PREDICTION OF BIRTH WEIGHTS FROM BODY WEIGHTS OF NEWBORNS

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Manuscript received: July 22,*1996; Initial review completed: August 6,1996; Revision accepted: November 26,1996*

Objective: *To evaluate the accuracy of prediction of birth weights from body weights of newborns till six days after birth.* ***Design:*** *Prospective follow-up.* ***Setting:*** *Four villages near Hyderabad.* ***Methods:*** *Weights of 47 newborns were recorded daily from the day of birth for seven days. The birth weights were regressed on the weights of the babies taken on the 2nd day to the 7th day. Specificity and sensitivity of the predicted birth weights to arrive at the prevalence of low birth weight (LBW) were computed.* ***Results:*** *The co-efficient of determination (R-square) for between the days measurements decreased from 95% on the second day to 86% on seventh day with an increase in the standard error of the estimate from 84 g to 154 g. Based on the "predicted birth weights", the prevalence of LBW in the community was arrived at and compared with the actual observation. The sensitivity and specificity of these regression equations was high and ranged from 0.95 to 0.85 and 0.96 to 0.93, respectively.* ***Conclusions:*** *In situations where the birth weight cannot be recorded, weight of the baby taken within the first week after birth may be reliably utilized to assess the "birth weight", particularly in relation to categorization as LBW. This methodology can serve as a tool to monitor various developmental programs aimed at improving birth weights.*

Key words: *Birth-weight, Low birth weight, Newborn.*

DATA available on birth weights in India or many developing countries is mostly hospital based, where only about twenty per cent of the total deliveries are conducted(l). However, the rest of eighty per cent deliveries are conducted by traditional birth attendants in rural homes. In such a situation, birth weights are generally not recorded. The health functionaries who can, if at all, record birth weights in the given situation cover about five thousand population. Hence, she will not be able to reach every home reporting a delivery on the same day. Therefore, recording of birth weights within 24 hours of delivery particularly in rural areas is a difficult task.

In India the prevalence of low birth weight is estimated to be between 30 to 40%(2-6). Keeping in view, the fact that birth weight is one of the most important determinant of child survival, the National Health Policy has set a goal of bringing down the prevalence of low birth weight by 10% by 2000 AD(7). The Government of India is implementing several intervention programmes to improve pregnancy outcome in order to lower the existing high prevalence of low birth weight (LBW), and the consequent high infant mortality rates

(IMR). Hence, the need to monitor the birth weights is being increasingly felt.

Attempts have been made earlier to study the changes in weight and other anthropometric measurement(8,9) during early neonatal period mainly to assess the growth pattern and factors affecting growth. However, in this study an attempt has been made to predict birth weight from body weights of infants recorded on the subsequent 6 days after birth and arrive at the prevalence of low birth weight.

Subjects and Methods

Considering the operational feasibility for following-up of newborns for 7 consecutive days, a sample size of 50 was decided for this study. Due to loss to follow-up in 3 babies, body weights of 47 infants born in four villages near Hyderabad were recorded. Thus all singleton, full term, normal home deliveries on whom birth weights were available within 24 hours of delivery, were considered for the study. Trained post-graduate investigators residing in the study area recorded the weights at their houses within 24 hours after delivery. Lever actuated baby weighing scales (Chatillon Make) with an accuracy upto 20 g were used. The regular standarization procedures were employed in training of the investigators to minimize the intra and inter investigator variations. The study was conducted during the months of May and June when temperature in the region ranged from 38 to 42° C. There were 24 male and 23 female babies participating in the study. The birth weights ranged from 1630 g to 3540 g and there were 20 babies weighing less than 2500 g at birth. Subsequently, the body weights of these infants were recorded every day at fixed time for the next 6 consecutive days. Six separate linear regression lines ($y = a + bx + e$) were fitted using SPSS/PC package to predict the birth weight, taking first day weight (birth weight) as dependent variable and subsequent six day weights as independent variable. Specificity and sensitivity of the "predicted" birth weights to calculate the prevalence of low births weight were analyzed.

Results

Results of the analysis *(Table I)* showed that the mean birth weights steadily reduced from 2528 g on the day one to 2505 g on day three and there after they gradually increased to 2647 g on day 7. Standard deviation of the body weights varied from

TABLE *I*—*Summary Statistics of Regression Analysis to Predict Birth Weight*

Day of weigh t record	Birth weight(g)		Intercept coefficient	Regression	R^2 (%)	Standard error of the estimate (g)	95% confidence limits for prediction of birth weight(g)
	Mean	SD					
1	2528	406.8	—	—	—		
2	2428	391.7	1.1224	1.0169	95.6	84.0	2359-2697
3	2505	391.3	6.178	1.0065	94.0	103.0	2321-2735
4	2541	394.2	13.907	0.989	92.0	117.0	2293-2763
5	2584	404.1	77.67	0.948	89.0	138.0	2251-2805
6	2618	409.5	76.06	0.937	88.0	137.0	2253-2803
7	2647	419.3	145.85	0.899	86.0	154.0	2218-2837

391 g to 419 g. The co-efficients of determination (R^2) steadily decreased from 95% on the second day to 86% on the seventh day and the standard error of the estimate steadily increased from 84 g to 154 g.

The sensitivity and specificity of each of these regression equations was calculated by comparing the "estimated birth weight" of each infant with that actually recorded on its day of birth. Infants are classified as either 'normal' or 'low' birth weight using 2500 g as the cut-off level.

The results presented in *Table II* show higher levels of sensitivity (0.85-0.95) and specificity (0.93 to 0.96) thereby demonstrating the usefulness of the regression equations. A decreasing trend in these levels with age of the infant is in line with the increase in the SE of the estimates. The regression model was tested using analysis of variance technique taking birth weight as dependent variable and subsequent days body weights, one at a time, as independent variable. The F value obtained was 1044.8 which is highly significant. The power of regression model was tested using power of F test (random model)(10). The power of the test observed was 0.99 for second day weight and 0.98 for the seventh day weight. Therefore, it can be stated that the efficiency to predict birth weight from the subsequent days' weight using the regression model was high and the sample size in the present study is adequate enough to draw the conclusions.

TABLE II-*Specificity and sensitivity of regression equation in predicting low birth weight*

Day of birth weight	Sensitivity	Specificity
2nd day	0.95	0.96
3rd day	0.90	0.96
4th day	0.85	0.93
5th day	0.95	0.96
6th day	0.85	0.96
7th day	0.95	0.93

Discussion

The present exercise clearly demonstrates that in situations where birth weight cannot be taken, one can make use of the data on weights of infants taken within seven days after birth. Hence, the peripheral health workers can record the weights of infants (within 7 days) and 'advise' accordingly the family in taking appropriate care of the baby, particularly, if it happens to be a high risk baby of LBW category. Since it is mandatory to record birth weights of all the infants by the Anganwadi workers in the ICDS programme (likely to be expanded to cover the entire country) this methodology can be gainfully employed to fill in gaps of information on birth weight, wherever needed. Since one of the aims of many developmental programmes is to lower the prevalence of low birth weights in the country, this methodology can be gainfully employed as a tool to monitor or evaluate such programmes.

The methodology or the model suggested to predict birth weights may hold good for a climatic area comparable to Hyderabad. However, for areas of extremes of climate, the exercise may have to be repeated to arrive at the slopes of the regression before employing the methodology. Further, since the study pertains only to term newborns, similar studies may be required in preterms.

In conclusion, birth weights of rural home delivered newborns can be predicted from body weights of babies recorded within one week of delivery to estimate the prevalence of low birth weights, identify at risk children and monitor ongoing developmental and supplementary feeding programmes for pregnant women.

Acknowledgements

The authors thank the Director, National Institute of Nutrition, Hyderabad for the keen interest in the study. The authors are grateful to Dr. Padam Singh, Director, Institute for Research in Medical Statistics, for his valuable comments and suggestions. They also thank the mothers and their newborns who participated in the study.

REFERENCES

1. National Family Health Survey (MCH and Family Planning). Bombay International Institute for Population Sciences, 1995.
2. Shatrugna V, Ramnath T, Raman L. Influence of weight changes in the neonatal period in the prediction of birth weight. J Trop Pediatr 1987; 33: 218-219.
3. A National Collaborative Study of Identification of High Risk Families, Mothers and Outcome of their Offspring with Particular Reference to the Problem of Maternal Nutrition, Low Birth Weight, Perinatal and Infant Morbidity and Mortality in Rural and Urban Slum Communities. New Delhi, Indian Council of Medical Research, 1990.
4. Achar ST, Yankaver A. Studies on birth weight of South Indian Infants. Indian J Child Hlth 1962; 11:157-167.
5. Radha RA, Agarwal JR. Observation on the newborn: A study of 10,000 consecutive live births. Indian Pediatr 1969; 6: 729-742.
6. Sainaba MK, Indira DC, Mathai NM. Low birth weight babies. Indian J Pediatr 1972; 39: 389-396.
7. National Nutrition Policy. Department of Women and Child Development, Ministry of Human Resource Development, Government of India, 1993.
8. Singhi P, Singhi S, Bhalla AK. Growth of term infants in early neonatal period. Indian Pediatr 1985; 22: 485-491.
9. Pandove SP, Singh K, Sandhu AS. Growth of term infants during neonatal period. Indian Pediatr 1994; 31: 675-678.
10. Pearson ES, Hartley HO. Power of F-test (random model). *In:* Biometrical Tables for Statisticians, Vol. II, Eds. Pearson ES, Hartley H.O. Cambridge, Cambridge University Press, 1976, p 18.