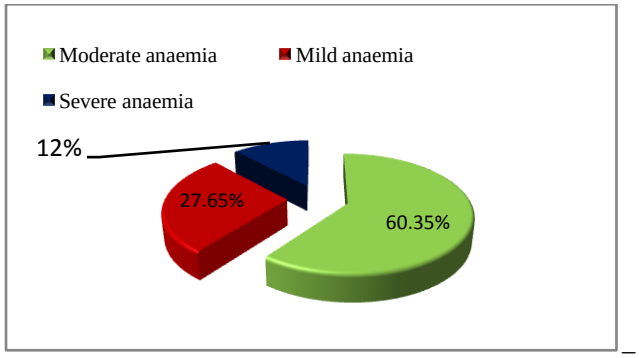
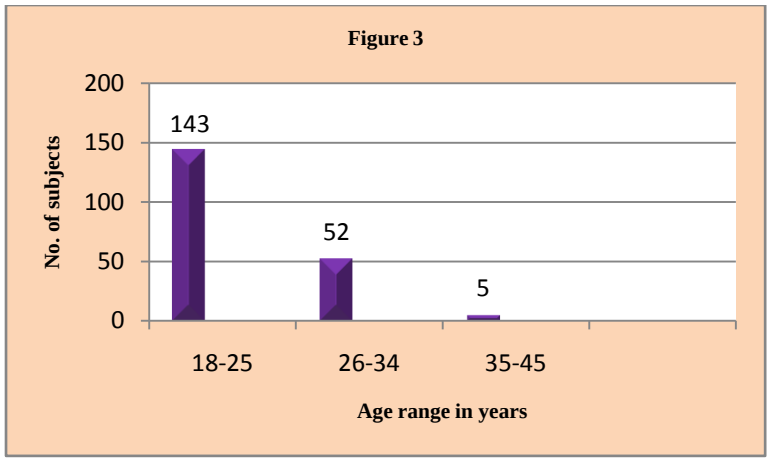


Fig.3 shows that majority of the pregnant women 143(71.5%) were in age group of 18-25 years.

Figure 3 showing age incidence of the subjects



3.1 Table 1 shows that compared to non-anaemic group (67%) more anaemic women (80.4%) were in the age range of 17-23.Most women (75.25%) had BMI >23 with 44.3% being anaemic and 55.7% normal.
With regard to the educational status, the least number of women (19) were college educated while 89 were illiterate and 89 school educated. Most of the illiterate women 53(59.6%) were anaemic in comparison to school educated women.
One hundred and seventy one (86.8%) women were unemployed with 60.2% being anaemic.
Monthly family income of majority of women (68.7%) was between Rs 5000-10,000/- with 58.8% belonging to anaemic group.
Segregation of women into different communities showed that significant number of them belonged to backward scheduled caste (SC) and scheduled tribe (ST) community 105 (55.5%) with most of anaemic women belonging to SC community (61%).

Table 1 showing sociodemographic and economic characteristics of study population

Maternal Variables	**Values**	**Anaemic group No.(%)**	**Non-Anaemic group No. (%)**	**Total No.(%)**	***p*-value**
Age in years	17-23	37 (38.5)	59(61.5)	96 (100)	0.516
	>23	9 (31)	29 (69)	29 (100)	
BMI	<18.5	0 (0)	1(100)	1 (100)	0.285
	18.5-23	16(33.3)	32 (66.7)	48 (100)	
	>23	66(44.3)	83 (55.7)	149 (100)	
Education status	Illiterate	53 (59.6)	36 (40.4)	89 (100)	0.130
	Schooling	48 (53.9)	41 (46.1)	89 (100)	
	College	15 (78.9)	4 (21.1)	19 (100)	
Occupation	Working	13 (50)	13 (50)	26 (100)	0.393
	Not-working	103 (60.2)	68 (39.8)	171 (100)	
Monthly income of family in Rs	< 5000	9 (69.2)	4 (30.8)	13 (100)	0.652
	5000-10,000	80 (58.8)	56 (41.2)	136 (100)	
	10,000-50,000	27 (55.1)	22 (44.9)	49 (100)	
Community	SC+ST	64 (61)	41 (39)	105 (100)	0.6
	OBC	44 (57.1)	33 (42.9)	77 (100)	
	OC	3 (42.9)	4 (67.1)	7 (100)	
	Others	20 (43.5)	26 (56.5)	46 (100)	

***p*-value was considered significant if *p*< 0.05**

Abbreviations: BMI- Body mass index, SC- Scheduled caste, ST- Scheduled tribe, OBC- Other backward caste, OC- Other caste

3.2 Table 2 revealed that 31(55.4%) anemic women and 25 (44.6%) non-anaemic women had three or more previous pregnancies.

Although the total number of primiparous women was observed to be high 75 (37.8%) in our study, the incidence of women with a single living child was slightly higher 81 (40.9%).

Four women had previous history of still births which was statistically significant (*p*-0.029).Nineteen (9.5%) had a history of spontaneous abortion among which 11(57.9%) were anaemic.

Significant number (*p*-0.05) of both anaemic 115 (58.4%) and non-anaemic 82 (42.6%) women had antenatal visits to hospital. Among these women who attended five or more times showed that 80 (54.8%) were anaemic and 66 (54.2%) were non-anaemic with statistically significant difference in the values (Adjusted odds ratio /AOR= 2.18, 95% CI: 0.99-4.79).
One hundred and thirty five (93.2%) women reported hospital as the previous place of delivery.

Application of bivariate and multivariate analyses identified few variables which were significantly associated with anaemia. These were history of still births, number of antenatal visits, signs of weakness, palor, palpitation and pedal oedema.

Table 2 showing obstetric history of study population

Maternal Variables	Values	Anaemic group No.(%)	Non-Anaemic group No. (%)	Total No.(%)	*p*-value
Gravida	1	46 (63.9)	26 (36.1)	72 (100)	0.519
	2	39 (55.7)	31 (44.3)	70 (100)	
	>=3	31 (55.4)	25 (44.6)	56 (100)	
Parity	Primi	47 (62.7)	28 (37.3)	75 (100)	0.551
	1	47 (58)	34 (42)	81 (100)	
	>=2	22 (52.4)	20 (47.6)	42 (100)	
H/o Still births	Yes	0 (0)	4 (100)	4 (100)	*0.029
	No	113(59.5)	77 (40.5)	190 (100)	
H/o Spont.Abortions	Yes	11 (57.9)	8 (42.1)	19 (100)	1.00
	No	105 (58.7)	74 (41.3)	179 (100)	
H/o Induced Abortions	Yes	0 (0)	1 (100)	1(100)	0.414
	No	116 (58.9)	81 (41.1)	197 (100)	
H/o PIH	Yes	2 (33.3)	4 (66.7)	6 (100)	0.234
	No	114 (59.4)	78 (40.6)	192 (100)	
H/o PID	Yes	0(0)	0(0)	(0)	--
	No	116 (100)	82 (100)	198 (100)	
H/o Bleeding disorders	Yes	0(0)	0(0)	(0)	--
	No	116 (100)	82 (100)	198 (100)	
No. of Antenatal visits	<5	35 (68.6)	16 (31.4)	51 (100)	0.05
	>=5	80 (58.4)	66 (41.6)	146 (100)	
Previous place of Delivery	Hospital	73 (54.1)	62 (45.9)	165 (100)	0.228
	Home	9 (75)	3 (25)	12 (100)	
T.T Injection	Yes	113 (97.4)	80 (97.5)	193 (100)	1.00
	No	3 (60)	2 (40)	5 (100)	
Trimester of giving T.T inj.	1st	2 (50)	2 (50)	4 (2)	0.67
	2nd	111 (58.7)	78 (41.3)	189 (100)	
	3rd	1 (50)	1 (50)	2 (100)	

***p*-value was considered significant if *p*< 0.05** , **Abbreviations:**PIH-Pregnancy induced hypertension, PID-pregnancy induced diabetes, T.T- Tetanus toxoid

3.3 Table 3

Significant number of study participants complained of weakness, dyspnoea, palpitation, pedal oedema and palor all of which were more evident in the anaemic group.

Among the independent factors of anaemia, the variable 'palor' showed the strongest association (AOR = 6.99, 95% CI: 2.85-17.13) with anaemia followed by weakness (AOR=6.96, 95% CI: 2.3-21.06), pedal oedema (AOR=3.14, 95% CI:1.49-6.64), palpitation (AOR=2.16, 95% CI: 0.89-5.22), antenatal visits (AOR= 2.18, 95% CI:0.99-4.79).

Table 3 showing clinical history of study population

Maternal Variables	Values	Anaemic group No.(%)	Non-Anaemic group No. (%)	Total No.(%)	*p*-value	COR (95% CI)	AOR (95% CI)
Weakness	Yes	110 (64)	62 (36)	172 (100)	*0.00	5.6(2.13-14.8)	6.96(2.3-21.06)
	No	6 (24)	19 (76)	25 (100)			
Dyspnoea	Yes	62 (63.9)	35 (36.1)	97 (100)	0.15	-	-
	No	53 (53.5)	46 (46.5)	99 (100)			
Palpitation	Yes	26 (22.4)	9 (25.7)	35 (100)	*0.05	2.31(1.02-5.24)	2.16(0.89-5.22)
	No	90 (55.6)	72 (44.4)	162 (100)			
Chest Pain	Yes	9 (56.3)	7 (43.8)	16 (100)	1.00	-	-
	No	106 (58.9)	74 (41.1)	180 (100)			
Palor	Yes	108 (66.3)	55 (33.3)	163 (100)	*0.00	6.63(2.82-15.55)	6.99(2.85-17.13)
	No	8 (22.9)	27 (77.1)	35 (100)			

Koilonychia	Yes	3 (60)	2 (40)	5 (100)	1.00	-	-
	No	113 (58.5)	80 (41.5)	193 (100)			
Pedal Edema	Yes	96 (63.2)	56 (36.8)	152 (100)	*0.02	2.23(1.14-4.35)	3.14(1.49-6.64)
	No	20 (43.5)	26 (56.5)	46 (100)			
Pulse	<85	2 (40)	3 (60)	5 (100)	0.65	-	-
	>=85	114 (59.1)	79 (40.9)	193 (100)			
Systolic BP	<140	116 (58.6)	82 (41.4)	198 (100)	--	-	-
	>140	0 (0)	0 (0)	0 (0)			
Diastolic BP	<90	116 (59.2)	80 (40.8)	196 (100)	0.17	-	-
	>90	0 (0)	2 (100)	2 (100)			

***p*-value was considered significant if $p < 0.05$**

Abbreviations: COR- Crude odds ratio, AOR- Adjusted odds ratio, CI- confidence interval

3.4 Table 4

Birth weight (2.80 ±0.38 kgs), crown-rump length (30.48 ±1.47cms), skin-fold thickness (1.24±0.19cms), head circumference (30.70 ±1.48cms) and mid-arm circumference (12.90±1.09cms) were observed to be lower in children born of women with anaemia.

Table 4 showing anthropometric data of newborns born of anaemic and non-anaemic mothers

Variables	Anaemic group	Non-Anaemic group	*p*-value
Placental weight in gms	416.03 ± 90.65	422.82 ± 91.66	0.609
BMI mothers	24.50 ± 2.51	24.71 ± 2.51	0.551
Birth weight in kgs	2.80 ± 0.38	2.87 ± 0.49	0.258
Crown rump length in cms	30.48 ± 1.47	30.52 ± 1.68	0.882
Skinfold thickness in cms	1.24 ± 0 .19	1.27 ± 0.26	0.300
Head circumference in cms	30.70 ±1.48	30.78 ±1.65	0.702
Mid-arm circumference in cms	12.90 ± 1.09	12.91 ± 1.17	0.937

Values are in mean ± SD

Abbreviation: BMI- Body mass index

3.5 Table 5

Placental weight positively and significantly correlated with BMI of mothers and skin fold thickness of newborns.

BMI of mothers significantly positively correlated with placental weight and mid-arm circumference of newborns while significantly negatively with crown-rump length.

Highly significant positive correlation was observed between birth weight, placental weight, mid-arm circumference and the C-R length of the newborns.

Table 5 showing Pearson's correlations between the study parameters

	Hb Mothers	Placental	BMI mothers	Birth	CR	Skin	Head	Mid-

		weight		**Weight**	**length**	**fold Thick Ness**	**Cicum ference**	**Arm Circum ference**
Hb Mothers	1	0.007	0.007	0.097	0.000	0.004	-0.007	0.081
Placental weight		1	0.146*	0.405	0.269	0.041*	0.243	0.232
BMI Mothers			1	0.106	-0.004*	0.013	0.083	0.104*
Birth Weight				1	0.361**	0.268	0.394	0.503*
CR length					1	0.514*	0.641	0.333*
Skinfold thickness						1	0.536	0.345*
Head circum ference							1	0.308*
Mid-arm circum Ference								1

** Correlation is significant at the 0.001 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Abbreviations: Hb- Hemoglobin, BMI- Body mass index, CR- crown rump

3.6 Table 6
Birth weight, head circumference, mid-arm circumference, skin fold thickness and crown-rump length values were observed to be lowest in women with severe anaemia and significantly increased with decrease in severity of anaemia.

Table 6 showing relation between different grades of anaemia and newborns anthropometric data

Hb level in g/dl	**Birth weight in kgs**	**Head circumference in cms**	**Mid-arm circumference in cms**	**Crown-rump length in cms**	**Skin fold thickness in cms**
<7 (n=14)	2.54 ±0.35	30.43± 2.17	12.18± 1.54	30.28± 1.43	1.21± 0.09
7-9.9 (n=67)	2.79± 0.36	30.69± 1.48	12.90± 1.09	30.47± 1.93	1.24 ±0.23
10-11 (n=31)	2.87 ±0.49	30.74 ±1.56	12.98± 1.11	30.48 ±1.47	1.25± 0.15
>11 (n=82)	2.93± 0.38	31.03± 1.62	13.10 ±1.02	30.74± 1.12	1.27± 0.26
P value	*0.02	0.65	0.07	0.80	0.65

*$p < 0.05$

IV. Discussion

The current comprehensive study involved several social and biological variables and characterized maternal anaemia and the factors associated with it in women in labor with a prevalence of 116 (59%).This prevalence of maternal anaemia in our study is higher than the National prevalence of 50.3% and of 49.8% of Telangana state [8].

Majority of women in our study were in the age group of 18-25 years with most being anaemic (80.4%). This finding is similar to other studies [9,10,11] in which most of the participants were in a younger age range thus showing that younger age at pregnancy poses higher risk for developing maternal anaemia.

Significant number of anaemic women in our study had moderate anaemia (60.35%). These findings do not coincide with NFHS-4 data of Telangana state and 2 other studies in which mild anaemia was commonest (37%) [8,10,11]. The reason for higher incidence of moderate anaemia cases in our study could be either poor compliance of women in taking iron and folic acid tablets supplied to them by the government or concurrent Vit B12 deficiency. This aspect of anaemia needs further studies in order to address and solve this problem which is rampant in our country.

Majority of women (75.25%) had an insignificant relation between anaemia and high BMI >23. These findings are comparable those in the studies by Nair et al [12] and Kefiyalew et al [11] who also reported higher BMI in the non-anaemic group when compared with the anaemic group.

Our study showed no significant association of educational status, employment status, family income, occupation and community with anaemia. These findings are comparable those by Kefiyalew et al [11]. Majority with anaemia were illiterate and unemployed. This shows that illiteracy, low family income, lower levels of education are a risk for development anaemia either due to inaccessibility to food or due to lack of knowledge on intake of iron rich food which thus play an important role in development of anaemia in these women.

Ebuy et al [13] found a statistically significant association between severe anaemia and gravidity which is similar to our study where almost one-fourth of anemic women had three or more pregnancies. Investigators of the above study interpreted this finding to multi-gravidity reducing iron reserves at every pregnancy, due to hemo-dilution and also due to blood-loss at each delivery.

Number of ante-natal visits appeared to play an important role in development of anaemia in our study where it was observed that women with <5 ante-natal visits were 2 times more prone to develop anaemia (AOR=2.18, CI: 0.99-4.79). Moreover, the number of mothers who had at least 4 antenatal visits constituted 74.2% of our study which is similar to Telangana state number of 75% but higher than national figure of 51.2% [8]. Increased number of antenatal visits definitely lead to better assessment of iron status of mothers in each trimester hus leading to an early intervention to tackle anaemia.

Majority of women in our study reported previous deliveries in hospital which almost matches with both National (Institutional births-78.9% and home delivery – 4.3%) and Telangana state data (Institutional births-91.5% and home delivery –2.9%) [8]. However, most women who had previous delivery at home, belonged to anaemic group. Thus, hospital delivery proves to be better than home delivery with respect to development of anaemia due to availability of better facilities and also better emergency services which can be offered in case of any delivery complications.

Application of bivariate and multivariate analyses identified few variables like history of still births, antenatal visits, weakness, palor, palpitation and pedal oedema which were associated significantly with anaemia. Among these, palor was the commonest clinical sign (AOR of 6.99) associated with anaemia followed by weakness (AOR of 6.96), pedal oedema (AOR=3.14) and palpitation (AOR=2.16).

Birth weight of newborns was observed to be lower in those born of women with anaemia and significantly increased with decreasing severity of anaemia. Increasing crown-rump length, skin-fold thickness, head circumference and mid-arm circumference with decrease in severity of maternal anaemia in our study are consistent with Hadipour et al [14], Ekta et al [15] and Samta et al [16] .The linear relationship between maternal Hb and different components of fetal anthropometry indicates that fetal growth is compromised in maternal anaemia and that it may be interpreted to the fact that maternal anaemia leads to chronic deprivation of oxygen to the developing fetus.

Placental weight significantly positively correlated with BMI, Hb of mothers and skin fold thickness, birth weight of newborns in our study. Effects on birth weight and foetal outcome seem to be mediated through placenta due to presence of a high correlation between placental weight, birth weight and maternal Hb.

Highly significant positive correlation was observed between birth weight and placental weight, mid-arm circumference. and C-R length of newborns. Laaxmichaya et al [17] too found statistically significant correlation between birth weight and placental weight.

Crown rump length showed highly statistically significant positive correlation with placental weight, birth weight, skin fold thickness and mid-arm circumference. Ashraf et al [18] and Erbil et al [19] too found highly significant correlations between placental weights and growth parameters (weight, length and head circumference) of full term singleton infants at birth.

V. Conclusion

Prevalence of anemia was high among pregnant women in our city with predominance of moderate anaemia. Anaemic mothers had greater chances of delivering low birth weight babies with lower head, mid-arm circumference, crown-rump length and skin fold thickness. This reiterates the importance of controlling maternal anaemia not only for mothers but also for the health of the baby.

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