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Original Research Article

Effect of Maternal Undernutrition on Foetal Outcome

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ABSTRACT

Introduction: Maternal dietary nutrient intake during pregnancy plays a key role in the growth of the foetus. Understanding the relation between maternal nutrition and birth outcomes may provide a basis for developing nutritional interventions that will improve birth outcomes and long-term quality of life and reduce mortality, morbidity, and health-care costs. Maternal body mass index (BMI) and gestational weight gain (GWG) represent the major determinants of maternal adaptation to incremental energy needs during pregnancy. Maternal undernutrition associated with low birth weight, preterm birth, low APGAR score, still birth and neonatal mortality. The aim of the present study was to distinguish the effect of maternal undernutrition on the foetal outcome.
Materials and Methods: In the present study 197 placentae were collected under 2 groups. Group-I (Control group): normal pregnant women. Group II (Study group) consists of Subgroup IIA - Undernourished mothers with anaemia, Subgroup-IIB: Undernourished mothers without anaemia, Subgroup-IIC: Anaemic mothers with pre-pregnancy BMI>18.5kg/m2. Out of 197 placentae, 92 were of group I, 41 of subgroup IIA, 20 were of subgroup IIB and 44 were of subgroup IIC.
Results: In the present study, it was observed that increased numbers of low birth weight babies, preterm births, low APGAR score, NICU admissions and still births or intrauterine deaths were significantly increased in undernourished group particularly in undernourished mothers with anemia (Subgroup IIA).
Conclusion: Maternal undernutrition gives poor outcome of pregnancy. Counseling should be needed to all women in reproductive age group so that they can attain normal BMI before conception as well as adequate gestational weight gain during pregnancy. Regular antenatal care is mandatory to take the all sufficient supplements in order to prevent the adverse outcome of pregnancy.

Keywords: Undernutrition, Maternal Body Mass Index, Gestational weight Gain, Anaemia, Foetal Outcome

I. INTRODUCTION

Maternal dietary nutrient intake during pregnancy plays a key role in the growth of the foetus. In population, Malnutrition is very common particularly it increases during pregnancy. Whenever pregnant women suffer by this condition; their fetus is also affected. [1] Understanding the relation between maternal nutrition and birth outcomes may provide a basis for developing nutritional interventions that will improve birth outcomes and long-term quality of life and reduce mortality, morbidity, and health-care costs. [2] Maternal body mass index (BMI) and gestational weight gain (GWG) represent the major determinants of maternal adaptation to incremental energy needs during pregnancy. [3] According to 2009 IOM/NRC13 guidelines for rate of total weight gain during pregnancy for women with singleton foetus are: For women with a BMI < 18.5 Kg/m2, a weight gain of 28–40lb (12.7Kg -18.1 Kg) was recommended; with a BMI of 18.5-24.9 Kg/m2, a weight gain of 25–35lb (11.3Kg-15.8 Kg) is recommended. [4] The weight of the infant at birth is a powerful predictor of infant growth and survival, and is dependent on maternal health and nutrition during pregnancy. [5] Low birth weight is defined by the World Health Organization (WHO) as weight at birth less than 2500 g (5.5lb). Low birth weight continues to be a significant public health problem globally and is associated with a range of both short- and long term consequences. Overall, it is estimated that 15% to 20% of all births worldwide are low birth weight, representing more than 20 million births a year. [6] Maternal nutritional status of pre-pregnancy and gestational weight gain (GWG) affects the preterm birth (PTB). [7] According to World Health Organization, Preterm birth is defined as babies born alive before 37 weeks of pregnancy are completed. [8] Preterm birth infants are associated with low APGAR score and neonatal mortality. [9]

In 1952, Dr. Virginia APGAR developed the score known as APGAR score which is a quick method to know the health of new-born children. [10,11] It was calculated by five features: Appearance (skin colour), Pulse (Heart rate), Grimace response (reflexes), Activity (muscle tone) and Respiration of baby which is summarized in Table 1. Each scored on a scale of 0 to 2, with 2 being the best score, then summing up the five values thus obtained. The resulting APGAR score ranges from zero to 10. The test is generally done at one and five minutes after birth, and may be repeated later if the score is and remains low. Scores 7 and above are generally normal, 4 to 6 fairly low, and 3 and below are generally regarded as critically low. [12]

TABLE 1

	Sign	Score		
		2	1	0
A	Appearance (Skin Colour)	Normal over entire body	Normal except extremities	Cyanotic or pale all over
P	Pulse (Heart rate)	>100bpm	<100bpm	Absent
G	Grimace (Reflexes)	Sneezes, coughs, pulls away	Grimace on suction or aggressive stimulation	No response
A	Activity (Muscle Tone)	Active	Arms and legs flexed	Absent
R	Respiratory effort(Breathing Rate)	Good, Crying	Slow, Irregular	Absent

At 1-minute test low APGAR score may show that the neonate has need of medical attention [13] but does not necessarily indicate a long-term problem, particularly if the score recovers at the five-minute test. An APGAR score that remains below 3 at later time such as 10, 15, or 30 minutes may indicate long-term neurological damage, including a small but significant increase in the risk of cerebral palsy. However, the APGAR test's purpose is to determine quickly whether a new-born needs immediate neonatal intensive care. [10]

Maternal malnutrition may leads to stillbirth and neonatal mortality. [14] According to WHO stillbirth is defined as a baby born with no signs of life at or after 28 weeks' gestation. [15] The first 28 days of life is the neonatal period which represent the most susceptible time for a child's survival. If the death occurs in this period is known as neonatal death. [16] The aim of the present study to distinguish the effect of maternal undernutrition on the foetal outcome.

II. MATERIALS AND METHODS

This study was conducted at the Department of Anatomy, Rama Medical College, Hospital and Research Centre, Rama University, Kanpur (India). The material for the study consists of 197singleton pregnant women who were attended and admitted in the department of Obstetrics and Gynaecology at Rama hospital with permission from the institutional ethical committee and consent of pregnant women. In the present study, 2 groups were made. Control group (Group I): normal pregnant women (Pre-pregnancy BMI between 18.5 kg/m2 - 25 kg/m2, Total weight gain during pregnancy between 11.3Kg-15.8Kg and Hb level is >11grms/dl). Study group (Group II) consist of subgroup IIA - Undernourished mothers with anaemia (Pre-pregnancy BMI <18.5 kg/m2, Total weight gain during pregnancy <12.7Kg and, Hb level is <11grms/dl) Subgroup-IIB: Undernourished mothers without anaemia: (Pre-pregnancy BMI <18.5 kg/m^2, total weight gain during pregnancy <12.7Kg and, Hb level is >11g/dl). Subgroup-IIC: Anaemic mothers with pre-pregnancy BMI>18.5kg/m^2. Out of 197 placentae, 92 were of group I, 41 of subgroup IIA, 20 were of subgroup IIB and 44 were of subgroup IIC. Non anaemic mothers with pre-pregnancy BMI>25kg/m^2 and Twin pregnancies were excluded. In the present study, pregnancy outcome such as low birth weight, preterm births, APGAR score, neonatal intensive care unit (NICU) admissions, stillbirths, neonatal deaths were recorded and analysed.

The Statistical Package for the Social Sciences (SPSS) was used for all data analyses. The outcome variables were expressed as the absolute number (percentage). Logistic regression analysis was performed to compute odds ratios with 95% confidence intervals in subgroups IIA, IIB, and IIIB versus Group I women for well-known foetal outcome.

III. RESULTS

The present study conducted for the foetal outcome of the undernourished mothers which is summarized in Table 2.

TABLE II: EFFECT OF UNDERNUTRITION ON FOETAL OUTCOME

Variables	Groups	YES (%)	NO (%)	OR (95% CI)	P- Value
Low Birth Weight	Group-I (n=92)	10 (10.87)	82 (89.13)	1.0 (Reference)	
	Subgroup-IIA (n=41)	27 (65.85)	14 (34.15)	15.81 (6.29-39.71)	<0.0001
	Subgroup-IIB (n=20)	10 (50)	10 (50)	8.20 (2.74-24.51)	0.0002
	Subgroup-IIC (n=44)	9 (20.45)	35 (79.55)	8.20 (2.74-24.51)	0.1372
Preterm Birth	Group-I (n=92)	14 (15.22)	78 (84.78)	1.0 (Reference)	
	Subgroup-IIA (n=41)	19 (46.34)	22 (53.66)	4.81 (2.08-11.11)	0.0002
	Subgroup-IIB (n=20)	7 (35.00)	13 (65.00)	3.00 (1.02-8.84)	0.0463
	Subgroup-IIC (n=44)	13 (29.55)	31 (70.45)	2.34 (1.00-5.50)	0.0537
APGAR score <7 at 1 min	Group-I (n=92)	14 (15.22)	78 (84.78)	1.0 (Reference)	
	Subgroup-IIA (n=41)	23 (56.10)	18 (43.90)	7.11 (3.08-16.47)	<0.0001
	Subgroup-IIB (n=20)	12 (60.00)	8 (40.00)	5.57 (1.96-15.84)	0.0013
	Subgroup-IIC (n=44)	15 (34.09)	29 (65.91)	2.88 (1.24-6.70)	0.0140
APGAR score <7 at 5 min	Group-I (n=92)	10 (10.87)	82 (89.13)	1.0 (Reference)	
	Subgroup-IIA (n=41)	20 (48.78)	21 (51.22)	7.80 (3.18-19.16)	<0.0001
	Subgroup-IIB (n=20)	9 (45.00)	11 (55.00)	5.47 (1.80-16.58)	0.0027
	Subgroup-IIC (n=44)	8 (18.18)	36 (81.82)	1.82 (0.66-4.99)	0.2437
Still Birth/ Intrauterine Death(IUD)	Group-I (n=92)	1 (1.09)	91 (98.91)	1.0 (Reference)	
	Subgroup-IIA (n=41)	5 (12.20)	36 (87.80)	12.64 (1.43-111.97)	0.0227
	Subgroup-IIB (n=20)	1 (5.00)	19 (95.00)	4.79 (0.29-80)	0.2755
	Subgroup-IIC (n=44)	1 (2.27)	43 (97.73)	2.11 (0.12-34.64)	0.5992
NICU Admission	Group-I(n=90)	10 (11.11)	80 (88.89)	1.0 (Reference)	
	Subgroup-IIA (n=36)	17 (47.22)	19 (52.78)	7.15 (2.83-18.09)	<0.0001
	Subgroup-IIB (n=18)	10 (55.56)	8 (44.44)	5.09 (1.60 -16.13)	0.0057
	Subgroup-IIC (n=43)	10 (23.26)	33 (76.74)	2.42 (0.92-6.36)	0.0723
Neonatal Death	Group-I (n=90)	1 (1.11)	89 (98.89)	1.0 (Reference)	
	Subgroup-IIA (n=36)	2 (5.56)	34 (94.44)	5.24 (0.46-59.63)	0.1823
	Subgroup-IIB (n=18)	1 (5.56)	17 (94.44)	5.23 (0.31-87.83)	0.2499
	Subgroup-IIC (n=43)	1 (2.33)	42 (97.67)	2.12 (0.13-34.7)	0.5986

OR: Odds Ratio; CI: Confidence Interval.

In this study, it was analysed that low birth weight babies in subgroup IIA and IIB were 15.81 and 8.2 times greater than group I which were highly significant (95%CI: 6.29-39.71; p<0.0001) and(95% CI:2.74-24.5; P= 0.0002) respectively whereas in subgroup IIC, it was not significant.

In the present study, it was observed that in subgroup IIA and IIB, preterm birth was 4.81 and 3 times greater than Group-I which were significant (95%CI: 2.08-11.11; p=0.0002 and (95% CI: 1.02-8.84;p= 0.0463) respectively. But, in subgroup IIC, it was 2 times greater than the group I which was showing border line significance (95% CI: 1.00-5.50; p= 0.0537).

In subgroup IIA, IIB and IIC, APGAR score <7 at 1min of born baby was 7.11, 5.57 and 2.28 times greater than group I which were highly significant (95% CI: 3.08-16.47 p<0.0001), (95% CI: 1.96-15.84;p=0.0013) and (95% CI: 1.24-6.70 p=0.0140) respectively. In subgroup IIA, IIB APGAR Score <7 at 5min of born baby was 7.80 and 5.47 times greater than group I which were highly significant (95% CI: 3.18-19.16; p<0.0001) and (95% CI: 1.80-16.58; p=0.0027) respectively But, in subgroup IIC, it was 1.82 times greater than group I which was not significant with the p value 0.2437.

Still Birth/IUD also noticed in subgroup IIA was 12.64 times greater than group I (95%CI: 1.43-111.97) which was significant with the p value: 0.0227 whereas in subgroup IIB and IIC were 4.79 and 2.11 times greater than group I which were not significant with the p value: 0.2455 and 0.5992 respectively.

In subgroup IIA and IIB, NICU admissions were 7.15 and 5.09 times greater than group I which were highly significant (95%CI: 2.83-18.09; p<0.0001) and (95% CI: 1.60-16.13; p=0.0057) respectively whereas in subgroup IIC, it was 2.42 times greater than group I with the p value 0.0723.

In subgroup IIA, IIB and IIC, neonatal death was 5.24, 5.23 and 2.12 times greater than group I but it was not significant with the p value 0.1823, 0.2499 and 0.5986 respectively.

IV. DISCUSSION

In the present study, it was analysed that low birth weight babies in subgroup IIA and IIB were 15.81 and 8.2 times greater than group I which were highly significant p<0.0001 and 0.0002 respectively whereas in subgroup IIC, it was not significant. Saha D et al., (2013) observed that 72% low birth weight babies in underweight mothers [17] while Bharpoda NY et al., (2016) noticed that 69.69%. [18] According to Sangeeta VB et al., (2014) study in anaemic mothers, low birth weight and very low birth weight was found with 54%, 9% respectively. They also analysed that there was a 2.8 times risk of low birth weight in the anaemic group (95% CI=2.1-3.8). [19]

In the present study, it was observed that in subgroup IIA and IIB, preterm birth was 4.81 and 3 times greater than Group-I with the p value 0.0002, 0.0463 respectively. Xinxo S et al., (2013) observed that the women belong to the underweight group were more likely to have a preterm birth [OR =2.7 CI: (1.3 4.1) p<0.001] compared to normal weight women. [7] A meta-analysis of Rahman M et al., (2015) also found underweight women have higher risk of preterm birth. [20] Lone FW et al., (2004) studied that risk of preterm delivery was four times higher among anaemic women with a statistical significant association (95% CI: 2.5–6.3). [21] Sangeeta VB et al., (2014) observed that risk of preterm delivery was 1.7 times higher among anaemic women with a statistically significant association (95% CI: 1.3-2.1). [19] Nair A et al., (2016) noticed that there was statistically significant increased risk of preterm delivery among anaemic women, 27.9% preterm birth in anaemic group and 7.2% in non-anaemic group. [22]

In our study, in subgroup IIA, IIB and IIC, APGAR score <7 at 1min of born baby was 7.11, 5.57 and 2.28 times greater than group I which were highly significant with the p value: <0.0001, 0.0013 and

0.0140 respectively. In subgroup IIA, IIB APGAR Score <7 at 5min of born baby was 7.80 and 5.47 times greater than group I which were highly significant with the p value: <0.0001 and 0.0027 respectively) But, In subgroup IIC, it was 1.82 times greater than group I which was not significant with the p value 0.2437.In the study of Bharpoda NY et al., (2016), APGAR score ≤7 was 10 (30.30%) in underweight group and 6 (13.04%) in normal weight group. [18] Lone FW et al., (2004) analysed that the risk of an APGAR score <7 at 5 min was 1.7 (95% CI: 1.2–3.7) for anaemic women. [21] Ahmad MO and Kalsoom U (2015) observed that the 16 out of 50 babies delivered to mothers in the anaemic group in their study showed a low APGAR at 1 min as against 04 out of 50 in the babies delivered to the mothers in the non-anaemic group. The difference between the two groups was found to be statistically very significant (p<0.003). In their study, 12 out of 50 babies delivered to mothers in the anaemic group showed a low APGAR at five minutes as against 03 out of 50 in the babies delivered to the mothers in the non-anaemic group. The difference between the two groups was found to be statistically significant (p<0.012). The number of anaemic mothers who showed a low APGAR score of their infants were more at both one (32%) and five minutes (24%) as compared to the non-anaemic group (08% and 06% respectively), with a statistically highly significant difference of these two variables (p<0.003 and p<0.01 respectively) between the two groups. [23]

Still Birth/IUD also noticed in subgroup IIA was 12.64 times greater than group I (OR: 12.64; CI: 1.43-111.97) which was significant with the p value: 0.0227 whereas in subgroup IIB and IIC were 4.79 and 2.11 times greater than group I which were not significant with the p value: 0.2455 and 0.5992 respectively. In subgroup IIA, IIB and IIC, neonatal death was 5.24, 5.23 and 2.12 times greater than group I but it was not significant with the p value 0.1823, 0.2499 and 0.5986 respectively. In Kumar HAS et al., (2017) study, 2 neonatal deaths out of 32 in underweight group were observed. [24] On average, the study found 15 stillbirths and 37 early neonatal deaths per 1000 live births. This is consistent with other low- and lower middle-income countries. [25,26] F.W. Lone et al., (2004) found that the risk association of IUD was 3.7 times higher among anaemic women (95% CI: 0.86–14.6). The risk of PNM was 3.2 times higher among anaemic women (95% CI: 0.7–14.6). [21] Sirpurkar M et al (2015) observed that stillbirths are more common in anaemia group (10.53%) as compared to normal pregnancies (3.33%) which is quiet obvious as these conditions are known to affect the perinatal outcome [27] Sangeeta VB et al., (2014) They also were at 1.8 times increased risk of IUD compared to the non-anemic population (95% CI=1.4-2.4). [19]

In subgroup IIA and IIB, NICU admissions were 7.15 and 5.09 times greater than group I which were highly significant with the p value: <0.0001 and 0.0057 respectively whereas in subgroup IIC, it was 2.42 times greater than group I with the p value 0.0723. Hoellen F et al., (2014) observed that admission on neonatal intensive care unit (ICU) was necessary in significantly more cases among underweight group than in normal weight group. [28] Kumar HAS et al., (2017) also noticed that the NICU admissions were 6 (20.67%) in underweight group. [24]

V. CONCLUSION

The present study concluded that maternal undernutrition gives poor outcome of pregnancy with increased number of low birth weight babies, preterm births, low APGAR score, NICU admissions, still births and neonatal deaths. Adverse foetal outcome was greater in maternal undernutrition with anaemia. Counselling should be needed to all women in reproductive age group so that they can attain normal BMI before conception as well as adequate gestational weight gain during pregnancy. Regular antenatal care is mandatory to take the all sufficient supplements in order to prevent the adverse outcome of pregnancy.

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