

The Effect of Biological Factors on Birth Weight and Gestation in South Indian New-Borns

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Abstract

Background: Understanding the effect of biological factors on birth weight of new-borns has public health importance because these indicators are associated with infant health and survival and influence development and health in later life.

Aim: The study was undertaken to determine the birth weight and gestational age characteristics in south Indian babies and correlated to biological factors.

Settings and design: A retrospective study of consecutive singleton live births, who delivered in the hospital in a metropolitan city of Bangalore, South India.

Materials and methods: A cohort of singleton live births, born from January 2015 to May 2017 were analysed to determine the mean birth weight and gestation and influence of various biological factors such as gender of baby, birth order, mother's age, obstetric complication such as PIH and Diabetes etc.

Results: Among a total of 2789 singleton live births, the mean birth weight was 2873.73 ± 498.6 g, mean gestation was 38.2 ± 2 weeks and Low Birth Weight (LBW) <2500 g was 19.1%. The Term, male, later births, older mothers above 30 years and pregnancy of Pregnancy Induced Hypertension (PIH) and diabetes were associated with statistically significant higher birth weight $P=0.001$, $P=0.002$, $P=0.0001$, $P=0.001$, $P=0.0006$ and $P=0.0001$, respectively.

Conclusion: The mean birth weight and gestation for singleton live births in South India were determined, as well as the statistically significant impact of various biological criteria.

Keywords: Birth weight; Gestation; Biological factors

Aim

This is a retrospective study. The study was carried out with an aim of:

- Estimation of birth weight and gestational age of new-born confirmed by ultrasonogram undertaken within 18-20 weeks in singleton live term new-borns in order to obtain a standard birth weight and gestation reference range for Bangalore, South India
- Comparison of average birth weight of male and female babies
- Estimation of average birth weight in firstborn and that of later born babies
- Effect of other biological factors such as mother's age and complications of pregnancy such as PIH and Diabetes on birth weight and gestation
- Comparison of the above mentioned statistics with available national and other regional studies.

Introduction

Birth weight is one of the most important factors that predict the survival, future development and growth pattern of a new-born baby

[1-5]. Birth weight is mainly influenced by duration of gestation but other biological factors such as gender, birth order, mother's age, obstetric complications etc. also play a role. The present study was undertaken in a Speciality hospital in Bangalore, South India to determine the average birth weight and gestation as well the positive correlation of biological factors including complications of pregnancy such as PIH and Diabetes.

Materials and Method

All 2789 singleton live born babies included in this study among a total 2808 consecutive births from January 2015 to May 2017, at Shifaa Hospital, a multispecialty center catering mainly to the middle and lower socioeconomic strata, in the metropolitan city of Bangalore. Exclusion criteria were 19 twin deliveries and 18 stillbirths. All women received adequate prenatal care and gestational age assessed by Last Menstrual Period (LMP) correlated with Crown-rump length (CRL) measurement by ultrasound examination undertaken within 18-20 weeks to establish fetal age when menstrual dates were unknown or in pregnancies with discrepancy greater than ± 7 days. If CRL and menstrual dates agreed to within the normal range of error (± 7 days), then LMP was used to establish fetal age.

Birth weight was recorded within 24 h of birth on a digital weighing machine accurate up to 10 g. Sources of data were Labor room register, new-born register and maternal and neonatal records when required. Data was entered into EPIDATA entry software, 3.1.2701.2008 and data analysis with statistical significance was done using STATA version 13.1.

Results

There were a total of 2808 deliveries during the 29 month period from 1st Jan 2015 to 31st May 2017, exclusion criteria were 19 twin deliveries and 18 stillbirths. Among the 2789 singleton live births included in the study, birth weight was missing for 2.9% (n=81), gestation was missing for 8.9% (n=251), gender was missing for 3.7% (n=105), birth order was missing for 4.1% (n=116) and mother's age was missing for 7.3% (n=206).

Infants with normal birth weight (NBW) \geq 2500 g comprised 80.9% (n=2191) among which infants weighing 2500-3999 g comprised

79.8% (n=2163), of whom 38.1% (n=1032) weighed 2500-2999 g, 34.1% (n=936) weighed 3000-3499 g and 7.2% (n=195) weighed 3500-3999 g. NBW 2500-3999 g had mean gestation of 38.7 ± 1.2 weeks, High birth weight (HBW) \geq 4000 g comprising 1% (n=28) had mean gestation of 39.1 ± 1.2 . This difference was not statistically significant (NS). However mean gestation in LBW < 2500 g 37.1 ± 2.3 and NBW \geq 2500 g being 38.7 ± 1.2 weeks was statistically significant ($P < 0.0001$).

Term new-borns \geq 37 weeks comprised 88.3% (n=2243) and preterm < 37 weeks was 11.6% (n=295). There were no post term births beyond 42 weeks. The mean birth weight for term and preterm babies was 2938 ± 442 g and 2330 ± 585 g, respectively, a difference of 608 g being highly statistically significant ($P = 0.0001$). Most term infants 39% (n=875) weighed 2500-2999 g contrasted with preterm 36.6% (n=108) weighing less between 2000-2499 g.

Criteria		Birth weight in grams (g)								Total	Mean Birth Wt. (g) \pm S.D.	P Value
		≤ 999	1000-1499	1500-1999	2000-2499	2500-2999	3000-3499	3500-3999	>4000			
Singleton births		15	30	61	411	1032	936	195	28	2708	2873 \pm 498	
Gestation	<37	7	21	39	108	83	31	6	0	295 (11.6)	2330 \pm 585	P=0.0001
In weeks	>37	8	9	18	283	875	852	174	24	2243 (88.3)	2938 \pm 442	
Sex	Male	4	15	29	182	480	506	115	19	1350 (50.3)	2916 \pm 501	P=0.0002
	Female	8	13	32	225	548	421	78	9	1334 (49.7)	2835 \pm 481	
Birth Order	First Born	3	10	28	155	365	257	52	6	876 (32.7)	2817 \pm 484	P=0.0001
	Later Born	12	20	32	252	648	672	139	22	1797 (67.2)	2899 \pm 503	
Mother's Age/ year	<30	13	23	50	335	829	722	143	15	2129 (82.4)	2857 \pm 492	P=0.001
	>30	2	6	8	56	159	172	41	10	454 (17.5)	2941 \pm 509	
Mode of Delivery	Normal	9	17	32	222	566	505	76	8	1435 (52.9)	2848 \pm 477	NS
	Elective LSCS	1	3	5	50	160	135	36	8	398 (14.6)		
	Emergen LSCS	5	10	24	125	257	237	72	9	739 (27.3)	2850 \pm 529	
PIH	Yes	2	5	9	27	36	44	13	0	136 (5.0)	2730 \pm 511	P=0.0006
	No	13	25	52	385	996	891	182	28	2572 (95.0)	2881 \pm 496	
Diabetes	Yes	0	2	0	14	41	44	19	4	124 (4.6)	3039 \pm 553	P=0.0001
	No	15	28	61	398	991	892	175	24	2584 (95.4)	2853 \pm 515	

Table 1: Distribution of birth weight in relation to biological criteria.

Sex ratio revealed 984 females to 1000 male infants. However more nearly half of male babies 47.4% (n=640) weighed ≥ 3000 g when compared to about one-third female babies 38.4% (n=508). The mean birth weight for male and female was 2916 ± 501 g and 2835 ± 481 g respectively, a difference of 81 g being statistically significant ($P < 0.0001$). However slightly more males 12.6% (n=160) were premature < 37 weeks compared to females 10.3% (n=130). The mean gestation for male and female was 38.3 ± 1.7 and 38.4 ± 1.6 weeks, respectively, was statistically significant ($P = 0.02$) as shown in Tables 1 and 2.

First birth infants comprised 32.7 (n=876), while second and later births comprised two-thirds 67.2% (n=1797). However 37.7 % (n=1797) of later births weighed more 3000-3499 g, compared to 41.6% (n=876) first birth infants who weighed less 2500-2999 g. The

mean birth weight for first and later birth infants was 2817 ± 484 g and 2899 ± 503 g, respectively, a difference of 82g being highly statistically significant ($P = 0.0001$). Prematurity was low 8.9% (n=75) in first births compared to 12.8% (n=220) of later births. The mean gestation in first and later birth infants was 38.5 ± 1.5 and 38.2 ± 1.6 weeks, respectively, the difference being statistically significant ($P < 0.001$).

Teenage mothers, 19 years and below comprised 8.5% (n=220), majority 39.1% (n=1012) were 20-24 years and 34.7% (n=897) between 25-29 years, thus nearly three fourth 73.8 percent of mothers were in their twenties 20-29 years, 14.4% (n=373) older mothers 30-34 years comprised and 3.1% (n=81) were above 35 years. Hence majority 82.4% (n=2129) were young mothers below 30 years and 17.5% (n=454) were 30 years and above.

Criteria		Gestational Age in weeks				Mean Gestation in weeks \pm S.D.	P Value
		<37	37-40	40+	Total		
No. of births		295 (11.6%)	1696 (66.8)	274 (10.8)	2538 (100)	38.2 ± 2	
VLBW	<1500 g	28 (62.2)	13 (28.8)	4 (8.8)	45 (1.77)	33.7 ± 4.2	P<0.001
LBW	1500-2500 g	147 (32.8)	285 (63.6)	16 (3.5)	448 (17.6)	37.3 ± 1.8	
NBW	2500-4000 g	120 (5.9)	1653 (81.8)	248 (12.27)	2021 (79.6)	38.7 ± 1.2	NS
HBW	≥ 4000 g	0	18 (75)	6 (25)	24 (0.94)	39.1 ± 1.2	
Sex	Male	160 (12.6)	982 (77.5)	125 (9.86)	1267 (50.1)	38.3 ± 1.7	P=0.02
	Female	130 (10.3)	984 (78.0)	147 (11.6)	1261 (49.9)	38.4 ± 1.6	
Birth Order	First Born	75 (8.9)	645 (77.2)	115 (13.7)	835 (32.8)	38.5 ± 1.5	P<0.001
	Later Born	220 (12.8)	1334 (77.9)	157 (9.1)	1711 (67.2)	38.2 ± 1.6	
Mother's Age	≤ 30 years	238 (9.6)	1572 (75.1)	229 (11.2)	2039 (82.7)	38.4 ± 1.6	P=0.005
	>30 years	79 (11.5)	343 (80.7)	33 (7.7)	425 (17.2)	38.1 ± 1.5	
Mode of Delivery	Normal	132 (9.8)	1062 (77.8)	170 (12.4)	1364 (56.1)	38.5 ± 1.6	P<0.001
	Elective LSCS	43 (11.4)	314 (83.5)	19 (5.0)	376 (35.2)	38.1 ± 1.3	
	Emergency LSCS	114 (16.5)	510 (73.9)	66 (9.5)	690 (64.7)	38.1 ± 1.8	
PIH	Yes	33 (24.8)	90 (67.7)	10 (7.5)	133 (5.1)	37.5 ± 2.0	P<0.001
	No	263 (10.8)	1902 (78.3)	265 (10.9)	2430 (94.8)	38.4 ± 1.6	
Diabetes	Yes	27 (21.9)	93 (75.6)	3 (2.4)	123 (4.8)	37.7 ± 1.4	P<0.001
	No	269 (11)	1899 (77.8)	272 (11.1)	2440 (95.2)	38.4 ± 1.6	

Table 2: Gestational age characteristics of new-borns <37 weeks, 37-40 weeks and 40+ weeks.

Most 38.9% (n=826) infants of young mothers below 30 years weighed 2500-2999 g while 37.8% (n=172) infants of older mothers ≥ 30 years weighed more 3000-3499 g. The mean birth weight in young mothers below 30 years was 2857 ± 492 g compared to 2941 ± 509 g for older mothers, difference of 84 g was highly statistically significant ($P = 0.001$). However older mothers ≥ 30 years had higher incidence of prematurity 11.5% (n=79) compared to 9.6% (n=238) in younger mothers, and mean gestation of 38.1 ± 1.5 and 38.4 ± 1.9 weeks respectively was statistically significant ($P = 0.005$).

Another variable of mode of delivery, normal vertex vaginal delivery occurred in half 53.2% (n=1364) followed by Caesarean Sections (C.S.) in 41.6% (n=1066), Vacuum extractions 3.5% (n=97) and Low Perineal Forceps (LPF) delivery 1.4% (n=39). Breech presentation occurred in 2.5% (n=50), but only 0.5% (n=10) were assisted vaginal breech delivery and remaining 1.5% (40) by emergency C.S. However among a total 1066 C.S, most 64.7% (n=690) were emergency C.S and 35.2 % (n=376) elective or planned C.S. Repeat C.S. were performed in one third 32.6% (n=348). The mean birth weight for normal deliveries was 2831 ± 477 g and C.S. 2850 ± 529 g, difference of 19 g being

statistically significant ($P=0.047$). Incidence of prematurity was higher 16.5% ($n=114$) in emergency C.S. compared to 11.4% ($n=43$) in elective C.S. The mean gestation for emergency C.S. and elective C.S. was 38.1 ± 1.3 and 38.1 ± 1.8 weeks respectively was not significant (NS) ($P=0.94$). However the mean gestation in infants delivered normally compared to overall C.S. was 38.5 ± 1.6 and 38.1 ± 1.8 weeks respectively being statistically significant ($P<0.001$).

The incidence of obstetric complications of Pregnancy Induced Hypertension (PIH) was 5% ($n=136$) and Diabetes 4.6% ($n=124$). Most infants 32.3% ($n=44$) with obstetrical complications of PIH and 35.4% ($n=44$) with maternal diabetes weighed between 3000-3499g. The mean birth weight with and without PIH complicating pregnancy was 2730 ± 511 g and 2881 ± 496 g, respectively, the difference of 151g being highly statistically significant ($P=0.0006$). However infants of diabetic mothers weighed more, mean birth weight 3039 ± 455 g compared to 2853 ± 515 g in non-diabetic mothers, a difference of 186 g, was highly statistically significant ($P=0.0001$).

Incidence of prematurity was high 24.8% ($n=33$ /total 136) with PIH complicating pregnancy compared to 21.9% ($n=27$ /total 124) infants of diabetic mothers who had low mean gestation of 37.5 ± 2.0 and 37.7 ± 1.4 weeks, respectively compared to 38.4 ± 1.6 in uncomplicated pregnancy being statistically significant ($P<0.001$).

Discussion

In this study 2789 singleton live births, had mean birth weight of 2873.73 ± 498.6 g, mean gestation 38.2 ± 2 weeks and LBW <2500 g 19.1%. A study from North India also reported mean birth weight 2725.40 ± 424.64 g, mean gestation of 38.1 ± 1.9 weeks and LBW 19.8% (4). Term infants ≥ 37 weeks comprised 88.3% ($n=2243$) and 11.6% ($n=295$) preterm in present study compared to North India with 76.8% term and 23.2% preterm, respectively. (4). Mean birth weight for term 2938 ± 442 g and preterm 2330 ± 58 5 g, difference of 608 g was statistically significant ($P=0.0001$). In the present study VLBW <1500 g comprised 1.6% had mean gestation of 33.7 ± 4.2 weeks as compared to LBW 1500-2499 g with 37.3 ± 1.8 weeks being statistically significant ($P<0.001$).

According to UNICEF LBW rates were 7%, 16% and 19%, respectively in industrialized, developing and least developed countries [6]. LBW and preterm birth rates were 17.0% versus 5.5% and 12.3% versus 6.9%, respectively in South India and Nova Scotia, Canada [7]. Unlike in Western countries, where the incidence of LGA babies has spiralled upward, it has remained nearly at the same level over one and a half decades, reported in South India, despite improvements in socioeconomic status and obstetric care, the mean birth weight 2846 g in 1996 remained at 2907 g in 2010 over 15 years, with a difference of only 61 grams [5,7]. Thus Indian women will continue to have a high incidence of LBW up to 27.4% reported in rural India [8] though it is unclear whether high rates of LBW in South Asia are due to poor fetal growth or short pregnancy duration [9]. In contrast western population report a high mean birth weight of 3446 g in U.S born white women, a difference of 573 g compared to the present study [10]. Globally of the 20 million LBW representing 15.5% of all births, 95.6% are in developing countries with India alone accounting for 40% LBW in developing countries [11], however in developing countries the majority of LBW new-borns have intrauterine growth restrictions rather than being born preterm [12] hence a redefinition of LBW is indicated in ethnic Asians so as to more accurately identify prematurity as cause of LBW [12].

Sex ratio was 984 females to 1000 male infants; a skewed 804 female/1000 male infants was reported from North India [4]. Male babies had higher mean birth weight of 2916 ± 501 compared to female babies with 2835 ± 481 , difference of 81 g being highly statistically significant ($P<0.0001$), similarly also reported in another study male weighed 45 g more than female babies, mean birth weight being 2934 g and 2889 g, respectively [4]. However more males 12.6% ($n=160$) were born preterm <37 weeks, compared to females 10.3% ($n=130$). The mean gestation in males and females being 38.3 ± 1.7 and 38.4 ± 1.6 respectively also statistically significant ($P=0.02$).

First births were lighter with mean birth weight of 2817 ± 4 84 g compared to 2899 ± 503 g in later born infants, difference of 82 g being statistically significant ($P=0.0001$). However more 12.8% ($n=220$) later births were preterm <37 weeks, compared to 8.9% ($n=75$) first birth infants, with a mean gestation of 38.2 ± 1.6 weeks and 38.5 ± 1.5 weeks, respectively being statistically significant ($P<0.001$). Other study also reported later birth infants being heavier by 100g with the mean birth weight of 2880 g compared to 2770 g for first born babies [4].

Infants of young mothers 20-29 years had lower mean birth weight of 2857 ± 492 g compared to 2941 ± 509 g in older mothers ≥ 30 years, a difference of 84 g being statistically significant ($P=0.001$). However older mothers ≥ 30 years had higher incidence of prematurity 11.5% ($n=79$) compared to 9.6% ($n=238$) infants born to younger mothers. The mean gestation for mothers <30 and ≥ 30 years was 38.4 ± 1 and 38.1 ± 1.5 weeks, respectively being statistically significant ($P=0.005$).

Caesarean section rate increased to 41.6%, majority being emergency section 64.7% and in 35.2% elective or planned sections. Repeat section was performed in one third 32.6%. In contrast other studies report a low cesarean rate of 15.3% in North India [4] and 3.1% in 1986-87 increasing to 10.9% in 2004-2005 in South India while in Nova Scotia, Canada it increased from 20.2% to 28.4% [5]. Understandably though emergency cesarean section delivery was related to a higher incidence of prematurity 16.5% compared to 11.4% among elective sections, the mean gestation between emergency and election sections was not statistically significant ($P=0.94$), contrasted with mean gestation of 38.5 ± 1.6 weeks in infants with normal delivery compared to 38.1 ± 1.6 C.S being statistically significant ($P<0.001$). In contrast infants of normal delivery had lower mean birth weight of 2848 ± 477 g to 2850 ± 529 g in caesarean births, difference of 19g being statistically significant ($P=0.047$). A higher incidence of LBW 22.1% was noted for emergency sections compared to 14.8% in elective sections. Thus the risk for LBW and prematurity was higher with emergency sections.

Obstetric complications of PIH and Diabetes had higher incidence of prematurity 24.8% and 21.9%, respectively with mean gestation of 37.5 ± 2.0 weeks and 37.7 ± 1.4 weeks respectively compared to 38.4 ± 1.6 weeks in uncomplicated pregnancy of statistical significance ($P<0.001$). Similarly a low mean birth weight of 2730 ± 511 g in infants with PIH complicating pregnancy contrasted with higher mean birth weight of 3039 ± 455 g in infants of diabetic mothers, in contrast pregnancy uncomplicated with PIH and diabetes had mean birth weight of 2881 ± 496 and 2853 ± 515 g, respectively, this difference of 151 g and 186 g, respectively being highly statistically significant ($P=0.0006$) in the former and ($P<0.001$) in the latter.

Conclusion

Mean birth weight is a good indicator for any population to determine outcome of new-borns. This study reveals that though

duration of gestation had a major impact on birth weight other biological factors such as gender with male babies, second and later births, as well as infants born to older mothers tended to have statistically significantly higher mean birth weight. In contrast infants of mothers with PIH registered lower mean birth weight to infants of diabetic mothers with higher mean birth weight but significantly shortened gestation.

Mean birth weight is a good indicator for any population to determine outcome of new-borns. This study reveals that though duration of gestation had a major impact on birth weight other biological factors such as gender with male babies, second and later births, as well as infants born to older mothers tended to have statistically significantly higher mean birth weight. In contrast infants of mothers with PIH registered lower mean birth weight to infants of diabetic mothers with higher mean birth weight but significantly shortened gestation compared to uncomplicated pregnancy.

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