Special Articles

WOMEN'S HEALTH AND FETAL OUTCOME

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If health is to be "A state of complete physical, mental and social well being and not merely the absence of disease or infirmity"(1), then ideally maternal health would require more efforts on social, economic and cultural fronts than on a Maternal Health Programme. The latter should pay attention to women's health throughout her life time and must involve many fields–Obstetrics, Nutrition, Family Planning, Control of Sexually Transmitted Diseases and other infectious diseases, Health Education and Community Development.

"Status of a woman in society will determine her care and upbringing as a child and thereby her stature as an adult. Her future role within the cultural setting will determine her education and training. These in turn will determine her age at entry into the reproductive role and the tempo of family formation and thereby the eventual family size"(2). Over 60% of women and girls live in countries where the status is poor to extremely poor. These 1.4 billion women live under conditions that threaten their health(3). In most of these societies, females live as third class citizens. The 'Girl Child' is unwanted, female feticide and infanticide are prevalent. In Bombay city alone an estimated 40,000 female fetuses were aborted in 1984(4). Female infanticide is still practiced in many of the communities in Rajasthan (India).

The vital years of girl's development are lost due to discrimination in the area of nutrition and health; she spends long hours each day on household work and care of younger sibs. She is not sent to school or withdrawn early. The female literacy rate for all ages is 24.82 and male literacy rate is 46.89 according to the 1981 census India. The enrolment ratio and school dropout ratios for boys and girls in India are compared in *Table I.*

The 'Girl Child' is presumed to be safer at home and there she is made to work to add to the family income. Miseries do not end here, many of them are married in early adolescence despite prohibitory laws (*Table II*). She starts reproducing even when physically and mentally unprepared to do so and ultimately ends up with a large family. In the process, if a low birth weight female child is born, another victim enters the vicious circle.

The women who would benefit most from prenatal care–the uneducated and poor get it least and less than half the world's women give birth attended by a trained health care provider(5). More than half a million women, nearly all of them in developing countries, die each year in pregnancy or child birth. This amounts to one every minute(3).

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The effect of maternal health, particularly the nutritional status, on the course of pregnancy and its outcome is profound. It has been computed that fetal wastages–abortion, intrauterine deaths and stillbirths–occur in about 20% of conceptions in poorer segment of the population in deveoping countries(6). The percentage of low birth weight (LBW) babies, who have a higher risk of neonatal morbidity, mortality and severe congenital malformations(7), is more. Birth weight is also a determinant of duration of breast feeding(8) and death due to infection(9). The high incidence of LBW babies and increased mortality rates in this group is one of the important contributory factors to high infant and perinatal mortality as reported in many hospital based studies in India(10-13). The association of LBW babies with poor socio-economic status, poor antenatal care and pregnancy complications has also been exhaustively reported(14-16). With respect to prevalence of LBW, it seems that not much has changed in India. Studies carried out in 1955 showed that the proportion of LBW babies in poor rural communities in South India was 38% and in a recent multicentric study this figure ranged from 30 to 50% in the underprivileged population(16,17).

As a generalization, maternal malnutrition is associated with poor body size, body weight and weight gain during pregnancy. Malnourished mothers are more likely to suffer from other nutritional deficiencies like anemia and of micronutrients. Not only is their energy consumption low, they are likely to spend more energy during pregnancy, for majority of them belong to poorer sections of society and add to their

TABLE I–*Education in Relation to Sex*

Parameter	Male	Female
Literacy rates (1981)		
All ages	46.89	24.82
5-19 years	54.46	36.91
Enrolment ratios (1988-89)		
I-V class	115.7	82.5
VI-VIII class	70.8	42.3
School dropout rates (1985-86)		
I-V class	45.84	50.27
VI-VIII class	60.70	70.04

TABLE II–*Sex and Marital Status*

		Male			Female		
1.	Mean age at marriage in India		23.3			18.3	
2.	Percentage of females married						
		R	U	T	R	U	T
	10-14 yr	3.1	1.0	2.6	7.7	2.3	6.5
	15-19 yr	14.7	5.5	12.2	48.2	28.1	43.4
3.	Per cent currently married female who married before the legal age (18 yr)		67.7				
4.	Per cent fertility rates (15-19 yr)		88.3				

R–Rural, U–Urban, T–Total.

family income by indulging in strenuous work even during pregnancy. The ensuing section briefly outlines some aspects of maternal health in relation to fetal outcome, particularly in the Indian context.

Prepregnancy Weight

Various studies have shown that the relationship between prepregnancy weight and birth weight is positive. Karmer(18) did an indepth review of determinants of low birth weight (LBW) in developed and deveoping countries and found that the relationship betwen prepregnancy weight and birth weight is positive. It is approximately of the order of 10 g of birth weight added per kilogram of the woman's prepregnancy weight. A high incidence of LBW in Indian women who weighed less than 40 kg has been shown in ICMR sponsored studies(16,19). The mean birth weight was 2.5 kg if prepregnancy weight of the mother was 48 kg in another Indian study(20). Ramalingaswamy went to the extent of saying that no mother weighing less than 40 kg should be allowed to become pregnant(21). In a recent study(22) to evaluate the scoring system for predicting the risk of a preterm baby, previous history of preterm delivery and prepregnancy weight were the most predictive risk factors in multiparous and nulliparous mothers. The chances of infection in the newborn are also higher(23), especially if the mother's prepregnancy weight is less than 40 kg and weight gain during pregnancy is less than 6.5 kg.

Maternal Height

There is enough evidence to suggest that maternal height has an independent effect on birth weight(24,25) and perinatal mortality. Thirty six per cent of chronically malnourished mothers (height <147 cm) delivered LBW babies in a study conducting in a developing country(20) while only 14% women over 147 cm delivered LBW babies. In an ICMR trial, a higher risk of neonatal mortality was documented with a maternal height below 145 cm(26). The antenatal care programme of Mozambique recommends all nulliparous women below 150 cm in height to give birth at a provincial hospital(27). A higher incidence of prematurity was reported if maternal height was less than 155 cm in an Indian study(28).

The estimated prevalence of 'high risk' women in India in relation to weight and height are summarized in *Table III*. The

TABLE III—*Percentage of Women at Obstetric Risk*

Age (yrs)	Data base	Weight below 38/40 kg	Height below 145 cm
14	Rural (NNMB)	68	45
15	Rural (NNMB)	47	39
18	Rural (NNMB)	24	16
13-49	Urban (ICMR multicentric)	30	20
	Rural (ICMR multicentric)	34	12

NNMB—National Nutrition Monitoring Bureau, Maharashtra.
ICMR—ICMR Multicentric Study(16).

mean heights and weights of Indian women as reported by the National Nutrition Monitoring Bureau and ICMR are shown in *Table IV*.

TABLE IV– *Mean Heights and Weights Indian Women*

Source	Height	Weight
NNMB		
Rural	150.6	42.4
Urban		
High income	154.9	52.2
Middle income	151.8	49.2
Low income	150.4	44.8
Industrial worker	150.7	44.8
Slum dweller	150.0	42.2
ICMR		
Rural	150.7	42.0
Urban	152.7	44.3

NNMB– National Nutrition Monitoring Bureau, Maharashtra
ICMR–ICMR Multicentric Study(16).

Weight Gain During Pregnancy

Maternal nutrition during pregnancy can be assessed by weight gain during pregnancy. It has been shown that with a mean weight gain of 9.9 kg during pregnancy, the mean gestational age was 39.2 weeks and mean birth weight was 3211 (±467 g)(20). Haron and co-workers(29) found that women who gained less than 9 kg gave birth to infants who weighed 120 g less at birth than did women who gained more than 9 kg. Other studies(30,31) have also shown a high risk of LBW and perinatal mortality with weight gain less than 9 kg.

Nutrition During Pregnancy

Women need to eat well throughout their lives and not just when they are pregnant. Undernutrition during childhood can lead to stunted growth and a small and deformed pelvis which in turn can cause obstructed labor. Also, undernutrition and deficiencies of certain nutrients during a woman's reproductive years are suspected to increase the risk of infection and hemorrhage during pregnancy, pre-eclampsia and preterm labor. Surveys in over 80 developing countries have found that 20-45% of women aged 15-44 do not consume enough calories each day(3).

Studies on nutritional requirement during pregnancy suggested that pregnant women need an extra allowance of about 300 kilo calories(32). The Indian Council of Medical Research has recommeded that the dietary allowances for pregnant women should include an additional 300 Kcal of energy and 10 to 15 g of protein daily over and above the recommended intake for the age and matched person during the nonpregnant period(33). Several studies have been undertaken in India and other developing countries to define the effect of low dietary intake on outcome of pregnancy. Ramachandran reviewed(34), the various Indian studies and concluded that women from upper income group consumed more calories per day, had better pregnancy weight and mean birth weight as compared to lower income group (*Table V*).

Poverty alone is not the reason for maternal malnutrition; various other socio-culture factors play an important role in the genesis of malnutrition. Traditionally females get lesser and inferior share of food at home. Food fads and taboos restrict a number of nutritious foods during pregnancy and lactation when the requirement is actually more. Lack of awareness about nutrition due to illiteracy is also a

TABLE V— *Relation to Dietary Intake, Prepregnancy Weight, Weight Gain During Pregnancy and Mean Birth Weight*

Group	Calorie intake Kcal	Pre-preg. weight in kg	Wt. gain during preg. in kg	Mean birth weight in kg
Upper income group (urban)	2000-2500	45-55	11	3.1
Lower income group (urban)	1200-1600	43	6	2.7
Lower income group (rural)	1200-1600	41-42	5	2.7

Adapted from Ramachandran(34).

significant contributory factor to genesis of malnutrition.

Effect of Food Supplementation During Pregnancy

The effect of supplementation during pregnancy has been studied in many developing and developed countries. Various interventional studies implemented to test the effect of supplementation on birth outcome have been reviewed by Villar and Gonzales(23,35) and are reproduced in *Table VI*. It was concluded that nutritional supplementation during pregnancy is associated with a reduction in incidence of LBW. The effect is more pronounced, the more malnourished the mother is before pregnancy. However, it is unrealistic to expect that the nutritional handicap developed during many generations can be overcome in a period of three to five months of modest nutritional supplementation initiated only after the onset of pregnancy.

One of the Indian studies showed an increase of as much as 458 g in the mean birth weight when mothers with pre-pregnancy weight of less than 45 kg were given supplementation. Prolonged supplementations have better results. The outcome of second pregnancy is better if supplementation has been continued through lactation and interval between the second pregnancy. Encouraged by the results of these trials many developing countries have started food supplementation programmes. But even when the logistics of reaching the food to women have been meticulously worked out and efficiently carried out, food sharing in the family reduces the impact(23,35).

Physical Activity and Energy Expenditure During Pregnancy

Maternal nutrition and outcome of pregnancy does not solely depend on caloric intake during pregnancy. It is the 'calorie gap' between the consumption and energy expenditure that will determine the outcome of pregnancy. Indian women according to one study, work for an average of 13-18 hours a day(36). Poor health facilities, physiological stress of pregnancy and labor in a hard working malnourished mother collectively increase the morbidity and mortality in the mother and newborn. Physical activity increases energy expendi-

TABLE VI--*Summary of Supplementation Trials*

	New York	Montreal
Type of study	Random distribution double blind	Food given at dispensary
Sample size (suppl. + non-suppl.)	768	2426
Population	Poor black; previous LBW protein-intake < 50 g/day	Low SES; inadequate diet
Anthropometry	< 110 lb; low weight gain in pregnancy	
Supplement	Flavoured drink to 2 groups + medical attention to all; real increase in intake; (1) 27 g protein/ 275 kcal; (2) 4 g protein/212 kcal; (3) no kcal, no protein; all received vitamins + minerals	Eggs, milk, oranges
Duration of suppl.	Before 30 weeks of pregnancy	
Effect on:		
Mother	Increased weight gain in suppl. mothers; greater if early enrolment	Increased weight gain in suppl. mothers (0.3 lb; NS)
Birth weight	High-protein group: decreased BW by 32 g; Low protein group: increased BW by 41 g (both $p < 0.05$)	40 g (3251 vs 3291 g) ($p < 0.05$)
Prematurity	Increased premature births in high protein-group	5.7% in suppl.; 6.8% in control (NS). Difference in gestational age 0.4 days; NS
Differential impact depending on sex	Not detected	No
Adverse effects	Increase preterm, IUGR, neonatal mortality in high-protein group	None
Others		Increased effect on 1st birth; increased effect on BW if pre-gest. weight was < 140 lb (difference 53 g *vs* 40 g)

TABLE VI *(Contd.)*

	Birmingham	WIC
Type of study	Not random; suppl. given to Asian mothers of 1 maternity	National level; food + education to women of low SES
Sample size (suppl. + non-suppl.)	142	788
Population	Suppl. given independent of nutritional status	High nutritional and economic risk; control for confounding
Anthropometry	+155 cm ht.;54 kg weight (50th percentile)	Different for each study; no data
Supplement	(1) 30 mg vit. C + 30 mg Fe; (2) 1 + 273 kcal; (3) 1+2+26 g protein	Milk, eggs, cheese, cereals with iron, beans, peanut butter, orange juice
Duration of suppl.	Suppl. offered from 18-20 weeks of gestation	1st, 2nd or 3rd trimester; no effect due to suppl. duration
Effect on Mother	Increased weight gain in 2nd trimester (fat); increased increment in lighter mothers	Not studied
Birth weight	Not equal between 3 groups; the lightest suppl.*vs* unsuppl.difference in BW was 310 g	Increased 108 g (80 g adjusted for gestational age); increased 174 g in adolescent mothers (<20 yr); 5.2% decrease in LBW
Prematurity	Not reported	5½ days increase
Differential impact depending on sex	No	Not reported
Adverse effects	None	Not reported
Others	No effect on well-nourished women	Increased effect on black, Hispanic and adolescent mothers

TABLE VI--*(Contd.)*

	Mexico	India
Type of study	Supplement to pregnant women; analysis done by matching by weight, height, parity, health,	Poor women hospitalized given suppl.; high SES and low SES used as controls SES
Sample size (suppl. + non-suppl.)	80	32
Population	Suppl. women ate more than unsuppl. after controlling for suppl.; mean intake before suppl. 1950 kcal/ 50 g protein	Poor, low SES; diet before suppl.: 1400-1800 kcal/40 g protein
Anthropometry	144-156 cm height	45 kg w/o clinical signs of malnutrition
Supplement	300 kcal/20 g protein	At hospitalization women were given 2300 kcal/80 g protein + bed rest
Duration of suppl.	From last menstruation	From 36 weeks gestation
Effect on:		
Mother	Increase increment in suppl. mothers (3.4 kg)	Not reported
Birth weight	Increased 180 g; 29.6% decrease LBW	Increased 458 g
Prematurity	Not reported	Not reported
Differential impact depending on sex	Not reported	Not reported
Adverse effects	Not reported	Not reported
Others		

TABLE VI--*(Contd.)*

	Bogota	Guatemala
Type of study	Random assignment to pregnant women	Suppl. to women of four communities; attendance voluntary; *ad libitum* intake (measured)
Sample size (suppl. + non-suppl.)	385	405
Population	Poor; women with at least 50% of children with 85% wt/age; diet before suppl.: 1600 kcal/35 g protein	Poor, endemic malnutrition in community; ;high infection: previous mean intake: 1500 kcal/40 g protein
Anthropometry	149.9 cm	149 cm
Supplement	Dry skim milk; enriched bread; veg. oil; vitamins + minerals for the whole family, net increase 155 kcal/20 g protein	*Ad libitum* intake (measured) of calories and protein or of calories only
Duration of suppl.	1st or 2nd trimester of gestation	Any trimester (measured)
Effect on:		
Mother	Increased weight gain only in those bearing male fetuses	Increased weight gain; increased placental weight; increased RNAse activity; decreased post partum amenorrhea; decreased interval between births
Birth weight	Increased 51 g NS; only males, 95 ($p<0,05$); females, NS	Positive effect; dose response 29 g increase 10,000 kcal suppl.: 10% decrease LBW; <20,000 *vs* >20,000 kcal intake ± 111 g diff.
Prematurity	No effect	Yes; no effect if enrolment only during 3rd trimester; 1.1 day/ 10,000 kcal; 1sr *vs* 3rd tercile of ingested suppl.: difference 1.4 wk
Differential impact depending on sex	Selected effect only for males; no effect on males	Not reported
Adverse effects	None	Not detected (authors report under-registration and there could be bias)
Others	Decrease neonatal and perinatal mortality in suppl. group (NS)	

TABLE VI--*(Contd.)*

	Taiwan	Gambia
Type of study community	Random double-blind	Suppl. to all pregnant women of
Sample size (suppl. + non-suppl.)	506	274
Population	Poor women with at least 1 son: previous mean intake: 1200 kcal/40 g protein	Rural population; previous mean intake: 1480/1800 kcal during dry/ wet season
Anthropometry	7	7
Supplement	3 groups: (1) 800 kcal/40 g protein, (2) 80 kcal/0 g protein (3) nothing; medical attention to all	Groundnuts, biscuits, tea with vits.; approx. 1000 kcal 481 kcal net increase
Duration of suppl.	Pregestational and during entire pregnancy	Started before week 16; lasted atleast one mo.
Effect on:		
Mother	None (same weight gain)	Increased weight gain when supplemented
Birth weight	Increased 42 g in males; increased 63 g in females; decrease % LBW in suppl.	224 g difference mean pre-post suppl. (controlling for gest. age) in the wet season
Prematurity	No effect	After *vs* before suppl.: -0.33 wk in males; +0.65 in females (both NS)
Differential impact depending on sex	No clear tendency	No difference
Adverse effects	None	None
Others		Effect only during wet season; no effect during dry season

Note: Offered supplements should not be completely added to habitual diet, because this decreases slightly as a result of the supplement (substitution effect). Some studies report the increment is the result of the supplement. This Table contains the available information from the studies.
SES = socio-economic status.
Adapted from Villar *et al.*(23,25).

ture and, therefore, requirements. It may decrease blood flow to fetal and placental unit. Some studies(37,38) have shown that physical activity adversely affects not only the birth weight but also duration of pregnancy.

The Ethiopian study(39) showed that poor women with heavy physical activity had babies weighing approximately 200 g less than the babies of women of similar socio-economic strata but without demanding physical work. Intensity of work outside the home estimated by an activity score was found to be associated with birth outcome in another study(20).

In India(34), urban working women of high, middle, low middle and low income group added to the purchasing power of their families. Nutritional status of mother and children did not show any differences in working and non working mothers in high and middle income groups. Improved maternal nutrition status was found in employed lower middle income group. Employment prevented deterioration of nutritional status due to poverty in the urban low income group. The effect of strenuous work in urban poor has not been studied adequately in India. In rural poor, work otuside house affects the nutrition of the mother.

Effect of Anemia

Hemoglobin level is an important indicator of the nutritional status of a woman. According to the WHO estimates(3), three of five pregnant women in developing countries except China are anemic (Hb below 11 g/dl). A diet lacking in absorbable iron, previous menstrual bleeding, malaria and worm infestation are the important causes of anemia in pregnant women.

Anemic women have poor resistance to infection and are less likely to survive hemorrhage or other complications of labor and delivery. In a study(41) in 12 Indonesian hospitals, anemic women were four times as likely to die in child birth as non anemic women. A close association has been shown between the incidence of prematurity, low birth weight and perinatal mortality on one hand and level of hemoglobin on the other(42). There is two to three fold increase in perinatal mortality rate when maternal hemoglobin levels fall below 8 g/dl and 8-10 fold increase when maternal hemoglobin falls below 5 g/dl.

Anemia not only results in poor fetal growth but also acute or chronic hypoxia, which in turn is responsible for intrauterine death as well as chronic growth failure *in utero*. A collaborative study(43) done in rural areas of Hyderabad, Calcutta and New Delhi and urban areas of Madras showed that percentage of women with anemia varies from 22.3 to 99.2 (*Table VII*). One of the hospital based studies(44) from India recorded that 40% of the mothers in the age group 20-25 yrs had anemia. The incidence of iron deficiency was 68%,

TABLE VII—*Percentage of Anemic Women in India*

Age group (years)	Hyderabad (Rural)	Calcutta (Rural)	Delhi (Rural)	Madras (Urban)
15-24	73.9	98.3	65.9	22.3
25-44	66.8	99.2	66.1	33.8

dimorphic anemia 30% and megaloblastic anemia 2%. Cardiac failure in the mother was a very common (78%) complication. Nearly 24% mothers delivered prematurely and 10% had intra uterine growth retardation. Another hospital based retrospective analysis(45) showed that 43% of mothers presented with severe anemia (Hb<6g/dl). Nearly 93% of these patients had dimorphic anemia and only 7% showed microcytic hypochromic anemia. Most of the patients belonged to poor socio-economic strata. The perinatal mortality was 46.3% as compared to 18% in controls; 61.7% had LBW babies with a mean birth weight of 2.2±0.64 kg as compared to 2.6±0.53 kg in controls. Nearly 41% deliveries were preterm as compared to 18% in controls. The incidence of prematurity was reported to be three times more in anemic mothers (Hb 10 g/dl) than in controls in another Indian study(28).

Adolescent Pregnant Female

The adolescent period is a crucial phase of growth since it offers the second and last chance of growth in the life cycle of girls(46). In many cultures, early marriage and child bearing are the norm. Early marriage is most common in the Indian subcontinent and in Africa. It is least common in East Asia and Latin America(3). On an average, women who marry between 15 and 19 years bear six or seven children.

Since there is a strong correlation between women's stature and birth outcome, a WHO report estimates that children born to adolescent mothers are about 40% more likely to die during the first year of life than children born to women in their twenties. Maternal mortality rates are reported to be five times higher in 10-14 years old as 20-24 years(47).

Adolescent mothers belonging to poor socio-economic strata suffer more because chronic undernutrition retards skeletal growth and maturation, postpones menarche and extends the length of growth periods. Hence, these girls are denied the advantage of better growth and better body built. A study from urban population of India(48) indicates that the average height and weight of low socio-economic girls is 146 cm and 37.4 kg as compared to 154.8 cm and 46.6 kg, respectively for the high socio-economic group.

During pregnancy and lactation, the adolescent mothers have a definite disadvantage. Adolescent pregnant women gained less weight during pregnancy and lost more weight during lactation as compared to adult pregnant women(49). The mean birth weight of baby was also less in adolescents. Infants of adult women had significantly better growth in weight and height after birth in the same study.

To raise the age of marriage, only legislation may not be very effective as experienced in India. However, in combination with education of girls it may prove helpful. In Ghana(3) a study found that most uneducated women married between 13 and 16, while women with at least primary education waited till after the age of 18 years.

In conclusion, maternal health particularly nutritional status is an important reflector of maternal and fetal morbidity and mortality. Chronic malnutrition through early childhood and adolescence results in a short statured mother with a low prepregnancy weight. Nutritional intervention during pregnancy has a limited role in improving the outcome of pregnancy. The caloric gap during pregnancy is more important than the calories consumed and calories spent (physical exersise) considered separately. Malnourished girls who

get married and produce children during adolescence have a much higher risk of adverse outcome of pregnancy.

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NOTES AND NEWS

EIGHTH ASIAN CONGRESS OF PEDIATRICS

The Eighth Asian Congress of Pediatrics is scheduled to be held at New Delhi from *February 6-12, 1994.* Suggestions are invited for a suitable theme and logo for the Congress. The selected entries will be suitably acknowledged/rewarded. The suggestions may kindly be mailed to:

Dr. R.K. Puri,
Secretary-General (Organizing),
Eighth Asian Congress of Pediatrics,
Department of Pediatrics,
Maulana Azad Medical College,
New Delhi 110 002.