
Correlation of Non-Medical Factors with Newborn's Body Parameters

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Abstract

Background: Birth weight and occipitofrontal circumference (OFC) are an important parameters of newborn's well being, and they are highly affected by factors that influence fetal growth.

Objective: The identification of non-medical factors (maternal and fetal) affecting the birth weight and OFC.

Methods: A cross sectional study was performed on 350 live born neonates with gestational age (37-42weeks), they were studied for the period between 1st of February-30th of July 2004 and they were all born in Al-Hayat maternity hospital and St.Raphael hospital in Baghdad. Babies of mothers with risk factors (gestational hypertension, gestational diabetes mellitus, cigarette smoking and multiple gestation), premature, and dysmorphic babies were all excluded. Relationships of maternal factors (age, parity, occupation, height, weight) and fetal factor of sex with newborn's birth weight and OFC were studied.

Results: We found that; the mean newborn's birth weight was 3.344(+/-0.479) Kg, while the mean newborn's occipitofrontal head circumference was 34.480(+/-1.281) Kg. Male sex, mother's weight and height are significantly and positively correlated to birth weight and OFC. While there was an insignificant correlation of birth weight and OFC with maternal body mass index, occupation, educational level and parity. Maternal age has a significant positive correlation with newborn's occipitofrontal head circumference but not with birth weight. A significant positive correlation of newborn's birth weight and OFC was found.

Conclusion: Maternal genetic factors are more significantly affecting newborn's occipitofrontal head circumference and birth weight than maternal related environmental factors.

Key word: Birth weight, occipitofrontal circumference, maternal risk factors, maternal body mass index.

Introduction:

The birth size is the result of fetal growth^[1]. The fetal growth which commences shortly after conception is largely determined genetically with the modification of this genetic process by the environment^[2, 3].

The fetal experience is unique and influenced by parental, placental, and fetal factors. Furthermore, it is likely that there are complex interactions between genetic and environmental factors of parental, placental, and fetal origin^[1].

There is considerable variability in the estimates of the fetal and parental components of these genetic influences from 18 to 69.4% and from 3 to 20% variance of birth size respectively. Familial trends in birth weight (which correlates well with occipitofrontal circumference) have also been observed^[1, 4, 5].

Parental genetic influences are likely to be polygenic, but the exact genes involved and how they act is not fully understood^[1, 6, 7, 8].

The placenta is critically involved in transporting nutrition and acting as a barrier to infection and maternal corticosteroids. In most cases, it is genetically identical with the fetus, but in 1–2% of conspectuses confined placental mosaicism is observed, in which a cytogenetic abnormality is detected in the placenta and not the fetus & an alteration of placental function occurs^[1,9].

Environmental factors with a known association with birth size are nutrition, smoking, maternal illnesses and genital infection. The association of

other factors such as stress and exposure to some types of work during pregnancy remains unproven^[10, 11, 12, 13, 14, 15]. Other risk factors for low birth weight babies such as maternal age, although not themselves environmental factors are strongly influenced by the social environment^[2, 16].

Epidemiological studies estimate that environmental influences account for about 25% birth weight variance and genetic influences account for 38–80% birth weight variance^[2]. There is significant correlation between parental birth weights and birth weight in index cases using multiple regression analysis^[6, 17, 18, 19, 20, 21].

Subjects & Methods:

It was a cross sectional study designed to examine the correlation of selected maternal and fetal factors with neonatal parameters (newborn's birth weight and occipitofrontal circumference). The study was done on 350 live born neonates, all newborn infants were term babies (gestational age 37-42weeks according to the Dubwitz score assessment), carried out in two maternity hospitals (Al-Hayat maternity hospital and St.Raphael hospital in Baghdad) over a six months period (1st of February-30th of July 2004). All the premature, dysmorphic, congenitally anomalous babies were excluded from the study, so also babies of mothers with risk factors (gestational hypertension, gestational diabetes mellitus, cigarette smoking mothers and multiple gestation pregnancy).

Maternal medical and obstetrical history was obtained; name, age(years), parity number, total

years of education, mother's educational level, mother's occupation (house wife or employer), Measurements for height and weight of mothers were taken within 24 hours of birth, using the Fazzini scale for weight and height for adults sensitive to 100gm and 1mm respectively. Neonatal birth weight and occipitofrontal head circumference (OFC) measurements for neonates were measured soon after delivery by using a Seca scale for weight and a non-stretchable measuring tape sensitive to 10gm and 1mm respectively. Those babies with less than 2.5Kg body weight were considered low birth weight^[3].

Results were expressed in numbers and percentages, statistical analysis was done using t-Test.

Results:

The mean newborn's birth weight in the study group was 3.344(+/-0.479) Kg, while the mean newborn's occipitofrontal head circumference was 34.480(+/-1.281) Kg.

The low birth weight newborns in the study group were 6(0.017%).

There was a significant positive correlation of newborn's male/female sex with newborn's birth weight and OFC as shown in table 1.

The significant positive correlation of mother's weight groups with birth weight and OFC are shown in table 2.

Table 1: Relation of newborn's sex with newborn's birth weight and OFC*

	Sex	No./Total	%	Mean(+/-SD)	P value(Between groups)
Baby Weight (Kg)	Male	193/350	55.1	3.422(0.496)	0.001
	Female	157/350	44.9	3.249(0.441)	
	Total	350/350	100	3.344(0.479)	
OFC* (cm)	Male	193/350	55.1	34.810(1.261)	0.000
	Female	157/350	44.9	34.073(1.190)	
	Total	350/350	100	34.480(1.281)	

OFC* Occipitofrontal circumference in centimeters (cm)

Table 2: Correlations of maternal weight with the newborn's birth weight and occipitofrontal Circumference.

	Maternal Weight Percentile	No./Total	Mean(+/-SD)	P value(Between groups)
Baby weight (Kg)	<5th	83/350	3.261(0.380)	0.04
	5th -25th	18/350	3.597(0.686)	
	>25th -50th	21/350	3.257(0.381)	
	>50th -75th	25/350	3.329(0.311)	
	>75th -95th	37/350	3.250(0.407)	
	>95th	166/350	3.396(0.532)	
	Total	350/350	3.345(0.480)	
OFC* (cm)	<5th	83/350	34.172(1.337)	0.016
	5th -25th	18/350	34.883(1.047)	
	>25th -50th	21/350	34.247(1.183)	
	>50th -75th	25/350	34.668(1.181)	
	>75th -95th	37/350	34.145(1.041)	
	>95th	166/350	34.666(1.313)	
	Total	350/350	34.480(1.281)	

OFC* Occipitofrontal circumference in centimeters (cm)

The significant positive correlation of mother's height groups with birth weight and OFC is shown in table 3. The mother's BMI groups were insignificantly correlated with newborn's birth

weight and OFC, as shown in table 4. The mother's age groups showed a significant correlation with newborn's OFC and none with birth weight as shown in table 5.

Table 3: Correlations of maternal height with the newborn's birth weight and occipitofrontal circumference

	Maternal Height Percentile	No./Total	Mean(+/-SD)	P value(Between groups)
Baby weight (Kg)	<5th	43/350	3.176(0.325)	0.001
	5th -25th	104/350	3.255(0.448)	
	>25th -50th	94/350	3.329(0.453)	
	>50th -75th	68/350	3.475(0.516)	
	>75th -95th	40/350	3.593(0.561)	
	>95th	1/350	2.750(.000)	
	Total	350/350	3.345(0.480)	
OFC* (cm)	<5th	43/350	34.197(1.123)	0.017
	5th -25th	104/350	34.293(1.369)	
	>25th -50th	94/350	34.531(1.203)	
	>50th -75th	68/350	34.677(1.211)	
	>75th -95th	40/350	34.87(1.357)	
	>95th	1/350	32(0.000)	
	Total	350/350	34.480(1.281)	

OFC* Occipitofrontal circumference in centimeters (cm)

Table 4: Relation of mother's BMI* groups with newborn's birth weight and OFC

	Group	No./Total	Mean(+/-SD)	P value(Between groups)
Baby Weight (Kg)	Normal Weight**	162/350	3.332(0.469)	0.569
	Over Weight***	148/350	3.329(0.421)	
	Obese****	76/350	3.396(0.593)	
	Total	350/350	3.344(0.479)	
OFC (cm)	Normal Weight**	162/350	34.333(1.277)	0.093
	Over Weight***	148/350	34.738(1.257)	
	Obese****	76/350	34.738(1.257)	
	Total	350/350	34.480(1.281)	

BMI* Body mass index in Kilogram/meter² (Kg/m²), Normal Weight** Body mass index is 19.8-25.0Kg/m², Over Weight*** Body mass index is 25.1-30.0Kg/m²
Obese**** Body mass index is >30.0Kg/m²

Table 5: Relation of mother's age groups with newborn's birth weight and OFC

	Age Group Years	No./Total	Mean(+/-SD)	P value(Between groups)
Baby Weight (Kg)	<20	20/350	3.232(0.361)	0.751
	20-25	105/350	3.334(0.505)	
	>25-30	129/350	3.332(0.439)	
	>30-35	67/350	3.410(0.521)	
	>35-40	25/350	3.378(0.568)	
	>40	4/350	3.275(0.272)	
	Total	350/350	3.344(0.479)	
OFC* (cm)	<20	20/350	34.160(1.287)	0.047
	20-25	105/350	34.455(1.242)	
	>25-30	129/350	34.304(1.219)	
	>30-35	67/350	34.900(1.424)	
	>35-40	25/350	34.592(1.256)	
	>40	4/350	34.675(0.537)	
	Total	350/350	34.480(1.281)	

OFC* Occipitofrontal circumference in centimeters (cm)

Mother's educational level was insignificantly correlated with newborn's birth weight and OFC, as shown in table 6. Mother's parity groups were insignificantly correlated with newborn's birth weight and OFC, as shown in table 7. There was no significant correlation of

mother's occupation with newborn's birth weight and OFC as shown in table 8.

Finally newborn's OFC groups were found to be significantly and positively correlated with birth weight groups, as shown in the following table 9.

Table 6: Relation of educational Level groups with newborn's birth weight and OFC

	Group	No./Total	Mean(+/-SD)	P value(Between groups)
Baby Weight (Kg)	Primary school	100/350	3.321(0.451)	0.851
	Secondary school	90/350	3.358(0.551)	
	Diploma	39/350	3.411(0.477)	
	College	115/350	3.337(0.459)	
	Postgraduate study	6/350	3.241(0.159)	
	Total	350/350	3.344(0.479)	
OFC* (cm)	Primary school	100/350	34.505(1.345)	0.404
	Secondary school	90/350	34.392(1.303)	
	Diploma	39/350	34.494(1.149)	
	College	115/350	34.471(1.264)	
	Postgraduate study	6/350	35.466(0.871)	
	Total	350/350	34.480(1.281)	

OFC* Occipitofrontal circumference in centimeters (cm)

Table 7: Relation of mother's parity groups with newborn's birth weight and OFC

	Group	No./Total	Mean(+/-SD)	P value(Between groups)
Baby Weight (Kg)	Primiparus*	150/350	3.289(0.431)	0.108
	Multiparus**	183/350	3.376(0.504)	
	Grand Multiparus***	17/350	3.494(0.576)	
	Total	350/350	3.344(0.479)	
OFC (cm)	Primiparus*	150/350	34.344(1.272)	0.077
	Multiparus**	183/350	34.542(1.283)	
	Grand Multiparus***	17/350	35.017(1.221)	
	Total	350/350	34.480(1.281)	

Primiparus* Mother having single live newborn

Multiparus** Mother having two-five live newborns

Grand Multiparus*** Mother having six or more live newborns

Table 8: Relation of mother's occupation with newborn's birth weight and OFC

	occupation	No./Total	Mean(+/-SD)	P value(Between groups)
Baby Weight (Kg)	House Wife	282/350	3.349(0.503)	0.735
	Worker	68/350	3.327(0.369)	
	Total	350/350	3.344(0.479)	
OFC* (cm)	House Wife	282/350	34.475(1.294)	0.880
	Worker	68/350	34.501(1.237)	
	Total	350/350	34.480(1.281)	

OFC* Occipitofrontal circumference in centimeters (cm)

Table 9 The newborn's OFC groups in correlation with birth weight groups in the study group

Case Study			Baby weight (Kg) groups							P value
			<5 th centile	5-25 th	>25-50 th	>50-75 th	>75-95 th	>95 th centile	Total	
OFC* (cm) groups	<5 th centile	No.	2	11	3	2	0	0.000	18	0.000
		%	0.6%	3.1%	0.9%	0.6%	0%	0%	5.1%	
	5-25 th centile	No.	4	88	89	43	5	4	233	
		%	1.1%	25.1%	25.4%	12.3%	1.4%	1.1%	66.6%	
	>25-50 th centile	No.	0	6	21	31	10	7	75	
		%	0%	1.7%	6%	8.9%	2.9%	2%	21.4%	
	>50-75 th centile	No.	0	0	3	1	4	1	9	
		%	0%	0%	0.9%	0.3%	1.1%	0.3%	2.6%	
	>75-95 th centile	No.	0	0	2	4	6	3	15	
		%	0%	0%	0.6%	1.1%	1.7%	0.9%	4.3%	
	Total	No.	6	105	118	81	25	15	350	
		%	1.7%	30%	33.7%	23.1%	7.1%	4.3%	100%	

OFC* Occipitofrontal circumference in centimeters (cm)

Discussion:

The mean birth weight in the study group was 3.344(+/-0.479)Kg, which is closely similar to 3.4Kg by Robert D. Needlman^[3,22], and the mean OFC in the study group was 34.480(+/-1.281)cm which is also close to 35cm by Robert D.

Needlman^[22] and M.T. Dattani^[3]. The small number of low birth weight newborns in the study group was due to the primary exclusion of all premature and congenitally anomalous newborns from the whole study.

There was a significant sex difference (male/female) regarding birth weight (P 0.001) and OFC (P 0.000), similar to findings of M.T. Dattani and M.A. Preece^[3] and Robert D Needlman^[22].

Mother's weight is significantly correlated to birth weight and OFC, a finding is similar to that of Sachar RK et al^[20], Shahi V et al^[7], N Spencer et al^[2] and Sanin Aguirre LH et al^[19].

Mother's height is significantly correlated to birth weight and OFC, a finding is similar to that of Sachar RK et al^[20], Shahi V et al^[7], N Spencer et al^[2] and Sanin Aguirre LH et al^[19].

Mother's BMI was insignificantly correlated with birth weight (P 0.569) and OFC (P 0.093), a correlation which is statistically insignificant was also noticed by Shahi V and Tandon^[7].

There was an insignificant correlation of mother's age with birth weight (P 0.751) and a positive significant correlation with newborn's OFC (P 0.047), a finding which is dissimilar to the study of N Spencer et al^[2], Amarin VN^[16], Shahi V and Tandon^[7], Haiek L et al^[13], Sachar RK et al^[20] and Deshmukh JS et al^[14], as the age range in the present study group was (17-46 years) and small number of adolescent pregnancies (15-19 years of age^[23]) were enrolled in the present study, so a more extended study is needed to verify this relationship.

The educational level, mother's parity groups and mother's occupation were not significantly correlated with birth weight (P 0.851, P 0.108, P 0.735) respectively, and so as with newborn's OFC (P 0.404, P 0.077, P 0.880) respectively, a finding is similar to N Spencer et al^[4] and N Spencer et al^[2].

Finally newborn's OFC groups were found to be significantly and positively correlated with birth weight groups (P 0.000), which indicates a proportionate body parameters in healthy babies, a finding similar to Todros T et al^[5], Emanuel I^[18].

Conclusions & Recommendations:

Newborn's male sex, increasing maternal height and maternal weight would positively affect newborn's weight and OFC, which indicates a significant genetic influence on newborn's body proportions.

While mother's educational level, mother's parity and occupation were not significantly correlated with newborn's weight and OFC, which indicates an insignificant environmental factors on newborn's body proportions.

Newborn's weight and OFC are highly correlated with each other. Mother's BMI was insignificantly correlated with newborn's OFC and birth weight.

So favorable genetic factors play an important roll in a desirable newborn's body parameters.

References:

1-L. B. Johnston, A. J. L. Clark and M. O. Savage: Genetic factors contributing to birth weight,

Archives of Disease in Childhood, Fetal and Neonatal Edition 2002; 86:F2-F3

2-N. Spencer and S. Logan: Social influences on birth weight. Archives of Disease in Childhood Fetal and Neonatal Edition 2002; 86:F6

3-M.T.Dattani and M.A. Preece: Physical growth and development. In Forfar & Arnill's Campbell: Text book of pediatrics. 5th edition, 2000; 349-351

4-N. Spencer and S. Logan: The treatment of parental height as a biological factor in studies of birth weight and childhood growth. Archives of Disease in Childhood 2002; 87:184-187

5-Todros T, Sanfelici C, Corrao G, Gagliardi L.: Head shape and size and body weight in the newborn infant, Euro J Obstetric Gynecol Reprod Biol. 1999 Jan; 19(1):1-5

6-Langhoff-Roos J, Lindmark G and Gustavson KH: Relative effect of parental birth weight on infant birth weight at term. Clin Genet 1997; 32:240-8

7-Shahi V and Tandon J: A study of maternal determinants and fetal weight. Indian J. Matern. Child Health. 1999 Jan-Mar; 10(1):13-5

8-Nahum GG and Stanislaw: Relationship of parental factors to birth weight, J Reprod Med 2003 Dec; 48(12):963-8

9-Lestou VS and Kalouse DK: Confined placental mosaicism and intrauterine fetal growth. Arch Dis Child Fetal Neonatal Ed 1998; 79:F223-6

10-Elina Hyppönen, George Davey Smith and Chris Power: Parental diabetes and birth weight of offspring: intergenerational cohort study. BMJ 2003; 326:19-20

11-Valentino Conter, Ivan Cortinovia, Patrizia Rogari and Luca Riva: Weight growth in infants born to mothers who smoked during pregnancy. BMJ 1995; 310:768-771

12-Xiao R, Sorensen TK, Williams MA, Luthy DA.: Influence of pre-eclampsia on fetal growth, J Matern Fetal Neonatal Med. 2003 Mar; 13(3):157-62

13-Haiek L, Lederman SA: The relationship between maternal weight for height and term birth weight in teens and adult women. J Adolesc Health Care. 1989 Jan; 10(1): 16-22

14-Deshmukh JS, Motghare DD, Zodpey SP and Wadhva SK: Low birth weight and associated maternal factors in an urban area. Indian Pediatr. 1998 Jan; 35(1):33-6

15-Mathews N: Maternal nutrition and birth weight, BMJ 2000; 320:941

16-Amarin VN, Akasheh HF.: Advanced maternal age and pregnancy outcome, East Mediterr Health J. 2001 Jul-Sep; 7(4-5):646-51

17-Magnus P, Bakketeig LS and Hoffman H: Birth weight of relatives by maternal tendency to repeat small-for-gestational-age (SGA) births in successive pregnancies. Acta Obstet Gynecol Scand Suppl 1997; 165:35-8

- 18-Emanuel I, Filakti H and Alberman E: Intergenerational studies of human birth weight from the 1958 birth cohort. 1. Evidence for a multigenerational effect, *Br. J. Obstet. Gynaecol.* 1992; 99:67-74
- 19-Sanin Aguirre LH, Reza-Lopez S and Levario-Carrillo M: Relation between Maternal Body Composition and Birth Weight. *Biol. Neonate.* 2004; 86(1):55-62
- 20-Sachar RK, Soni RK, Singh H: Correlation of some maternal variables with birth weight. *Indian J. Matern. Child Health.* 1994 Apr-Jun; 5(2):43-5
- 21-Barbara J. Stoll and Robert M. Kliegman: Multiple Pregnancies. In Richard E. Behrman, Robert M. Kliegman, Hal B. Jenson: *The High-Risk Infant*, Nelson Textbook of Pediatrics: 17th edition. 2004; 547-550
- 22-Robert D Needlman: Growth and Development, In Richard E. Behrman, Robert M. Kliegman, Hal B. Jenson: *The High-Risk Infant*, Nelson Textbook of Pediatrics: 17th edition. 2004; 31-37
- 23-Renee R. Jenkins: Pregnancy, In Richard E. Behrman, Robert M. Kliegman, Hal B. Jenson: *Special Health Problems During Adolescence*, Nelson Textbook of Pediatrics: 17th edition. 2004; 671-673
-
- Al-Hayat maternity hospital and St. Raphael hospital in Baghdad