ORIGINAL ARTICLE

Impact of Antenatal Maternal Morbidity on Birth Weight and Gestational Age of the Baby

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Abstract:

Background: Maternal morbidity is one of the important risk factors associated with Low Birth Weight (LBW) and preterm births. LBW (birth weight < 2500 g) and prematurity (gestational age <37 weeks) are major contributors of neonatal and infant mortality and morbidity worldwide. Prematurity and LBW are priority public health concerns as both have ongoing impact on the individuals, families, the community as well as on the health system. Maternal risk factors for LBW and preterm births include presence of malnutrition and medical illnesses like anemia, pre-eclampsia, pregnancy induced hypertension etc. *Aim and Objectives:* To study the maternal morbidity in LBW and preterm births. *Material and Methods:* All consecutive eligible women were registered from 1st November 2013 to 30th November 2015. There were 2028 pregnant women who, were followed up during Antenatal Care (ANC) period and the outcome of the pregnancy was noted. Only the pregnant women giving birth to live born singleton babies were included in the study to find out co-relation between antenatal morbidity of the mother during pregnancy and the birth weight and the gestational age of the baby. Thus, the statistical analysis was done for 1876 mothers and babies only. *Results:* Among maternal factors anemia was present in 62.8% pregnant women at registration and was significantly associated with LBW and preterm birth in this study. Out of all conditions related to pregnancy, pre-eclampsia, hyperemesis gravidarum, Pregnancy Induced Hypertension (PIH), poly hydramnios, Ante Partum Hemorrhage (APH) and type of diet were associated with LBW and preterm birth. *Conclusion:* Anemia at registration could be prevented by care of adolescent girls by ensuring good nutrition and giving iron and folic acid supplementations. Good antenatal care and timely identification and management of maternal morbidities will go a long way in preventing LBW and preterm births.

Keywords: Antenatal Morbidity, Low Birth Weight, Preterm Birth, Anemia

Introduction:

Antenatal morbidity is an important factor which determines wellbeing of the baby. Various socio-demographic, maternal and fetal factors may have an etiological role in low birth weight. Maternal morbidity during antenatal period is usually recognized and treated during antenatal care visits. In developing countries, pregnancy and childbirth related complications are the leading causes of mortality and morbidity among women aged 15-44 years. The world development report estimated that 18% of the burden of disease for these women is due to maternal causes. A small prospective study conducted in a village in India reported that there are 16.5 severe pregnancy-related morbidities for every maternal death [1].

Based on some of these estimates, it has been calculated that there are 8.25 million maternal morbidities every year worldwide [2]. Others have calculated that there are over 100 acute morbid episodes for every maternal death, giving a global total of 62 million morbidities annually [3]. According to another estimate, in each year over 50 million women experience pregnancy related complications, 15 million of which lead to long-term illness or disability often because they have no access to medical care, pregnancy has exacerbated already existing malnourishment or illness, or because of substandard medical care that they do manage to access [1]. Most common pregnancy complications associated with Low Birth Weight (LBW) have been malnourishment of mothers, hypertensive disorders and preterm labour. In majority of the hypertensive disorders, pregnancy is terminated before term, leading to increased number of preterm babies [2] considering the importance of maternal morbidity, its association with other socio-demographic, nutritional factors and birth of LBW and preterm births was studied.

Material and Methods:

The present study was prospective cohort study. Samples of 1876 consecutive eligible pregnant women giving birth to singleton live born babies were registered from 1st November 2013 to 30th November 2015. Socio-demographic and information related to health and current pregnancy was collected. Notes of routine antenatal checkup were noted and they were followed up till delivery to identify maternal factors influencing the birth weight and gestational age of the babies. In-depth study of a subset of randomly selected 380 mothers was done to find out risk factors related to maternal occupation, nutrition, sleep at night, rest during day time and education of father. The data was collected by using structured interview schedule. For the present study the approval from Institutional Ethics Committee and informed consent of pregnant women for participation in the study was taken. The data was analyzed using version 20 SPSS software for calculating descriptive and inferential statistics. Descriptive statistics included frequency and percentage distribution of the demographic data of the respondents.

Inferential statistics included Chi-square (χ^2) test for qualitative data, Mean and Standard Deviations (SD), F-test and Bonferroni test for comparison of quantitative data to see variation within the groups. Pearson coefficient was computed to see correlation between two quantitative variables.

Results:

Out of 1876 pregnant women studied 1187 (63.6%) had preexisting maternal morbidity not related to the current pregnancy. Its relation to birth weight and gestational age was found out.

Table 1 shows that there was statistically significant association between antenatal morbidity at registration and proportion of LBW babies (χ^2 =30.273; p <0.001) whereas there was no significant association between antenatal morbidity at registration and proportion of preterm births. (χ^2 = 4.447; p = 0.349). There were seven cases of hypertension and one case each of malaria and TB. Due to small numbers no valid conclusion could be drawn. Anemia being highest morbidity it was studied in details (Table 2).

Table 1: Antenatal Morbidities at Registration and Birth weight, Gestational Age [N=1876]

Morbidities at Registration	Number (%)	Birth weight (g)	Number of LBW (%)	Gestational Age (days)	Number of Preterm (%)
Anemia	1178 (62.8)	2591.1 ± 477.8	430 (36.5)	265.0 ± 15.0	214 (18.2)
Known c/o hypertension	07 (0.4)	1948.1 ± 659.0	07 (100.0)	255.7 ± 8.3	02 (28.6)
Malaria	01 (0.1)	2300.0 ± *	01 (100.0)	259.0 ± **	00 (0.0)
TB	01 (0.1)	2100.0 ± *	01 (100.0)	266.0 ± **	00 (0.0)
Sub Total	**1187 (63.4)**	**2234.8 ± 568.4**	**439 (76.7)**	**261.4 ± 11.7**	**216 (23.4)**
No anemia / no morbidity	689 (36.6)	2651.0 ± 482.1	196 (28.4)	262.6 ± 16.8	150 (21.8)
Total	**1876 (100)**	**2442.9 ± 525.2**	**635 (33.8)**	**262.0 ± 14.2**	**366 (19.5)**
	χ^2 =30.273 ; p <0.001			**χ^2 = 4.447 ; p = 0.349**	

NB: All anemic cases 1178 include [mild anemia (683), moderate anemia (461), severe anemia (16), known c/o hypertension with anemia (15), malaria with anemia (01)

**Due to smaller number of number of malarial cases, investigator couldn't able to compute ± SD of birth weight of newly born babies and also gestational age of pregnant women who had malaria during pregnancy.*

***Due to smaller number of number of tuberculosis cases, investigator couldn't able to compute ± SD of birth weight of newly born babies and also gestational age of pregnant women who had tuberculosis during pregnancy.*

Table 2 shows that anemia during pregnancy and birth weight:

There was a significant direct positive correlation between the basic hemoglobin level of the mothers at registration and the birth weight of the baby. (ANOVA F = 5.875, p=0.001; Pearson Correlation (r) =0.097), p<0.001). The mean birth weight increased with increasing hemoglobin values. Those mothers with < 7g% hemoglobin in the first trimester had 37.5% babies with mean birth weight below 2500 g. Anemia of all grades i.e. mild, moderate and severe was associated with significantly higher rates of LBW. (χ^2 = 10.205; p = 0.017).

Anemia during Pregnancy and Gestational Age:

There was a significant inverse relationship with Hb g% at registration and the gestational period (ANOVA F=7.194; p< 0.001). Bonferroni test revealed that the mean gestational periods of mothers having< 7 g% and 7 to <10 g% of hemoglobin were significantly longer than those with Hb of ⩾ 11 g% (p = 0.005 and p < 0.001 respectively). There was no relationship between proportion of preterm births and Hb g% in 1st trimester.

Table 2: Association of Anemia at Registration with Birth Weight and Gestational Age of the Baby [N= 1876]

Hb g% 1st at Registration	Number (%)	Birth Weight (g)	Number of LBW (%)	Gestational Age (days)	Number of Preterm (%)
<7g%	16 (0.9)	2492.4 ± 472.3	6 (37.5)	271.6 ± 18.3	3 (18.8)
7 to <10g%	469 (25.0)	2533.4 ± 505.7	175 (37.3)	266.5 ± 16.6	81 (17.3)
10 to<11g%	693 (36.9)	2632.4 ± 454.3	249 (35.9)	263.9 ± 13.5	130 (18.8)
Subtotal Anemia <11 g%	**1178 (62.8)**	**2552.7 ± 477.4**	**430 (36.9)**	**267.3 ± 16.1**	**214 (18.3)**
11+g%	698 (37.2)	2642.7 ± 488.5	205 (29.4)	262.6 ± 16.7	152 (21.8)
Total	**1876 (100.0)**	**2610.3 ± 482.4**	**635 (33.8)**	**264.1 ± 15.7**	**366 (19.5)**

A very high proportion of pregnant women i.e. 62.8% were anemic at registration. There were 1178 (62.8%) women who were anemic and 693 (36.9%) could be classified as mild, 469 (25%), as moderate and 16 (0.9%) with severe anemia. The mothers showing mild or moderate anemia were given a higher dose of iron and folic acid tablets containing 60 mg of elemental iron and 1 mg of folic acid and 7.5 microgram cyanocobalamin i.e. 2 tablets daily and those in normal range of hemoglobin were given prophylactic iron and folic acid supplementation i.e. 1 tablet daily. Those with < 7 g% of hemoglobin were given packed cell transfusion or parenteral iron preparations as per the advice of the gynecologist. Status of anemia was found out in the second and third trimester.

The status of anemia during pregnancy was not constant throughout pregnancy. There were 1178 (62.8%) women in different grades of anemia at the time of registration, which got reduced to 612 (32.6%) at the time of delivery after appropriate management of anemia during pregnancy. The women with normal hemoglobin were 698 (37.2%) at registration, which increased to 1264 (67.4%) by 3rd trimester. Although the number of severely anemic women was similar at the time of registration and at third trimester, all those who were severely anemic at registration improved with intervention but some women from normal or mild to moderate anemic group shifted to severely anemic category in spite of oral iron supplementations due to some other associated factors. All of them were managed with packed cell transfusion to ensure that no pregnant woman was in severely anemic category at the time of delivery.

Table 3 shows that proportion of various morbidities in anemic and non-anemic women was found to not differ significantly.

Table 3: Antenatal Morbidity Rates during Pregnancy and Anemia at Registration

Morbidities during Pregnancy	Rate of Specific Morbidity among Anemic Women (n = 1178)		Rate of Specific Morbidity among Non-anemic Women (n = 698)		Rate of Specific Morbidity among All Pregnant Women (n = 1876)		χ2 – Test with Yates correction
	Number (%)	Rate / 100	Number (%)	Rate / 100	Number (%)	Rate / 100	
Pre-eclampsia	70	5.94	32	4.58	102	5.43	χ^2 =1.319; p = 0.2509
Hyperemesis gravidarum	48	4.07	28	4.01	76	4.05	χ^2 =0.0045; p = 0.9465
PIH	26	2.20	20	2.86	46	2.45	χ^2 =0.5425; p = 0.4614
Polyhydraminos	25	2.12	21	3.00	46	2.45	χ^2 =1.093; p = 0.2958
APH	17	1.44	18	2.57	35	1.86	χ^2 =2.498; p = 0.1140
Total	**186**	**15.78**	**119**	**17.04**	**305**	**16.25**	

Table 4: Pregnancy Related Morbidity and Low Birth Weight and Preterm Births in the Baby [N=1876]

Pregnancy related Morbidity	Number (%)	Birth Weight (g)	Number of LBW (%)	Gestational Age (days)	Number of Preterm Births (%)
Anemiaat 3rd trimester	612 (32.6)	2582.1 ± 482.9	222 (36.3)	264.1 ± 13.5	108 (17.6)
Pre-eclampsia	102 (5.4)	2496.9 ± 560.2	48 (47.1)	259.9 ± 17.4	27 (26.5)
Hyperemesis gravidarum	76 (4.1)	2658.8 ± 484.0	22 (28.9)	266.8 ± 14.9	11 (14.5)
Polyhydraminos	46 (2.5)	2568.1 ± 447.6	18 (39.1)	262.8 ± 13.7	06 (13.0)
PIH	46 (2.5)	2483.3 ± 528.7	21 (45.7)	268.4 ± 14.3	04 (8.7)
APH	35 (1.9)	2495.1 ± 749.4	16 (45.7)	249.2 ± 16.5	21 (60.0)
Sub Total	**917 (49)**	**2547.4 ± 542.1**	**347 (40.5)**	**261.9 ± 15.1**	**177 (23.4)**
No anemia/no morbidity	959 (51)	2648.8 ± 455.9	288 (30.0)	264.8 ± 16.6	189 (19.7)
Total	**1876 (100)**	**2598.1 ± 499**	**635 (33.8)**	**263.35 ± 15.9**	**366 (19.5)**
		χ2 = 22.251; p = 0.001		**χ2 = 46.942 ; p <0.001**	

All anemic cases 612 include [mild anemia (305), moderate anemia (124), severe anemia (11), APH with anemia (22), polyhydraminos with anemia (27), PIH with anemia (23), Pre-eclampsia with anemia (48), Hypermesis gravidarum with anemia (52)]

Table 5: Type of Diet and Pregnancy Related Antenatal Morbidities: [N=1876]

Type of diet	No. (%)	Pregnancy Related Antenatal Morbidities						
		No anemia/ no morbidity	All anemic cases at 3rd trimester	APH	Poly hydramnios	PIH	Pre-eclampsia	Hyperemesis gravidarum
Vegetarian	190 (10.1)	121 (63.7)	54 (28.4)	00 (0.0)	01 (0.5)	02 (1.1)	03 (1.6)	09 (4.7)
Mix	1686 (89.9)	838 (49.7)	558 (33.1)	35 (2.1)	45 (2.7)	44 (2.6)	99 (5.9)	67 (4.0)
Total	**1876 (100.0)**	**959 (51.1)**	**612 (32.6)**	**35 (1.9)**	**46 (2.5)**	**46 (2.5)**	**102 (5.4)**	**76 (4.1)**
$\chi 2 = 22.536$; p = 0.001								

Table 4 shows that there was statistically significant association between pregnancy related morbidities and proportion of LBW ($\chi^2 = 22.251$; p = 0.001) and preterm births ($\chi^2 = 46.942$; p <0.001). The mean birth weight of baby delivered by pregnant women who had pre-eclampsia during pregnancy was 2496.9 g with SD of ± 560.2 g and mean gestational age was 259.9 days with SD of ± 17.4 days. Among the antenatal morbidity group pre-eclampsia, APH and anemia had higher proportion of LBW and of preterm births.

Table 5 shows that there was statistically significant association between type of diet and pregnancy related antenatal morbidities. ($\chi^2 = 22.536$; p = 0.001). Vegetarian diet was associated with lower antenatal morbidities such anemia, APH, poly hydramnios, PIH, pre-eclampsia and hyperemesis gravidarum. There was no relationship of number of ANC visits, calories, protein, calcium and iron intake, rest in the afternoon and duration of night sleep of pregnant women and prevalence of antenatal morbidity.

Discussion:

In the present study, anemia of all grades i.e. mild, moderate and severe were associated significantly with higher rates of LBW. There was also a significant inverse relationship between Hb g% in 1st trimester and the gestational period (p<0.001). Low maternal hemoglobin concentration was associated with low birth weight babies in the study conducted by Viswanatha *et al*. [4] at Tumkur, Karnataka, India. In many studies the hemoglobin level (<8 g/dl to ⩾ 11 g/dl) during pregnancy was significantly associated with LBW [5-12]. Anemia as a common nutritional deficiency disorder in pregnant women worldwide has been reported by Monsen [12]. Prevalence of anemia in pregnant women in developing countries is higher than in developed countries [13].

In a retrospective study in British Columbia [13-14] by Smith *et al*. on 515,270 women, 65,906 (12.8%) had anemia. The anemic women had higher rates of preeclampsia, placenta previa and

cesarean delivery. However, in our study out of 1876 pregnant women, 305 had antenatal morbidities of pre-eclampsia, hyperemesis gravidarum, PIH, poly hydramnios, APH, we did not observe any significant difference in the rate of specific morbidity or proportion of women with anemia i.e. 186 (60.98%) as compared to 119 (39.01%) women with no anemia at registration.

A high proportion of anemia at the time of registration in the present study indicates that there was wide spread nutritional deficiencies in the adolescent girls. The anemia if present in the women should be detected and treated before pregnancy and prophylactic iron supplementation given during pregnancy to prevent anemia and its adverse effects on both the mother and the baby.

It is important to identify the risk factors early in the prenatal period so that appropriate interventions are established to ensure the well-being of the mother and child. In the present study, antenatal morbidity such as pre-eclampsia, hyperemesis gravidarum, Pregnancy Induced Hypertension (PIH), poly hydramnios, Antepartum Hemorrhage (APH) was significantly associated with lower mean birth weight and gestational period and the proportion of LBW and preterm birth ($p<0.001$) (Table 4). Similar findings were noted by Rafati *et al*. [15] in Tehran but, no significant association was shown by Sengupta *et al*. [16] in Punjab, India, Theresia *et al.* [17] in northern-eastern Tanzania observed that pregnancy induced hypertension/ pre- eclampsia was nearly seven folds more likely to have preterm delivery as compared to normotensive women. This is consistent in other studies by Zhang *et al*. [18] Alijahan *et al.* [19] Croteau *et al*. [20].

Hypertension decreases the utero-placental blood flow which leads to intrauterine growth restriction that causes preterm delivery. In a study done by Theresia *et al*. [17] also observed that antepartum hemorrhage due to placenta previa was seven times more likely to have preterm delivery as compared to those who had no placenta previa. There are other studies by Offer *et al*. and Zhang *et al*. [21, 18] who have also reported high risk of preterm delivery among women with placenta previa. This could be explained by the abnormal position of placenta where by uterine contraction can lead to heavy bleeding requiring immediate delivery or pregnancy termination. Another cause of APH is abruptio placentae which has been studied and found associated with increased risk of preterm delivery by Zhang [22] at Beijing, Theresia *et al*. [17] who also found mothers who had abruptio placentae to be 4 times more likely to have preterm delivery. This may be explained by separation of a normally implanted placenta from the uterine wall before term which can cause vaginal bleeding, hemorrhagic shock and fetal death which lead to emergency hospital induced delivery even before term. The obstetric and medical factors associated with preterm delivery should be identified early during prenatal period to prevent preterm delivery.

In the present study, 27 (36%) of mothers had PIH and delivered LBW babies, similar results were noted by Viswanatha *et al*. [4], and Aghamolaei *et al*. [23], Fairley [24] has shown maternal hypertension was associated with LBW. Maternal hypertension is thought to cause LBW by affecting placental blood flow thus limiting nutrient supply. Women with severe antenatal morbidity like pre-eclampsia, hyperemesis gravidarum, pregnancy induced hypertension, Poly hydramnios, antepartum hemorrhage, Tuberculosis, and Malaria have

a greater chance to deliver LBW and preterm babies.

In present study, there was statistically significant association between type of diet and pregnancy related antenatal morbidities. (χ^2=22.536; p=0.001). A case–control study, conducted by Frederick *et al*. in 2005 [25] revealed that in 172 pre-eclamptic pregnant women and 339 normotensive controls foods which were beneficial in decreasing the risk of preeclampsia were fruits, vegetables, cereals, dark bread, and low-fat dairy products. Haider *et al*. in 2018 [26] did meta-analysis and showed that vegetarian population exhibits lower stores of iron as compared to non-vegetarians. A study, conducted by Alwan *et al*. [27] on a cohort of 1274 pregnant women aged 18–45 years, showed that vegetarians had adequate iron intakes from diet and they complied with the recommended iron supplementation during the first and second trimesters of pregnancy more than non-vegetarians. Sharma *et al.* [28] described a high prevalence of anemia in Indian pregnant women because of very low frequency of meat eating. But generalization cannot be made as this study was cross-sectional and limited to a specific population. Chang *et al*. in 2018 [29] revealed that the overall estimated relation between vegetarian diet during pregnancy and LBW was marginally significant. Asian (India/Nepal) vegetarian mothers exhibited increased risks to deliver a baby with LBW. Due to controversial results in the comparative studies of antenatal morbidity and type of diet, there is need of additional in-depth studies.

Conclusion:

There was a significant association of maternal morbidities such as anemia, pre-eclampsia, hyperemesis gravidarum, and polyhydramnios, PIH, APH with LBW and preterm births. Regular ANC checkups and interventions to reduce antenatal morbidity will help reduce the severity and in turn reduce LBW and preterm births associated with it.

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