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Symphysiofundal Height (SFH) Measurement for prediction of Birth Weight – A New Formula

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Summary

Symphysiofundal height was measured in 100 pregnant women at or near term. Birth weight was estimated using Johnson's formula.

Jack-knife method was employed using the 1st 50 cases to derive an equation for calculating birth weight. This was tested on the next 50 patients for its reliability.

This new formula was then compared with the Johnson's formula for estimating birth weight.

The new formula derived was as follows :

Estimated birth weight in kg = 0.18 (symphysiofundal height in cm) – 2.89.

The correlation between estimated weight and actual weight using the new formula was 0.91 ($p<0.001$). The mean difference between predicted weight and actual weight was 0.09 kg using the new formula vs 0.39 kg using Johnson's formula. Both formulae however overestimated the actual birth weight.

Introduction

Growth is a basic fundamental of life. Since the abandonment of the concept that weight determines age, a host of terms have evolved to describe infants who demonstrated altered growth. Terms such as "Small for Gestational Age" (SGA) "Large for Gestational Age" "(LGA) and "Intrauterine Growth Retardation" (IUGR) have served to focus attention on the special problems of infants with growth disturbance. Women who are nutritionally deprived usually deliver small infants. There is also good correlation between maternal weight gain and birth weight. Low birth weight for gestation, is an important cause of perinatal morbidity and mortality especially in developing countries. Measurement of symphysiofundal height has become an established practice in many maternity units as the preferred way of screening for IUGR. Its advantages are speed, economy and general applicability. It can be measured during a routine examination and does not require special resources except a measuring tape. Large for gestational age infants again pose a problem at delivery. These infants are more prone to shoulder dystocia which can result in extreme morbidity and even death. Prediction of birth weight would hence enable the Obstetrician to (a) decide mode of delivery (b) anticipate problem during labour and hence close monitoring of labour could be done by electronic fetal monitoring for low birth weight infants and (c) anticipate possible shoulder dystocia and hence arrange for availability of a senior competent obstetrician at the time of delivery.

Material and Methods

Symphysiofundal height was measured in 100 consecutive pregnant women at or near term in the

Department of Obstetrics & Gynaecology at St. John's Medical College & Hospital, Bangalore. The estimated weight of the baby was calculated using Johnson's formula (Johnson & Toshach, 1954).

Estimated weight (gm) = Symphysiofundal height in cm 12 if vertex is at or above level of ischial spines or SFH (cm) 11 if vertex is below the level of ischial spines multiplied by 155 in either case.

This was then compared with the actual weight at birth. The measurements were made using a nonelastic measuring tape with the patient in the supine position with legs extended and bladder empty. Distance between the fundus of the uterus and the top of the symphysis pubis was measured with a tape lying in contact with the skin of the abdominal wall. Care was taken to ensure that the fundus was defined by gentle pressure exerted in a plane at right angle to abdominal wall. No correction was made for presentation, descent of presenting part, amniotic fluid volume, uterine obliquity, maternal height or weight. The measurements were taken by the same observer at each visit to the nearest 0.5 cm with the tape reverse side up for the observer not to be influenced by the values.

Results

The sample comprised 100 pregnant women at or near term. The age of the sample ranged from 18-39 years with a mean of 24.67 ± 4.30 years. A further age description of the sample is provided below in Table I.

Table I

Age Group	Number of patients
20 and below	23
21-25	40
26-30	28
31-35	8
Over 35	1
Total	100

Sixty-two women had a parity index of 0, and 38 had a parity index of 1.

The descriptive statistics for height (in cm) and weight (in kg of the sample are presented below in Table II

Table II

Variable	Mean	Std. Dev.	Minimum	Maximum	N
HT	152.64	4.93	141.0	165.0	100
WT	61.01	8.97	43.0	83.5	100

Symphysiofundal height (SFH) was measured and estimated weight of the baby was calculated at or near term; the weeks of pregnancy at which these were done were as given in Table III.

Table III

Gestational week	No. of Patients (N)
36	2
37	10
38	27
39	33
40	21
41	7
Total	100

The week of pregnancy in which delivery actually occurred is given in table IV.

Table – IV

Gestational Week	Number of Patients (N)
36	2
37	4
38	22
39	35
40	28
41	9
Total	100

Delay in delivery was calculated as the actual week of delivery minus the week in which the measurement of SFH and estimation of baby's weight was done. The average mean delay was 0.28 ± 0.6 Eighty-one women delivered in the same week as the week of assessments; 12 delivered one week later 5 delivered 2 weeks later, and 2 delivered 3 weeks later.

Of the 100 babies delivered, 53 were male and 47 female. The higher number of male babies born was not statistically significant (chi square = 0.36, df = 1 NS).

Apgar scores of the 100 babies were 3 (n=1) 7(n=2) and 8(n=97).

SFH in cm ranged from 26.5 to 40.5; with the mean of 33.98± 1.90.

Johnson's formula to estimate the baby's weight is: Estimated weight (gm) = 155 (SFH (cm) 12).

Using this formula, estimated weight of the babies was computed. The results with Johnson's formula were a follows: The estimated weight values obtained ranged from 2.24 to 5.56 kg, with a mean of 3.42 ± 0.36; the actual weights of the babies ranged from 1.44 to 4.30 kg , with a mean of 3.11 + 0.39.

There was a high correlation between estimated and actual weight (Johnson's product moment correlation coefficient, r 0.80, df = 98, P<0.001.)

However, the estimated weight was on an average 0.31 kg higher than the actual weight. The over-estimation of weight by Johnson's formula was statistically significant (paired t test, t = 13.03, df = 99, P<0.001).

The hypothesis was tested that the results with Johnson's formula become inaccurate if delivery occurs at a date distant from the measurement of SFH; accordingly, estimated weight and its difference from actual weight was computed only for the 81 women for whom delivery occurred in the same week as the week of assessment. The results in these 81 women were as follows : Mean estimated weight was 3.41 ± 0.39, while mean actual weight was 3.09 ± 0.40.

Johnson's formula again over-estimated the actual weight, this time by 0.32 kg. The difference was again statistically significant (paired t = 68, df = 99, P < 0.001).

An exercise was therefore conducted with the aim of deriving a formula to predict the baby's weight with greater accuracy than Johnson's formula (Johnson & Johnson, 1954). This exercise was conducted on the entire sample of 100 women, irrespective of the delay in delivery, because absence in delay did not seem to enhance the accuracy of estimations (see above). As a first step in this exercise, a correlation matrix was computed using the important variables recorded in the study. The correlation coefficients obtained were as follows in Table V.

All the correlations obtained were either non-significant or modestly significant; accordingly, all the variables were entered into a regression equation without fear of multicollinearity effects. The variables were: age, parity, height, weight, week at which the estimation was made, SFH, and sex of the baby.

In order to derive an equation and test it reliability, the Jack-knife method was employed: the equation was derived using the first 50 cases and tested on the next 50 cases. The regression equation was derived using a forward entry stepwise approach.

Of the 7 variables entered into the equation, only one emerged statistically significant. This variable was the SFH. The final regression equation was :
Estimaed weight (kg) = 0.18 (SFH in cm) 2.89

The characteristics of the regression were as follow

- The correlation between estimated weight (using this new formula) and actual weight in the first 50 cases was 0.91 (df = 48, P<0.001).
- SFH was found to explain 83% of the variance in actual weight of the baby.
- The equation predicted actual weight with a high degree of statistical significance (F 244.26 df 1 48 P<0.001).
- SFH itself was a highly significant predictor of actual weight (t=15.63, P<0.001).
- None of the remaining variables entered into the equation significantly predicted actual weight.

Using the formula newly derived from the first 50 cases, the predicted weight of the babies was computed for the next 50 cases. The results were as follows :

- The mean predicted weight was 3.25 ± 0.32, and the mean actual weight was 3.16 ± 0.39 kg.
- Although the estimation was still in excess of actuality, the mean difference was only 0.09 kg, and the statistical singificance of the difference was less (paired t-4.04, df = 49, P <0.001).
- The correlation between estimated and actual weight using the new formula was also higher (r 0.93 df 48, P<0.001).

Table V

	Age	Parity	HT	WT	WK	SFH	SEX
Age	1.0000	.3010*	.0217	.2237	-.2982*	.1234	.0211
Parity	.3010*	1.0000	.0919	.1065	-.0930	.0846	.2419
HT	.0217	.0919	1.0000	.4685**	-.0920	.1216	.0770
WT	.2237	.1065	.4685**	1.0000	-.768	.3079*	.0123
WK	-.2982*	-.0930	-.0920	-.0768	1.0000	.1001	.0957
SFH	.1234	.0846	.1216	.3079*	.1001	1.0000	.1649
SEX	.0211	-.2419	-.0770	-.0123	.0957	-.1649	1.0000

N 100 2 tailed signif : * – 0.01 ** – 0.001

- The hypothesis was tested that the second 50 cases may have been biased for better predictability of birth weight: accordingly Johnson's formula was applied only on to this subset. The results were as follows:
- The mean predicted weight was 3.46 ± 0.41, and the mean actual weight was 3.16 ± 0.39 kg.
- Johsnon's formula continued to show a similar, high error of 0.3 kg, the difference between predicted and actual weight remained significant (pair $t = 6.97$, $df = 48$, $P < 0.001$).

In conclusion, a formula for estimation of the baby's weight was derived. This formula, like Johnson's formula, employs the SFH as a predictor. The newly derived formula is more accurate than Johnson's formula, as tested using the highly acceptable Jack-knife approach.

Discussion

Estimation of fetal birth weight by symphysio-fundal height measurement has been reported by various authors including Dare et al (1990) Bergstrom & Liljestrand (1989) and Secher et al (1991), Labrecge & Boulianne (1987) conducted a study to evaluate the measurement of fundal height in labour as a mean of estimating birth weight in singleton pregnancies. As a diagnostic test they found fundal height useful on an individual basis and recommended that for a mass screening utilisation this procedure would have to be integrated to a complete programme of maternal and child health care.

Walraven et al (1995) found SFH to be better predictor of birth weight than maternal weight, pre-delivery weight or mid upper arm circumference.

In our study, the estimated weight was on an average 0.31 kg higher than the actual weight by using Johnson's formula. By using the new equation derived by Jack-knife method, it was found that the weight could be predicted with a high degree of statistical significance. SFH was found to be a highly significant predictor of actual weight, with a mean difference of only 0.09 kg and the statistical significance of the difference was less (paired $t = 4.04$, $df = 49$, $P<0.001$).

In conclusion, a new formula for prediction of birth weight using SFH was derived. This new formula is more accurate as compared the old Johnson's formula for prediction of birth weight.

References

1. Bergstrom S, Liljestrand J. J Trop Pediatr. 35(1): 27-30, 1989 Feb.
2. Dare F O, Ademowore AS, Ifaturoti 00, Nganwuchu A., Int J Gynaecol Obstet31(3):243-8, 1990
3. Johnson, RW, and Toshach, CE Am J Obst Gyn, 68: 891-6, 1954.
4. Labrecque M, Boulianne N. Rev Epidemiol Sante Publique 35: 378, 1987.
5. Secher NJ, Lundbye-Christensen S, Qvist-I, Bager P., Eur J Obstet Gynecol Reprod Biol. 38: 91, 1991.
6. Walraven GE, Mkanje RJ, Van-Roosmalen J, Van Dongen PWJ., Van Asten AGH., Dolmans WMV., Br J Obst Gyn. 102: 525, 1995.