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Influence of Maternal Pregravid Weight, Height and Body Mass Index on Birth Weight of Male and Female Newborns

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A B S T R A C T

The study included 2300 healthy couples and their healthy newborns delivered vaginally from singleton, normal term (37–42 weeks) pregnancies in Šibenik, Zadar and Split (Croatia). Both fathers and mothers of male newborns were older and had a higher weight than those of female newborns (p<0.05). Gestational age and birth weight were higher in male than female newborns (p<0.001). Increasing maternal pregravid weight led to increasing birth weight of both male and female newborns (p<0.001). Furthermore, increasing maternal height and body mass index resulted in increasing birth weight of male and female newborns (p<0.001). Thus, the fathers and mothers of male infants were older than those of female infants (p<0.05), and increasing pre-gravid body weight, body height and body mass index were associated with a higher birth weight in both male and female newborns.

***Key words**: pregravid, weight, height, body mass index, newborn*

Introduction

Numerous factors – genetic[1–5], maternal[6,7], paternal[2,8], fetal[9], placental[5], environmental[5,10], etc. – influence embryonic and fetal growth. During the first half of gestation, the growth is determined by fetal genome at fertilization, whereas maternal, placental and environmental factors are more prominent in the late gestational period[1]. Genetic effect on birth weight in normal fetuses is controlled through genetic loci. Birth weight is influenced by maternal and fetal genotypes[1,9]. Genetic factors influencing birth weight account for 38% (maternal genotype 20%, fetal genotype 15% and fetal sex 2%), and maternal influence and environmental factors for the remaining 62%[1].

The father's influence (paternal factor) on neonatal birth weight is effectuated through fetal autosomal genes and sex[8,10–12]. Age, pre-gravid weight, height, body mass index (BMI), weight gain during pregnancy[2,13–17], parity[6,18], smoking habits during pregnancy[8,13,17,18], and socioeconomic status[10,18,19] are important maternal factors that affect fetal growth.

Materials and Methods

This prospective study was conducted from January 1st, 2002, to June 30th, 2003, and comprised 2300 healthy couples and their newborn infants delivered at the maternity units of the Šibenik General Hospital (N=617), Zadar General Hospital (N=887) and Split Clinical Hospital (N=796).

Maternal and paternal parameters: age (in completed years), body weight (kg), body height (cm) and birth weight (g), were assessed by self-report or obtained from antenatal and/or hospital records. The BMI (kg/m^2) status was determined according to Nahum et al.[20], BMI values up to 19.9 kg/m^2 were categorized as low (poorly nourished persons), from 20.0 to 24.9 kg/m^2 as moderate (ideal, normal body weight), from 25.0 to 29.9 kg/m^2 as high (moderately overweight) and from 30.0 above as very high (obese, very overweight).

Live born healthy newborns delivered vaginally from term (37 to 42 weeks) singleton pregnancies (abnormal pregnancies excluded) were analyzed. Duration of pregnancy was determined according to last menstrual date,

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TABLE 1
AGE, WEIGHT, HEIGHT, BMI KG/M^{2,} BIRTH WEIGHT OF FATHERS AND MOTHERS OF NEWBORNS, MATERNAL GESTATIONAL WEIGHT GAIN, DURATION OF PREGNANCY, SEX AND BIRTH WEIGHT OF NEWBORNS

Parameters	Newborn sex		t-test	p
	Male, N = 1188 $\overline{X}$ ± SD	Female, N = 1112 $\overline{X}$ ± SD		
A) Father's				
Age (years)	31.8 ± 8.3	29.6 ± 8.1	6.47	< 0.001 –
Weight (kg)	84.2 ± 22.0	84.3 ± 22.2	0.1	n.s.
Height (cm)	182.8 ± 16.4	181.9 ± 17.2	1.31	n.s.
BMI (kg/m^2)	25.2 ± 5.2	25.5 ± 5.8	1.36	n.s.
Birth weight (g)	3626.6 ± 598.8 (746)	3548.6 ± 600.4 (740)	2.50	< 0.02
B) Mother's				
Age (years)	28.8 ± 8.2	27.7 ± 8.4	3.21	< 0.01 –
Pregravid weight (kg)	65.7 ± 12.2	65.8 ± 12.1	0.20	n.s.
Gestational weight gain (kg)	15.81 ± 5.60	13.61 ± 4.90	10.10	< 0.001 –
Height (cm)	170.6 ± 17.1	168.4 ± 16.8	3.14	< 0.01 –
BMI (kg/m^2)	22.6 ± 3.8	22.2 ± 3.7	0.29	n.s.
Birth weight (g)	3596.4 ± 570.2 (932)	3540.8 ± 572.0 (915)	2.13	< 0.05 –
C) Duration of pregnancy (days)	278.8 ± 14.2	276.0 ± 16.2	7.06	< 0.001 –
D) Newborn weight (g)	3685.8 ± 612.7	3570.0 ± 596.0	4.58	< 0.001 –

TABLE 2
MATERNAL PREGRAVID WEIGHT, HEIGHT, BODY MASS INDEX, AND BIRTH WEIGHT OF MALE AND FEMALE NEWBORNS

Parameters	N	Newborn sex	
		Male (n) $\overline{X}$ ± SD	Female (n) $\overline{X}$ ± SD
Mother's weight (kg)			
–49	26	3165.4 ± 602.5 (15)	3087.5 ± 561.0(11)
50–59	335	3450.6 ± 610.6 (161)	3349.0 ± 582.3(174)
60–69	951	3548.5 ± 611.4 (491)	3512.2 ± 595.2(460)
70–79	527	3650.2 ± 620.0 (281)	3601.8 ± 596.7(246)
80–89	323	3860.3 ± 618.4(163)	3830.0 ± 607.0(160)
90–99	103	3902.4 ± 590.4(56)	3881.0 ± 610.2(47)
100 and more	35	4136.0 ± 580.0(21)	4065.0 ± 615.2(14)
		F = 21.86; p < 0.001	F = 22.65; p < 0.001
Mother's height (cm)			
–154	81	3031.7 ± 525.8(39)	3103.1 ± 517.9(42)
155–159	245	3233.8 ± 544.1(119)	3271.6 ± 535.0(126)
160–164	500	3301.9 ± 561.6(251)	3350.0 ± 555.9(249)
165–169	655	3471.9 ± 611.6(335)	3512.3 ± 586.2(320)
170–174	339	3666.7 ± 653.6(165)	3722.0 ± 643.9(174)
175–179	153	3771.7 ± 685.8(84)	3891.7 ± 669.9(69)
180–184	126	3921.7 ± 681.8(71)	3920.7 ± 674.3(55)
185–189	15	4046.8 ± 679.6(68)	3928.2 ± 676.2(47)
190–194	60	4071.8 ± 641.6(39)	3950.0 ± 678.3(21)
195 and more	26	4161.9 ± 688.6(17)	3990.3 ± 676.6(9)
		F = 8.86; p < 0.001	F = 8.12; p < 0.001
Mother's BMI kg/m^2			
–19.9	451	3387.3 ± 595.9(210)	3459.7 ± 585.4(241)
20.0–24.9	1476	3647.2 ± 613.9(763)	3579.2 ± 595.6(713)
25.0–29.9	340	3827.3 ± 621.7(196)	3683.8 ± 607.7(144)
30 and more	33	3919.1 ± 655.5(19)	3841.6 ± 685.8(14)
		F = 11.10; p < 0.001	F = 11.75; p < 0.001

ultrasound evaluation and postpartum assessment according to Farr. Neonatal sex, weight and length were recorded at birth.

Statistical analysis was performed using t-test, analysis of variance, arithmetic mean, standard deviation and percentage. The significance of differences was set at $p<0.05$.

Results

Table 1 shows means of paternal parameters (age, body weight, body height, BMI and birth weight) of both male and female infants. The fathers of male infants were older and had higher birth weight than those of female infants ($p<0.05$). The means of maternal parameters were also calculated (age, pre-gravid body weight, weight gain during pregnancy, body height, BMI and birth weight). The mothers of male infants were older, had a higher weight gain during pregnancy and greater body height and birth weight than those of female infants ($p<0.05$). Pregnancies with male fetuses lasted longer and their birth weights were greater compared to female ones ($p<0.05$). The increasing maternal pre-gravid weight resulted in higher mean birth weight of male and female newborns ($p=0.001$). Similarly, the increasing maternal body height resulted in higher birth weight of male and female newborns ($p=0.001$). The birth weight of both male and female newborns increased with increasing pre-gravid BMI ($p=0.001$) (Table 2).

Discussion

Embryonic and fetal growth is controlled by numerous growth factors: IGF-I, IGF-II, insulin, nerve growth factor, epidermal growth factor, platelet-derived growth factor, beta-type transforming growth factor[1,3,4], etc. This study confirmed the previously reported results dealing with this geographic area[8,11], revealing the parents of male newborns to be older than those of female newborns ($p<0.05$). We found no literature data on parental age influencing the sex of their offspring. Maternal birth weight affects the birth weight of her newborn[21,22]. The increasing maternal birth weight increases her adult body weight and height[7,10]. Maternal pregravid weight and body height influence the birth weight of their offspring[21,22]. Weight-gain during pregnancy is positively correlated with the newborn's birth weight[10,17,22], although some authors disagree[16]. Excessive maternal weight gain during pregnancy results in high neonatal birth weight[8,14]. Pregnancies with male fetuses last longer than those with female fetuses ($p< 0.05$), although there are opinions that neonatal sex is not associated with duration of pregnancy[17]. The birth weight of male infants is greater than that of female infants[15,21], and gestational age is significantly associated with neonatal weight[6,23].

Increasing maternal pre-gravid weight (by weight groups) resulted in increasing birth weights of male and female newborns ($p=0.001$). Increasing maternal body height and BMI also increased birth weight of male and female newborns ($p=0.001$) (Table 2). Obese and tall women give birth to infants of greater birth weight than to women of average body weight and height[15,24].

In conclusion, the fathers of male newborns are older than those of female newborns; increasing pre-gravid body weight, body height and BMI increase the birth weight of both male and female newborns.

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UTJECAJ PREGRAVIDNE TJELESNE MASE, VISINE I INDEKSA TJELESNE MASE (BMI) MAJKE NA PORODNU MASU MUŠKE I ŽENSKE NOVOROĐENČADI

S A Ž E T A K

U radu je istraženo 2300 zdravih bračnih parova i njihova zdrava, donošena novorođenčad (od 37. do 42. tjedna trudnoće), iz jednoplodnih trudnoća, rođena vaginalnim putem u Šibeniku, Zadru i Splitu (Hrvatska). I otac i majka muške novorođenčadi su bili su stariji u odnosu na žensku novorođenčad ($p<0,05$) i veće su porodne težine ($p<0,05$). U trudnica s muškom djecom gestacijska dob je duža i porodna težina je veća nego sa ženskom djecom ($p<0,001$). S povećanjem pregravidne maternalne težine povećava se težina muške i ženske novorođenčadi ($p=0,00001$). I povećanje maternalne visine i BMI kg/m^2 povećava se porodna težina muške i ženske novorođenčadi ($p=0,00001$). Autori zaključuju da su očevi i majke muške djece stariji od očeva i majki ženske djece ($p<0,05$) te da se s povećanjem pregravidne tjelesne težine, visine i BMI kg/m^2 povećava porodna težina muške i ženske novorođenčadi.