

Effect of Parental Anthropometric Parameters on Neonatal Birth Weight and Birth Length

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ABSTRACT

Data on 550 healthy pregnant women, 550 healthy fathers and their healthy term neonates born from singleton pregnancies (37⁺⁰ through 41⁺⁶ week) during a one-year period were reviewed. Maternal mean age was 27.7±9.37 years, mean pregestational weight 64.0±9.50 kg, mean gestational weight gain 15.4±4.33 kg, mean height 169.7±5.81 cm, and mean gestational age 40.1±0.95 weeks. Paternal mean age was 31.4±6.22 years, mean weight 84.6±10.35 kg, and mean height 182.8±6.84 cm. Mean birth weight was 3,709.8±500.48 g and 3,562.5±443.02 g, and mean birth length 51.5±1.91 cm and 50.7±1.62 cm in male and female newborns, respectively, yielding a birth weight greater by 147.3 g and birth length by 0.8 cm in the former. Study variables showed statistically significant correlations: maternal age contributed to the significant correlation between maternal weight and parity, maternal pregestational weight, weight at delivery, gestational weight gain and body height correlated significantly with neonatal birth weight and birth length, gestational age correlated significantly with neonatal weight and length ($p=0.01$ all), parity had no major impact ($p>0.05$). Paternal height and weight correlated significantly with neonatal birth weight and birth length ($p=0.01$). Study results pointed to a significant correlation of maternal pregestational weight, gestational weight gain and body height, and of paternal weight and height with the neonate birth weight and birth length.

Key words: maternal weight, maternal weight gain, paternal weight, paternal height, fetal anthropometry

Introduction

Birth weight and birth length result from the interaction of genetic factors, and maternal, fetal, placental, paternal and environmental variables. Genetic control of fetal growth predominates during the first half of gestation, whereas other factors play major role in later periods of gestation^{1,2}. Maternal factors influencing fetal growth and thus birth weight and birth height include age, body height, pregestational body weight, gestational weight gain, parity, gestational age, smoking during pregnancy, ethnicity, general health state, and dietary habits during pregnancy^{3–13}. The activity of fetal factor as a biologic feature begins during intrauterine life and is mediated *via* genetic and endocrine basis, resulting in birth weight greater by 150–200 g and birth length greater by 0.5 cm in male *vs* female newborns^{14,15}. Paternal weight and height show positive correlation with neonatal birth weight^{1,6}. Man is surrounded by environmental factors, which include physical, biologic and social

factors^{17,18}. Physical environment refers to all the inanimate surrounding (water, air, soil), whereas biologic factors include all the living organisms in human surrounding, i.e. plants and animals. Social environment represents man in particular relationships with other people within and beyond the family.

Materials and Methods

Data on healthy parents and their healthy neonates born at term (gestational age 37⁺⁰ through 41⁺⁶ weeks) from controlled and normal singleton pregnancies free from pathologic conditions, in Šibenik-Knin County, Croatia, from January 1 to December 31, 2002, were reviewed. Data were collected by interview, direct determination of particular variables, and survey of maternity book and maternity ward protocol. A maternity book was

administered to each pregnant woman on initial gynecologic examination (up to 12th week of gestation), where general data of the woman (weight, height, age, parity and general health condition) and the father (weight, height, age and general health condition) were entered. If the woman could not provide father's data on initial examination, she did it on the next examination in 3–4 weeks. Gestational weight gain is a difference between pregestational weight (or weight in the first 12 weeks of gestation) and weight measured on the last examination (two weeks before delivery or at delivery). At birth, each newborn underwent sex identification, and measurement of birth weight (in grams) on a Libela scale (Libela, Celje, Slovenia) and birth length (in centimeters) in a Pirquet tub. The data thus collected were entered in the work-sheet of the Anthropometry in Perinatology project conducted from January 1, 2002 in the Šibenik-Knin County (Table 1).

Data on all study subjects were submitted to statistical analysis according to all study variables. The variables are presented numerically in tables, including evaluation of the basic parameters and their distribution (mean, standard deviation, standard error of mean, index of confidence, range, and percentiles). Relationship among all variables was tested by the coefficient of correlation. The significance of differences was set at $p < 0.05$. The structure of correlation among variables was tested by factorial analysis. Data were processed on a PC by use of Statistica for Windows, Release 5.5 H and SIPSS for Windows, Release 7.5.

Results

The study included data on 550 pregnant women, 550 fathers, and their 550 newborns (290 male and 260 fe-

male). Study parameters and variable distribution (arithmetic mean, standard deviation, coefficient of variation, standard error of mean, 95% confidence interval, and range) are presented in Table 2.

Percentile values (2.5, 5, 10, 50, 75, 90, 95 and 97.5) of variable distribution in 550 study couples and their newborns revealed 50% of the mothers and fathers to be aged < 27 and < 31 years, with body height < 170 cm and < 182 cm, and pregestational weight < 63 kg and body weight < 85 kg, respectively. Birth weight $< 3,700$ g and birth length of 51 cm were recorded in 50% of the newborns, however, 50% of female newborns had birth weight $< 3,550$ g and birth length < 51 cm (Table 3).

Correlation coefficients for pairs of all variables yielded a number of statistically significant correlations. Correlation coefficients were not independent, e.g., maternal age indirectly contributed to the significant correlation between maternal weight and parity ($p = 0.01$). Maternal pregestational weight, weight at delivery, weight gain during gestation and body height showed positive correlation with the neonate birth weight and birth length ($p = 0.01$). Paternal body weight and height correlated significantly with the neonate birth weight and birth length ($p = 0.01$). Gestational age showed positive correlation with the neonate birth weight and birth length ($p = 0.01$), whereas parity had no statistically significant effect on the latter two parameters ($p > 0.05$) (Table 4).

Discussion

In the 20th century, observations of an accelerated intrauterine growth and development were reported. In addition to a number of factors implicated, the potential causes of such a pattern include population migration

TABLE 1
STUDY VARIABLES

Project work-sheet code	Variable description	Category	
		Code	Male/Female
RB	Number		
DOB-M	Maternal age (yrs)		
TEZ-M-PR	Maternal weight before or in the first 12 weeks of gestation (kg)		
TEZ-M-PO	Maternal weight at delivery (kg)		
PRI-TT	Maternal weight gain during gestation (kg)		
VIS-M	Maternal height (cm)		
PARITET	Parity		
TR-TRUD	Gestational age (weeks)		
DOB-O	Paternal age (yrs)		
TEZ-O	Paternal weight (kg)		
VIS-O	Paternal height (cm)		
SPOL-N	Neonate sex	1	Male
		2	Female
TEZ-N	Neonate birth weight (g)		
DULJ-N	Neonate birth length (cm)		

Original codes from the Anthropometry in Perinatology project work-sheet.

TABLE 2
VALUES OF MATERNAL, PATERNAL AND NEONATE VARIABLES

Codes	Variable	N	X	SD	KV	SX	IC (95%)		Range	
							h ₁	h ₂	Min	Max
BOB-M	Maternal (yrs)	550	27.7	5.33	19.2	0.23	27.23	28.13	17.0	42.0
TEZ-M-PR	Maternal weight before or in the first 12 weeks of gestation (kg)	550	64.0	9.37	14.6	0.40	63.25	64.82	44.0	116.0
TEZ-M-PO	Maternal weight at delivery (kg)	550	79.4	9.50	12.0	0.40	78.63	80.22	58.0	130.0
PRI-TT	Maternal weight gain during gestation (kg)	550	15.4	4.33	28.1	0.18	15.03	15.75	4.0	32.0
VIS-M	Maternal height (cm)	550	169.7	5.81	3.4	0.25	169.21	170.18	150.0	185.0
TR-TRUD	Gestational (weeks)	550	40.1	0.95	2.4	0.04	40.05	40.21	37.0	41.0
DOB-O	Paternal age (yrs)	550	31.4	6.22	19.8	0.27	30.93	31.97	19.0	56.0
TEZ-O	Paternal weight (kg)	550	84.0	10.35	12.2	0.44	83.71	85.44	52.0	150.0
VIS-O	Paternal height (cm)	550	182.8	6.84	3.7	0.29	182.20	183.35	164.0	205.0
TEZ-N	Male neonate birth weight (g)	290	3709.8	500.48	13.5	29.39	3651.60	3767.60	2350.0	5400.0
DULJ-N	Male neonate birth length (cm)	290	51.5	1.91	3.7	0.11	51.24	51.69	45.0	56.0
TEZ-N	Female neonate birth weight (g)	260	3562.5	443.02	12.4	27.47	3508.36	3616.56	2500.0	4800.0
DULJ-N	Female neonate birth length (cm)	260	50.7	1.67	3.3	0.10	50.49	50.90	45.0	55.0

Original codes from the Anthropometry in Perinatology project project work-sheet. N – sample size, – mean, SD – standard deviation, KV – coefficient variation, S – standard error of mean, IC – confidence interval

TABLE 3
PERCENTILE VALUES OF VARIABLE DISTRIBUTION

Codes	Variable	N	Percentile								
			2.5	5	10	25	50	75	90	95	97.5
DOB-M	Maternal age (yrs)	550	19.0	20.0	21.0	24.0	27.0	32.0	35.0	38.0	39.2
TEZ-M-PR	Maternal weight before or in the first 12 weeks of gestation (kg)	550	49.8	51.6	53.0	58.0	63.0	68.0	76.0	82.0	86.2
TEZ-M-PO	Maternal weight at delivery (kg)	550	64.0	66.0	69.0	73.0	78.5	85.0	91.9	96.5	101.0
PRI-TT	Maternal weight gain during gestation (kg)	550	8.0	9.0	10.0	12.0	15.0	18.0	21.0	23.0	25.0
VIS-M	Maternal height (cm)	550	158.0	160.0	163.0	166.0	170.0	173.0	178.0	180.0	182.0
TR-TRUD	Gestational age (weeks)	550	38.0	38.0	39.0	40.0	40.0	41.0	41.0	41.0	41.0
DOB-O	Paternal age (yrs)	550	22.0	23.0	24.0	27.0	31.0	35.0	39.9	43.0	46.0
TEZ-O	Paternal weight (kg)	550	67.0	70.0	72.0	78.0	85.0	90.0	97.9	100.0	105.0
VIS-O	Paternal height (cm)	550	170.0	172.0	175.0	179.0	182.0	187.0	191.9	195.0	198.0
TEZ-N	Male neonate birth weight (g)	290	2663.8	2900.0	3050.0	3400.0	3700.0	4050.0	4350.0	4500.0	4800.0
DULJ-N	Male neonate birth length (cm)	290	47.0	49.0	50.0	51.0	51.0	53.0	54.0	54.4	55.0
TEZ-N	Female neonate birth weight (g)	260	2776.3	2900.0	3000.0	3250.0	3550.0	3900.0	4100.0	4350.0	4473.8
DULJ-N	Female neonate birth length (cm)	260	48.0	48.0	49.0	50.0	51.0	52.0	53.0	54.0	54.0

Original codes from the Anthropometry in Perinatology project work-sheet. N – sample size

and gene mixing^{19,20}. The newborn's ethnicity is associated with specific growth and development features caused by different hereditary factors and environmental conditions of the parental living setting. Belonging to a particular population group has a strong effect on the newborn's birth weight and birth length, as it is one of

the major intrinsic factors in the formation of the anthropologic frame of a human being^{20,21}. The mean age in our study mothers was 27.7±5.33 years. While birth weight increased with maternal age, there was no effect of maternal age on birth length (Table 4). Other authors report on a significant correlation of maternal age with

TABLE 4
VARIABLE CORRELATIONS

Variable	DOB-M	TEZ-M-PR	TEZ-M-PO	PRI-TT	VIS-M	PARITET
DOB-M	—	0.177 ¹	0.090 ²	-0.186 ¹	-0.108 ²	0.484 ¹
TEZ-M-PR	0.177 ¹	—	0.895 ¹	-0.201 ¹	0.330 ¹	0.211 ¹
TEZ-M-PO	0.090 ²	0.895 ¹	—	0.258 ¹	0.411 ¹	0.104 ²
PRI-TT	-0.186 ¹	-0.201 ¹	0.258 ¹	—	0.187 ¹	-0.228 ¹
VIS-M	-0.108 ²	0.330 ¹	0.411 ¹	0.187 ¹	—	-0.056
PARITET	0.484 ¹	0.211 ¹	0.104 ²	-0.228 ¹	-0.056	—
TR-TRUD	-0.023	0.022	0.040	0.039	0.052	-0.085 ²
DOB-O	0.751 ¹	0.216 ¹	0.141 ¹	-0.156 ¹	-0.094 ²	0.466 ¹
TEZ-O	0.140 ¹	0.148 ¹	0.144 ¹	-0.005	0.160 ¹	0.032
VIS-O	0.023	0.108 ²	0.135 ¹	0.063	0.273 ¹	-0.078
TEZ-N	0.101 ²	0.224 ¹	0.289 ¹	0.150 ¹	0.190 ¹	0.075
DULJ-N	0.064	0.245 ¹	0.294 ¹	0.114 ¹	0.215 ¹	0.030

Variables	TR-TRUD	DOB-O	TEZ-O	VIS-O	TEZ-N	DULJ-N
DOB-M	-0.023	0.751 ¹	0.140 ¹	0.023	0.101 ²	0.064
TEZ-M-PR	0.022	0.216 ¹	0.148 ¹	0.108 ²	0.224 ¹	0.245 ¹
TEZ-M-PO	0.040	0.141 ¹	0.144 ¹	0.135 ¹	0.289 ¹	0.294 ¹
PRI-TT	0.039	-0.156 ¹	-0.005	0.063	0.150 ¹	0.114 ¹
VIS-M	0.052	-0.094 ²	0.160 ¹	0.273 ¹	0.190 ¹	0.215 ¹
PARITET	-0.085 ²	0.466 ¹	0.032	-0.078	0.075	0.030
TR-TRUD	—	0.006	0.055	0.076	0.304 ¹	0.282 ¹
DOB-O	0.006	—	0.075	-0.079	0.056	0.015
TEZ-O	0.055	0.075	—	0.549 ¹	0.118 ¹	0.116 ¹
VIS-O	0.076	-0.079	0.549 ¹	—	0.153 ¹	0.164 ¹
TEZ-N	0.304 ¹	0.056	0.118 ¹	0.153 ¹	—	0.808 ¹
DULJ-N	0.282 ¹	0.015	0.116 ¹	0.164 ¹	0.808 ¹	—

¹ significant (p = 0.01); ² significant (p = 0.05);

Original codes from the Anthropometry in Perinatology project work-sheet. DOB-M=Maternal age (yrs), TEZ-M-PR=Maternal weight before or in the first 12 weeks of gestation (kg), TEZ-M-PO=Maternal weight at delivery (kg), PRI-TT=Maternal weight gain during gestation (kg), VIS-M=Maternal height (cm), PARITET=Parity, TR-TRUD=Gestational age (weeks), DOB-O=Paternal age (yrs), TEZ-O=Paternal weight (kg), VIS-O=Paternal height (cm), TEZ-N=Male neonate birth weight (g), DULJ-N=Male neonate birth length (cm), TEZ-N=Female neonate birth weight (g), DULJ-N=Female neonate birth length (cm)

birth weight and birth length^{3,4}. In our women, the mean pregestational weight was 64.0±0.50 kg, which is consistent with literature data^{5,6}. Women with a greater pregestational weight give birth to neonates of a higher birth weight than those with lower pregestational weight^{1,15,22}. Accordingly, maternal pregestational weight could be considered a good predictor of the newborn's birth weight. In the present study, the mean weight gain during the period of gestation was 15.4±4.33 kg, which exceeded the mean weight gain in the Croatian population¹³. Weight gain during gestation correlates significantly with the newborn's birth weight and birth length^{12,23}. The mean body height in our women was 169.7±5.81 cm. A significant correlation was recorded between maternal height and infant birth weight and birth length (p=0.01). Literature reports show the birth weight of both male and female newborns to increase with maternal height¹⁵. Also, children born to tall and obese mothers

have higher birth weight than those born to short and lean mothers^{3,12}. Gestational age has a major impact on infant birth weight and birth length^{3,4}. In our study, the mean gestational age was 40.1±0.95 weeks. While paternal age had no impact on infant birth weight and birth length (p>0.05), paternal weight correlated significantly with both of these parameters (p=0.01). Paternal body height has been reported to correlate significantly with infant birth weight, as also demonstrated in our study^{1,6,24}. In the present study, the mean birth weight of healthy term male and female newborns was 3,709.8±500.48 g and 3,562.5±443.02 g, respectively. Thus, birth weight was by 147.3 g greater in male than in female newborns, which is consistent with literature data^{3,12,15}. The mean birth length was 51.5±0.1 cm and 50.7±1.67 cm in male and female newborns, respectively, i.e. by 0.8 cm greater in male *vs* female infants.

Conclusion

Study results indicated maternal pregestational body weight, weight gain during gestation and body height,

and paternal body weight and body height to correlate significantly with infant birth weight and birth length.

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UTJECAJ ANTROPOMETRIJSKIH PARAMETARA RODITELJA NA TEŽINU I DULJINU NOVOROĐENČADI

SAŽETAK

Od 1. siječnja do 31. prosinca 2002. godine obrađeno je 550 zdravih trudnica-rodilja, 550 zdravih očeva i njihove zdrave donošene novorođenčadi iz urednih (jednoplodnih) terminskih trudnoća (od 37⁰ do 41⁺¹ tjedana) u Šibensko-kninskoj županiji. Srednja životna dob ispitanica je 27.7±9.37 godina, s pregravidnom težinom 64.0±9.50 kg, s prosječnim prirastom u težini tijekom trudnoće 15.4±4.33 kg, i s prosječnom visinom 169.7±5.81 cm. Prosječno trajanje trudnoće iznosi 40.1±0.95 tjedana. Prosječna životna dob očeva iznosi 31.4±6.22 godine, težina 84.6±10.35 kg i visina 182.8±6.84 cm. Prosječna porodna težina muške novorođenčadi je 3,709.8±500.48 g, a duljina 51.5±1.91 cm, dok je srednja porodna težina ženske novorođenčadi 3562.5±443.02 g, a duljina 50.7±1.62 cm. Muška su novorođenčad teža za 147.3 g i dulja za 0.8 cm od ženske. Statistički značajne korelacije ispitivanih parova varijabli su brojne. Značajnoj korelaciji težine majke i pariteta pridnosi životna dob majke (p=0.01). Pregravidna težina majke, težina majke na porodu, prirast u težini tijekom trudnoće, te visina trudnice značajno koreliraju s težinom i duljinom novorođenčeta (p=0.01). Trajanje trudnoće značajno korelira s težinom i duljinom novorođenčadi (p=0.01), dok paritet nema značajan utjecaj (p>0.05). Težina i visina oca u značajnoj su korelaciji s težinom i duljinom novorođenčadi (p=0.01). Autori zaključuju da pregravidna težina, prirast u težini tijekom trudnoće i visina trudnice značajno koreliraju s težinom i duljinom novorođenčeta. Težina i visina oca u značajnoj su korelaciji s težinom i duljinom novorođenčeta.