DETERMINANTS OF LOW BIRTH WEIGHT: A COMMUNITY BASED PROSPECTIVE COHORT STUDY

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ABSTRACT

The study aimed at identifying and quantifying determinants of low birth weight (LBW) by following a community based prospective cohort of pregnant women in 45 villages in Pune district. In the 1922 live births born to mothers without a chronic illness, in whom birth weight was available within 24 hours, the cumulative incidence of LBW(<2500 g) was 29%. The unadjusted relative risks for LBW were significantly higher for lower socio-economic status (RR=1.71), maternal age less than 20 years (RR=1.27), primiparity (RR=1.32>, last pregnancy interval less than 6 months (RR=1.48), non-pregnant weight less than 40 kg (RR=1.3), height below 145 cm (RR=1.51), hemoglobin less than 9 g/dl (RR=1.53) and third trimester bleeding (RR=1.87). Multivariate logistic regression analyis showed that the adjusted odds ratio for LBW decreased with increasing gestational duration, non-pregnant weight, parity and rising education level of the mother.

Socio-economic status, non-pregnant weight, maternal height, and severe anemia in pregnancy had substantial attributable risk percent for LBW(41.4%, 22.9%, 29.5% and34.5%, respectively). The findings suggest that selectively targetted interventions such as improving maternal education and nutrition, specifically anemia, wider availability of contraception to delay the first pregnancy and to increase pregnancy intervals may help in identifying and ensuring adequate care for those women at greatest risk of LBW.

Key words: *Low birth weight, Maternal education, Anemia, Pregnancy.*

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Birth weight is an important predictor of perinatal and neonatal survival(l). However, much of the information available on low birth weight (LBW) in India is hospital based(2,3). This study was undertaken to identify and quantify the risk factors for LBW using a community based prospective cohort study.

Material and Methods

Study Design

The study design was a community based prospective cohort drawn from a base population of 100,000, spread over 45 contiguous villages in Pune district of India. A census of eligible couples and currently pregnant women was prepared by a baseline house to house survey during the pilot phase of the study. Subsequent pregnancies in the 18 month study period were identified by periodic village visits made by medico social workers.

A village information system consisting of already enrolled pregnant women, traditional birth attendants, community health guides, elderly women, and members of women's groups, was developed. These 'notifiers' were instrumental in the early identification of new pregnancies and subsequently in ensuring that newborns were weighed within 24 hours of delivery.

Baseline information was collected on all the enrolled women by trained medico social workers using a pre-coded and pre-tested question schedule. Gestational age at identification was noted and subsequently verified by clinical examination by a physician. The women were followed up at monthly intervals during the pregnancy, and information collected on weight gain, antenatal care received, exposure to medications, tobacco and cooking fuel smoke. Hemoglobin was estimated every trimester by the photo-calorimetric method. Each woman was examined by a physician at least once in each trimester.

Delivery particulars of each mother were noted and the newborn weighed within 24 hours of birth wherever possible. Weight[%] was recorded to the nearest 25 g using a Salter type spring balance. In the study area, there is a tradition of temporary migration of the pregnant woman to her parent's house in the last 'trimester especially for primigravida women. A monitoring system was designed and implemented to follow such migrating mothers outside and into the study area, in order to minimize the 'loss to follow up'. A total of 1922 pregnant women who delivered live births and in whom birth weight was available within 24 hours were analyzed. Cases lost to follow up due to temporary and/or permanent outmigration, mothers with chronic illnesses and twin births were excluded from the analyses. All birth weights less than 2500 g were taken as LBW.

Results

The cumulative incidence of LBW in the cohort was 29%. The LBW group differed significantly from the normal weight group in the prevalence of certain risk factors *(Table I).* The proportion of very low income mothers, determined using an appliance code as a surrogate for socio economic condition, was significantly higher among the LBW newborns. Amongst the LBW there were a significantly greater proportion of primiparas, mothers below the age of 20 years and women with a last pregnancy interval less than 6 months. Severe anemia with hemoglobin level below 9 g/dl, non-pregnant weight below 40 kg, height less than 145 cm and gestational duration of less than 37 weeks was significantly more common amongst the mothers of LBW babies. This group also showed a preponderance of girls as compared to boys. These maternal factors also showed a significantly higher unadjusted relative risk and attributable risk per cent for developing LBW.

The adjusted odds ratios for developing LBW *(Table II)* decreases significantly with increasing gestational duration, increasing non-pregnant weight of the mother, increasing parity, and with increasing education status of the mother. The adjusted odds ratio for LBW is also lower for male newborns as compared to females. Logistic regression analysis also showed that some factors like tetanus immunization status of the mother, maternal height, 1st or 2nd trimester bleeding, and history of previous stillbirths adversely affected the risk for LBW.

Discussion

The 29% incidence of LBW is comparable to that reported from other studies in the Indian subcontinent(2,3,6-13). Analysis of the unadjusted relative risks showed many factors to be associated with an increased risk of LBW. Since most of them were interrelated, multivariate analytic techniques were used to study independent effects of each factor.

TABLE I—*Risk Factors and Relative Risks for Development of LBW.*

Risk factor (RF) (ref cat)[1] (a)	Prop. RF in LBW[2] (b)	Prop. RF in NBW[3] (c)	Unadj. RR 95% CI[4] (d)	AR % (PF)[5] (e)
Very low SE status (ref cat: high)	20.7%	15.3%	1.71 (1.2, 2.4)	41.4
Age 18-<20 yrs (ref cat: 20-<25 yrs)	22.6%	16.6%	1.27 (1.07, 1.5)	21.3
Education 8-10 yrs (ref cat: illiterate)	8.8%	11.6%	0.78 (0.6, 1.02)	(21.5)
Primiparity (ref cat: parity 2)	35.0%	24.2%	1.32 (1.1, 1.59)	24.4
Non-pregnant wt <40 kg (ref cat: 40-<45 kg)	47.1%	34.5%	1.3 (1.09, 1.54)	22.9
Hb 7-<9 g/dl (ref cat: ≥11 g/dl)	23.6%	20.3%	1.53 (1.1, 2.1)	34.5
Last pregnancy interval <6 mths (ref cat: 24-<36 mths)	40.5%	28.4%	1.48 (1.2, 1.9)	32.5
Height 140-<145 cm (ref cat: 150-<155 cm)	12.6%	7.7%	1.51 (1.2, 1.9)	29.5
Gestation duration <32 wks (ref cat: 37-<42 wks)	3.3%	0.0%	3.84 (3.5, 4.2)	73.9
3rd trimester bleeding (ref cat: no bleeding)	2.4%	0.9%	1.87 (1.24, 2.84)	46.6
Male newborn (ref cat: female)	46.0%	54.7%	0.78 (0.68, 0.9)	

1 Referent category of the maternal risk factor given in parenthesis.

2 Proportion of the risk factor in mothers with LBW newborns (Sample size : 557).

3 Proportion of risk factor in mothers with normal birth weight newborns (Sample size : 1365).

4 Unadjusted relative risk (with 95% confidence limits in parenthesis).

5 Attributable risk per cent (or preventive fraction in parenthesis).

TABLE II–*Interpretation of the Logistic Regression Model with Adjusted Odds Ratios and 95% Confidence Limits.*

Risk Factor[6]	Adjusted Odds ratio	95% Upper limit	95% Lower limit
Gestation Duration[7]	0.207	0.308	0.139
Non-pregnant weight[8]	0.711	0.806	0.626
Parity[9]	0.835	0.916	0.762
Maternal education[10]	0.869	0.966	0.782
Newborn sex[11]	0.326	0.678	0.045

[6] Risk factors which were retained in the final logistic regression model.
[7] Gestational duration categories: <32, 32 to <37, 37 to <42, > = 42 weeks.
[8] Pre-pregnancy weight categories: <40, 40 to <45, 45 to <50, > = 50 kg.
[9] Parity categories : 1, 2, 3, 4, > = 5.
[10] Mother's schooling categories : 0, 1 to 4, 5 to 7, 8 to10, > = 11 years.
[11] Newborn sex categories : Males, females.

Dowding(14) has shown socio-economic class of the mother to influence birth weight. In our study, the only socio-economic factor to retain significance was maternal education. Though the study was prospective in nature, non-pregnant weights of mothers were not available, as women were identified in pregnancy. The lowest recorded weight of the mother in the period 6 to 12 months after delivery was taken as the surrogate for non-pregnant weight. The risk of LBW was seen to decrease significantly with increasing parity. Similar results have been seen in other studies(14,19-21). Dougherty(20) and Roosmallen(21) report the mean birth weight of neonates born to primiparous mothers were less than that for multiparous mothers by 104 g and 100 g, respectively. Dowding(14) reported that the incidence of LBW was higher in the first, fifth and subsequent pregnancies. Murphy *et al.* (22) showed a slight increase in birth weight with increasing parity in the lower parity groups, but thereafter, no such trend is apparent.

The risk of LBW for male newborns was lower in our study. Similar findings have been reported by other studies(l,20,21). Dougherty(20) reports a mean birth weight of 118 g lower for females compared to males.

The potential importance of any factor taken in isolation in preventing LBW should be interpreted with caution as these may be interrelated. However, our results support the strategy that a substantial reduction in LBW could be achieved by selectively targetting limited resources to interventions for improving maternal education and nutrition, specifically anemia and delaying the age at first pregnancy and encouraging wider intervals between births, for mothers at greatest risk of having a LBW baby.

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