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Annals of Pediatrics & Child Health

Research Article

Early Assessment of Risk for Low Birth Weight Using Simple Scoring Tool among Mothers from Rural India

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Submitted: 12 November 2020

Accepted: 14 December 2020

Published: 17 December 2020

ISSN: 2373-9312

Keywords

- Early assessment; Pre-pregnant variables; Intra pregnancy variables

Abstract

Background: Identification of mothers at risk, early in gestation is essential In India as both maternal undernutrition and prevalence low birth weight (LBW) is high.Therefore, simple screening tool based on non-invasive early markers of risk for LBW at registration was attempted.

Method: Mothers registering for antenatal care (ANC), within 20 weeks of gestation at a rural hospital in Maharashtra, India were studied (n=370), for socioeconomic, demographic variables, dietary consumption pattern and anthropometric measurements and were followed up till delivery.

Result: Mothers were thin (weight 46.0 ± 7.4 kg), and short (height150.8 ± 6.1 cm) and undernourished (BMI<18kg/m2). 9.8 % of mothers were below 38 kg while 8.6 % of mothers were below 145 cmwhich are known risk cut offs for LBW. Among the pre-pregnant factors, significant risk (OR=2.2; CI: 1.1-4.3), for LBW was seen for maternal age (<20 yr); previous abortion (OR=3.0;CI:1.7-5.3), and for low (<42.5 Kg), maternal weight (OR=2.1;CI:1.2-3.6). Among intra pregnancy variables risk was seen for lower consumption (<2/d) of staple food roti (OR=1.7; CI: 1.0-2.9), and no consumption of milk (OR=1.8; CI:1.0-3.1). Receiver Operating Curve (ROC), analysis was used to obtain risk cut off for total score based on five maternal variables, all of which can be recorded at registration by a health worker lowest in hierarchy. This score showed 76% sensitivity in identifying LBW mothers. Risk of LBW was high (OR=3.0, CI: 1.4-6.3) in mothers with score 9 to 12 and was higher (OR=4.4,CI: 1.9-9.8), for score >12.

Conclusion: Early identification of high risk mothers will help providing them intervention during gestation.

ABBREVIATIONS

LBW: Low Birth Weight; FFQ: Food Frequency Questionnaire; BMI: Body Mass Index; OR: Odds Ratio; ANOVA: Analysis of Variance.

INTRODUCTION

Low birth weight (LBW), is a prospective marker of future growth and development and a retrospective marker of mothers' nutritional and health status. Although several pre pregnancy (gestational age, maternal age, maternal smoking maternal pre-pregnancy weight, BMI, parity) and intra pregnancy (dietary intakes, weight gain during pregnancy), factors associated with birth weight are well studied [1,2], they differ with geographical, socio economical and ethnic variation [3-5]. It is critical that important factors need to be identified which can lead to prediction of risk of LBW at early gestation.

Intra pregnancy variables like total weight gain and BMI in third trimester and pregnancy induced hypertension, although are known to be major predictors, are not useful for early prediction. New technology such as ultra sonography, permits accurate estimation but is not easily accessible for rural population, where LBW is more prevalent. This further escalates the need for a simple screening tool for identification of this risk even by a health worker.

It is worthwhile to consider that apart from the usual anthropometric and demographic factors, it is essential to identify food(s) that are associated with risk of LBW. For example, intake of milk has been consistently shown to be positively associated with birth weight [6-9]. Birth size is also shown to be strongly related to intake of GLV and fruits at 28 weeks, showing its independent effect among rural undernourished mothers [8]. Recently, it is reported that the inadequate intake of staple food like roti and functional food like milk are risk factors for LBW among poor undernourished mothers [10].

Thus, LBW is an outcome of poor maternal environment that comprises of several socio economical, demographic, clinical, nutritional status and dietary factors acting simultaneously. Based on such factors, a simple screening tool is therefore required for rapid and early assessment of risk of LBW especially at registration. Risk scoring for LBW by earlier researchers [11], included clinical factors like low Hb, Rh-ve blood factor and pregnancy induced hypertension, foetal distress, gestational age less than 37 weeks, previous rupture of membranes and prolonged labour, which are useful only in identifying clinically

high risk cases but are not able to identify risk of LBW in clinically normal mothers at early gestation. Based on few pivotal maternal variables, present study attempts a simple risk scoring tool identifying the mothers at registration itself who are at risk of delivering LBW baby.

MATERIALS AND METHODS

Present study was a hospital based prospective study, carried out at Dr. Bhausaheb Sardesai Rural Hospital Talegaon, attached to MIMER medical college.

Subjects

The study population comprised of Antenatal Care cases who registered themselves at the Obstetrics and Gynecology out patients department of the hospital, for the first time within 20 weeks of gestation. Considering 35% prevalence of LBW with 5% tolerance estimated sample size was 425 cases allowing for 15% loss to follow up. Clinically apparently normal ANC cases within 18 to 40 years of age, were enrolled in the study after obtaining their oral informed consent. Out of 459 initially enrolled, there were exclusions due to abortions (21), still births (3), intra uterine growth retarded (IUGR) (2). Of the remaining 433 cases, exclusions due to multiple pregnancies (4), major illness (thyroid -1 and pregnancy induced hypertension-1), changing the place of delivery (6) and premature deliveries (51), data on 370 full term mothers is analyzed. Ethical clearance was sought from Ethical Committee of MIMER medical college.

Qualitative information

Maternal socio economic and demographic information was collected on each enrolled woman at the time of registration using a structured and validated questionnaire. It comprised of size of the family, monthly income, education and occupation of the mother as well as her husband. The demographic information about her age at menarche, marriage and at registration was also recorded. Similarly, obstetric information on variables like parity, spacing and previous abortions, if any, was recorded for each mother. Maternal activity was also recorded as time spent in domestic work, leisure activities and work done outside, using pretested activity questionnaire.

Anthropometric measurements

Maternal height was measured (up to 0.1 cm), using stadiometer (Standard Steel Co. Model SECA213, India), weight was measured using (up to 100 g) digital weighing balance (Smart Care Co. Model SCS110A, India) , mid arm and head circumference was measured (up to 0.1 cm), using non stretchable measuring tape and body fat (%), was recorded using body fat analyzer (HBF300, OMRON Corporation, Japan)at each ANC visit. Babies were measured at birth using digital weighing scale (Homedics Group Ltd. Model Salter 914, India), was used for measuring length.

Maternal dietary intake

Dietary intake was assessed using pre tested food frequency questionnaire (FFQ), to record consumption of various foods and their frequency in last one month. It covered total of 54 food items divided into 13 groups such as milk, milk products, cereals, lentils, legumes, vegetables, green leafy vegetables, fruits, non-vegetarian foods, snacks, bakery products etc. Amount of food intake was measured in terms of number of roties and in terms of serving spoons of standard size for other foods. Frequency of consumption in terms of once, twice or more in a day / week or month was noted.

Statistical methods

Variables deviating from normality were transformed for achieving it before using them in the statistical analysis. Means of two groups were compared using 't' test while linearity in group means was tested using analysis of variance (ANOVA). Logistic regression was done to estimate odd ratio (OR), for risk of LBW in higher category considering lower category as reference category for various risk factors. FFQ scores were used as grouped variable. We identified maternal risk factors for LBW which can be recorded at registration and ORs were used to develop a simple scoring system for screening the mother's risk of delivering LBW, which has high sensitivity and specificity. Statistical analysis of data thus collected was done using SPSS 19.0 version.

RESULTS

Pre pregnant variables and risk of LBW

Socio economic, demographic background of mothers: Most mothers (56.5%), had family size < 5 and over 80% of mothers and their husbands had education only up to 10thstd

Table 1: Socioeconomic, demographic, obstetric and anthropometric measures of mothers.

Variable	Category	N	Mean or % frequency
Family Size	<5	205	56.5
	>=5	158	43.5
Maternal education	Up to 10thstd	323	87.8
	>10th std	45	12.2
Husbands education	Up to 10th std	307	83.7
	>10th std	60	16.3
Mothers occupation	Household / farming	338	92.3
	Heavy	28	7.7
Husbands occupation	Unskilled	170	47.1
	skilled	191	52.9
Family income (Rs)	<2000	55	15.3
	2000-5000	162	45.0
	>5000	143	39.7
Parity	Primy	153	41.6
	>1	215	58.4
Spacing (yr)	<2	119	55.6
	>=2	95	44.4
No. of abortions	Nil	111	51.9
	>=1	103	48.5
Age at menarche (yr)	<14 14-15 >=15	105 141 119	28.8 38.5 32.7
Age at registration (yr)	< 20 20 -25 >=25	57 215 98	15.4 58.1 26.5

(Table 1). Mothers were either housewives or were engaged in farming (92%). Their husbands were also largely (47.1 %), engaged in unskilled jobs and almost all had low monthly income. Among the socioeconomic variables, mean birth weight increased marginally (p=0.07), only across sub categories of family income but was not associated with other variables (Figure 1).

Mean age at registration was 22.6 ± 3.3 yr and majority (73.5%), of mothers were young i.e. below <25 yr (Table 1). The reported age at menarche was > 14 yr in case of 71.2 % mothers while a large proportion (47.4%), had age at first conception less than 20 yrs. 41.6 % of mothers were primiparous and among multiparous mothers 55.6% had small interval (< 2 yr), between two successive pregnancies, while 48.5% of mothers had at least one previous abortion (Table 1). Among the demographic variables age at registration showed significant (p<0.01), inverse association with birth weight (Figure 1).Young mothers (<20 yr), at registration had babies with lowest birth weight, (2458 ±

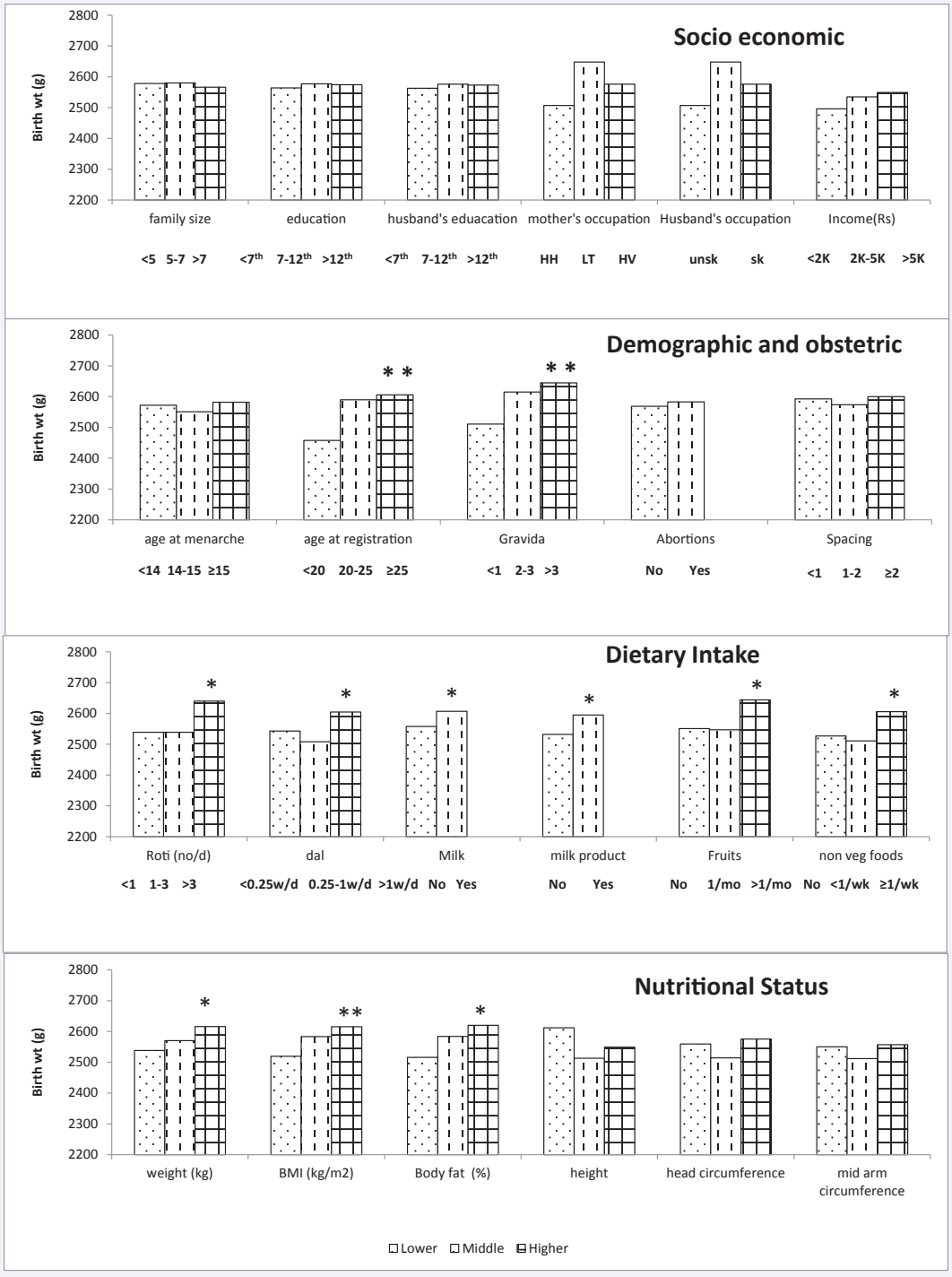

Figure 1 Mean birth weight (g) by levels of maternal nutritional status, socioeconomic, demographic, obstetric and dietary factors.

Table 2: Pre-pregnant and intra pregnancy maternal variables and OR for risk of LBW.

Variable	Categories	n	Mean birth weight (g)	% LBW	OR(CI)
Maternal age (yr)	<20	57	2458±270	61.4	2.2 (1.1-4.3)
	20 -25	217	2590± 312	35.9	0.8
	>=25	96	2605± 297	41.7	1.0
Previous abortion	No	107	2658 ±317	27.1	3.0(1.7-5.3)
	Yes	106	2575± 340	52.8	1.0
Maternal Wt (kg)	<42.5	131	2538± 318	48.9	2.1(1.2-3.6)
	42.5 – 48	141	2557± 286	41.8	1.6(0.9-2.7)
	>=48	96	2646± 309	31.2	1.0
Maternal BMI (Kg/m2)	< 18.5 18.5 – 21	117	2527± 299	50.4	1.8(1.1-2.9)
	≥ 21	116	2574± 322	38.8	1.1
		126	2611± 290	36.5	1.0
Consumption of foods Roti(no/d)	<2	150	2539 ±287	46.7	1.7(1.0-2.9)
	2 -4	128	2559± 318	43.0	1.4
	>=4	76	2640± 306	34.2	1.0
	<1/wk 1/wk to 1/ d ≥ 1/d	254	2558± 314	44.5	1.8(1.0-3.1)
		46	2596± 256	39.5	1.4
Milk (cup/d)	< once/wk≥ once / wk<	70	2614± 302	31.4	1.0
	once/wk≥ once / wk	148	2535 ±313	48.6	1.7(1.1-2.5)
Milk (or milk products)		222	2599 ±298	36.5	1.0
		148	2535 ±313	48.6	1.7(1.1-2.5)
		222	2599 ±298	36.5	1.0

+ - CI: confidence interval given for only significant odds ratio
BMI- Body mass index; LBW- Low birth weight; OR- odds ratio; wk- week; no/ d- number per day

Table 3: Simple scoring for assessing risk of LBW based on Maternal variables measurable at registration.

Component	Variable	Category Score 3 2 1	Score Min.-max.
Demographic	Mother's age (yr)	< 20 20 – 25 ≥ 25	1 – 3
Obstetric	Previous Abortions	Yes - No	1 – 3
Nutritional status	Wt (kg)	< 42.5 42.5 – 48 ≥ 48.5	1 – 3
Consumption of foods	Roti (no/d)	<2 2-4 ≥ 4	1 - 3
	Milk (cup/d)	<1/wk 1/wk to 1/ d ≥ 1/ d	1 - 3
Total score			5 – 15

Wt- maternal weight; wk- week; no/ d- number per day

270 g), and had highest prevalence of LBW (61.4%), with highest risk (OR= 2.2; p<0.05) for delivering LBW (Table 2). Similarly, among the obstetric variables, mean birth weight was lowest for primiparous (2511± 258g), and increased significantly (p<0.001), with the parity of the mother (Figure 1). Although, the prevalence of LBW among primiparousm others was high (44.2%), the OR for parity was not significant indicating that it is not a risk factor for LBW. In contrast, previous abortion conferred a significant risk (OR=3.0; p<0.00), for LBW baby, but the mean birth weight of babies of mothers with or without previous abortion did not differ significantly.

Maternal anthropometry: Nutritional status of the mothers as assessed by anthropometric measures shows that they were thin (mean weight 46.0 ± 7.4 kg), and short (mean height 150.8 ± 6.1 cm). Almost 9.8 % were below 38 kg and 8.9 % were below 145 cm for height, which are considered to be risk cut offs for LBW. They were undernourished (mean body mass index (BMI), 20.3 ± 3.2 kg/m2), and almost 25.6.0% mothers had BMI below 18kg/m^2. Consequently, the overall mean birth weight was only 2573 ± 305 g and the prevalence of LBW was 41.4 %.

Maternal nutritional status is known to be a major determinant of birth weight and all the three anthropometric indicators of mother's nutritional status viz., weight, BMI, and body fat; showed positive association with birth weight. Thus, mean birth weight of the babies born to mothers in the lowest tertile of weight (2538 ± 318g), or BMI (2519 ± 307g), or body fat (2516 ± 299g) was lowestand increased significantly from lowest to highest tertile of these indicators (Figure 1). Thus, significant (p<0.05) risk for LBW was observed (Table 2), for both low (<42.5 Kg), maternal weight (OR-2.1; CI:1.2-3.6) as well as for low (<18.5 Kg/m^2), BMI (OR-1.8;CI-1.1-2.9), but it was not significant for low body fat. Similarly, no such associations were seen for either maternal height or head circumference or mid arm circumference.

Intra pregnancy variables and risk of LBW

Dietary intake of mothers: Majority of mothers were vegetarian and Roti or Bhakari (bread made from wheat or sorghum), was a major food item consumed at all the three meals and contributed more than 75% of day's energy intake. Rice was mostly included only at dinner time. Almost half of the mothers (44.8%), consumed dal on alternate days. Only 35% mothers had one serving or more of vegetables every day and 16%

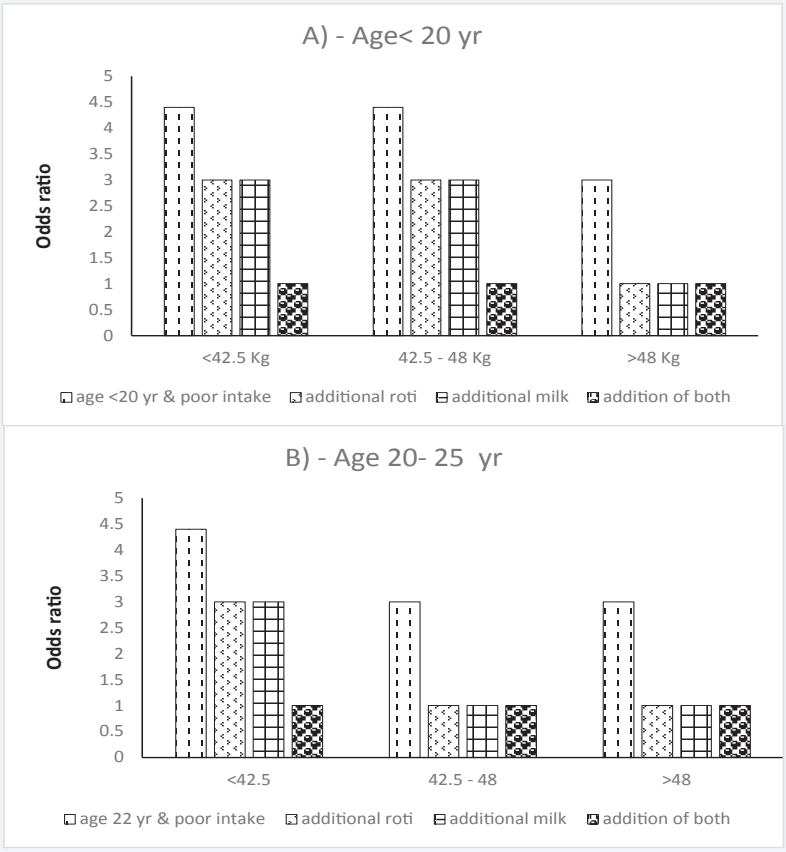

Figure 2 Estimate of risk (OR) of LBW in mothers (A) - with age <20 yrand (B) with age 20-25 yr after addition of one roti or one serving milk or both.

included green leafy vegetables in their daily diet. Their diets clearly lacked variety. Intake of milk was very low and two third (66.4%), mothers never drank milk. Nearly 42% mothers had fruits daily which included seasonal fruits like banana, oranges, guava, grapes and berries and apple.

Analysis of food frequency questionnaire revealed importance of consumption of specific foods. Mean birth weight of babies born to mothers with low (<2/d), consumption of roti (2539 ± 287 g) and low (<2 times/wk) consumption of dal (2543±324 g), were significantly (p<.05 for both) low compared to those with higher consumption of these foods, but no such association was seen with consumption of rice (Figure 1). Accordingly, prevalence of LBW was high among mothers with low consumption of roti (46.7%), or low consumption of dal (46.2%). However, odds ratio was significant (Table 2), only for roti consumption (OR=1.7, p<0.05).

Similarly, no consumption of non-vegetarian foods (egg or meat or chicken or fish), resulted in lower birth weight (2538 ± 303 g) compared to those who consumed it at least once a week (2604 ±305 g; p=0.04). The prevalence of LBW among these mothers was 45.9% but non consumption of non-vegetarian foods was not a risk factor. Among the functional foods significant (p<0.05), low birth weight of babies was observed among mothers who never consumed milk (2558 ± 314 g), or milk products (2547 ± 306 g) with high prevalence of LBW viz., 44.5% and 47.2% respectively. Significant odds ratio was observed (Table 2) for no consumption of milk (OR=1.8, p<0.05), and no consumption of milk products (OR=1.7, p<0.05). Fruit consumption showed marginal (p=0.06), association with birth weight but was not a risk factor.

Maternal activity: Time spent in different activities was highly variable. More than 45% mothers spent more than 5 hours per day in domestic activities. Child care took substantial time (130 min), of many mothers. However, average time spent in work outside (as nurse, teacher, maid, sales girl and small business), was significantly more (p < 0.003), in primiparaous mothers as compared to others, which means that having children limits the working time of rural mothers. None of the maternal activities in this population showed significant association with risk of LBW.

Simple screening tool: The riskfactors and their categories and respective scores are shown in Table 3. Though weight and BMI both showed significant risk, only weight is considered for scoring, as it is easily measurable at registration by the health worker. Similarly, though drinking milk or taking any milk product (like curd, buttermilk or ghee), both showed significant risk, only milk consumption was considered for scoring for ease in recording it by the health worker. Thus, the total score based on five maternal factors viz., age at registration, previous abortion, maternal weight and intake of roti and intake of milk, ranged between 5 to15. Higher the score higher is the risk for LBW. The ROC cut off comes out to be 10 (area under the curve = .66, p<0.00), and has sensitivity of 78 with specificity of 50%. Considering groups of total score (as <8, 8-10, 10-12 and

>=12), the logistic regression showed the highest risk of LBW for mothers with score greater than 12 (OR=4.4, CI: 1.9-9.8), followed by those between 10 and 12 (OR=3.0,CI-1.4-6.3), but no significant risk for those between 8 to10 (OR= 1.2,CI- 0.54-2.8).

We further illustrate the risk analysis for different maternal situations is shown in Figure 2 (A and B), how the scoring system will reveal the reduction in the risk of LBW in case the nutrition intervention is to be planned. Thus the mother whose age is < 20 yr (i.e. Score 3), has no previous abortion (score 1), but whose intake of roti is <2/d (score 3), who does not consume milk (score 3), and whose weight is < 42.5 Kg (score 3), will have the total score of 13 indicating the risk of 4.4. Addition of roti (1/ meal) alone (reduces roti score to 1) or addition of milk 1cup/d (reduces milk score to 1) alone will reduce her total score to 11 and the risk from 4.4 to 3.0. But if both these foods are added then her score will reduce to 9 indicating that there is no risk. On the other hand, if the mother's age is between 20-25yr. the risk is nullified immediately either by adding roti alone or adding milk alone at all the levels of maternal weight at registration (Figure 2B).

DISCUSSION

Despite the fact that a national intervention program (ICDS), for pregnant and lactating mothers is in operation for last three decades or more in India, there is only marginal reduction in prevalence of LBW [12]. In contrast, Gambian study where women were enrolled almost immediately after early confirmation of pregnancy and were given dietary supplement in the form of energy protein rich biscuits, showed an increase in birth weight of 136 g with significant reduction (6%), in incidence of LBW [13-16]. These observations underscore the need for identifying mothers at risk of delivering LBW baby at an early stage in pregnancy so that they can avail the benefit of supplementation over complete gestational period. We have shown that simple scoring system based on five major maternal factors can be developed for this purpose which can have high sensitivity for early identification of mothers at risk.

The only socioeconomic variable which showed marginal risk (OR=1.7; CI: 0.9-3.3), of LBW was low (<2000 Rs.), family income. It affects the food availability in India and food accounts for a larger share of expenditure [17]. In developed countries too, it has been observed that low income families spend less on milk, milk products, fruit and meat [18], suggesting that it limits access to both quantity and quality of foods. In particular, it has also been shown that monthly income is inversely associated with poor pregnancy outcomes like pre term, IUGR and LBW [19].

Adverse influence of early age at menarche [20], early age at marriage and early age at conception on reproductive health has been reported [21-23], largely in terms of increased risks for pregnancy wastage (stillbirths & abortion) and premature delivery [24], but not for risk of LBW. We observed that in our population younger age (<20 yr), at registration showed significant risk (OR-2.2; CI-1.1-4.3) of LBW. This can be attributed to the fact that in rural India it is customary to marry girls immediately after they attain menarche, leading to early conception imposing risks for poor pregnancy outcomes. Finally, our observation that history of previous abortion was a significant risk factor (OR- 3.0; CI-1.7–5.3), for LBW among these poor, undernourished mothers is in confirmation with reported studies [25-27].

Countries with higher percentage of LBW are the countries with higher percentage of women with low body mass index. Several studies have reported positive correlation between maternal anthropometry and birth weight in different populations [6,28,29]. India's poor fetal growth is at least partly caused by maternal chronic energy deficiency and stunting [30,31]. We observed significant positive association of maternal nutritional status with birth weight, but significant risk for LBW was seen only in case of low maternal weight (OR-2.1; CI-1.2-3.6) and BMI (OR-1.8;CI-1.1-2.9). With regard to maternal diet, significant risk for LBW was observed for the low (<2/d), consumption of staple food like roti (OR=1.7, CI-1.0-2.9), and no consumption of functional food like milk (OR=1.8,CI-1.0-3.1), even after adjusting for other maternal confounders. The finding assumes importance in view of the fact that maternal diet is the only modifiable avenue for tackling the problem of LBW.

One of the limitations of our study is that the cut off for enrolment was 20 weeks in view of the fact that in India mothers from rural or poorer sections are still not registering early in pregnancy and is always a problem. Nevertheless, MIMER hospital being in the periphery of Pune city we were able to get about 75% of mothers registering within 16 weeks. Although there may be factors in the 2nd trimester, related to pathophysiology of LBW, the smaller proportion registering late in pregnancy is unlikely to invalidate the findings based on scoring system.

CONCLUSION

In conclusion, we observed that a scoring system based on only 5 maternal variables all of which can be recorded at registration by a health worker lowest in hierarchy, can predict risk of LBW with high sensitivity. Further, it was also seen that mothers with poor reproductive health (poor pre pregnancy weight or younger age at registration), if advised to increase either the intake of staple food like roti or to initiate milk consumption of 1 cup/d, can substantially reduce risk for LBW. As it is hardly possible to improve upon the pre pregnant maternal variables like age, weight or obstetric history; dietary diversification remains to be the only option for reducing the risk of LBW. In view of both short term and long term health consequences of LBW, early prediction for risk of LBW is of utmost importance and will be of great help to increase the efficiency of the existing nutrition intervention programs in rural India.

ACKNOWLEDGEMENTS

We acknowledge the support of the management of MIMER medical college and department of Community medicine, MIMER Medical College for giving full support to do this study.

REFERENCES

1. Makhija K, Murthy GV. Socio-biologic factors influencing low birth weight at a rural project hospital. J Ind Med Assoc. 1990; 8: 215-217.
2. Patel V. Maternal psychological morbidity and low birth weight in India. Br J Psychiatry. 2006; 188: 284-285.
3. Kramer MS. Determinants of low birth weight: Methodological assessment and meta-analysis. Bull World Health Organ. 1987; 65: 663-737.

4. Nair NS, Rao RS, Chandrashekar S, Acharya D and Bhat HV. Socio-demographic and maternal determinants of low birth weight: A multivariate approach. Ind J Pediatr. 2000; 67: 9-14.

5. Parvez Ahmed, Jouni JKJ. Maternal occupation and adverse pregnancy outcomes: A Finnish population-based study. Occupational Medicine 2007; 57: 417-423.

6. Godfrey K, Robinson S, Barker DJP, Osmond C, Cox V. Maternal nutrition in early and late pregnancy in relation to placental and fetal growth. Br Med J. 1996; 312-410.

7. Rao S, Yajnik CS, Kanade A, Fall CHD, Margetts BM, Jackson AA, et al. Intake of micronutrient-rich foods in rural Indian mothers is associated with the size of their babies at birth: Pune Maternal Nutrition Study. J Nutr. 2001; 131: 1217-1224.

8. Ludvigsson JF, Ludvigsson J. Milk consumption during pregnancy and infant birth weight. Acta Paediatr. 2004; 93: 1474-1478.

9. Brantsæte AL, Olafsdottir AS, Forsum E, Olsen SF, Thorsdottir I. Does milk and dairy consumption during pregnancy influence fetal growth and infant birth weight? A systematic literature review. Food & Nutrition Research. 2012; 56: 20050

10. Swati Raje, Shobha Rao. Maternal Food consumption patterns and risk of low birth weight among poor communities in rural Maharashtra. Ind J Nutr Dietet. 2015; 52: 153-165.

11. Vijayalakshmi P, Mercy P. Birth weight in relation to the iron status of the pregnant women. *Ind J Nutr Dietet.* 1994; 31: 1-7.

12. Agarwal KN, Agarwal DK, Agarwal A, Rai S, Prasad R, Agarwal S, et al. Impact of the integrated child development services (ICDS) on maternal nutrition and birth weight in rural Varanasi. Ind Pediat. 2000; 37: 1321-1327.

13. Prentice AM, Whitehead RG, Watkinson M, Lamb WH, Cole TJ. Prenatal dietary supplementation of African women and birth weight. Lancet. 1983; 1: 489-492.

14. Prentice AM, Cole TJ, Foord FA, Lamb WH, Whitehead RG. Increased birth weight after prenatal dietary supplementation of rural African women. Am J Clin Nutr. 1987; 46: 912-925.

15. Prentice AM. Can maternal dietary supplements help in preventing infant malnutrition? Acta Paed Scand. 1991; s374: 67-77.

16. Ceesay SM, Prentice AM, Cole TJ, Foord F, Weaver LT. Effects on birth weight and perinatal mortality of maternal dietary supplements in rural Gambia: 5 year randomised controlled trial. Br Med J. 1997; 315: 786-790.

17. Saluja MR, Yadav B. Social accounting matrix for India2003-04. In: Growth and equity effects of agricultural marketing efficiency gains in India. Ed: Maurice Landes and Mary E. Burfisher. Economic Research Report No.89, USDA, 2009.

18. Kirkpatrick S, Tarasuk V. The relationship between low income and household food expenditure patterns in Canada. Pub Health Nutr. 2003; 6: 589-597.

19. Karim EM, Taylor CGN. The association between birth weight, socio-demographic variables and maternal anthropometry in an urban sample from Dhaka, Bangladesh. Ann Hum Biol. 1997; 24: 387-401.

20. Wyshak G. Age at menarche and unsuccessful pregnancy outcome. Ann Hum Biol. 1983; 10: 69-73.

21. Prakasam CP. Mother's reproduction and pregnancy loss in a rural set up. Demography India. 1993; 22: 155-168.

22. Thame M, Wilks RJ, McFarlane-Anderson N, Bennett FI, Forrester TE. Relationship between maternal nutritional status and infant's weight and body proportions at birth. Eur J Clin Nutr. 1997; 51: 134-138.

23. Lenders CM, McElrath TF, Scholl TO. Nutrition in adolescent pregnancy. Curr Opin Pediatr. 2000; 12: 291-296.

24. Rao S, Gokhale MK, Joshi SB and Kanade AN. Early life undernutrition and adolescent pregnancy outcome in rural India. Ann of Hum Biol. 2010; 37: 475-487.

25. Singh G, Sidhu K. Bad obstetric history: A prospective study. Med J Arm Forces Ind. 2010; 66: 117-120.

26. Nagargoje MM, Chaudhary SS, Deshmukh JS, Gupta SC, Misra SK. A case control study of risk factors of low birth weight in Nagpur, Maharashtra. Ind J Comm Health. 2011; 23: 4-7.

27. Brown JS, Adera T, Masho SW. Previous abortion and the risk of low birth weight and preterm births. J EpidemComm Health. 2008; 62: 16-22.

28. Rao, M. Diet and nutritional status of pregnant women in rural Dharwad. Eco Food &Nutr. 1986; 18: 125-133.

29. Bhatia BD, Tyagi NK, Sur AM, Satya K. Comparative evaluation of two maternal weight-height indices during pregnancy. Ind Pediatr.1989; 26: 353-357.

30. Gopalan C. Low birth weight in nutrition research in South East Asia: The emerging agenda of the future. World Health Organization. Regional Office for South East Asia, New Delhi. 1994; a: 13-31.

31. Fall CHD, Yajnik CS, Rao S, Davies AA, Brown N and Farrant HJW. Micronutrients and Fetal Growth. J Nutr. 2003; 133: 1747S-1756S.

Cite this article

Rao S, Raje S. Early Assessment of Risk for Low Birth Weight Using Simple Scoring Tool among Mothers from Rural India Ann Pediatr Child Health 2020; 8(10): 1215.