

# The Percentile Growth Curve of Live-Born Infants During 1997 and 2007 from the Tuzla Canton (BiH)

Amela Begić<sup>1,2</sup>, Lejla Mešalić<sup>3,4</sup>, Jasminka H. Halilović<sup>1</sup>

<sup>1</sup>University of Tuzla, Faculty of Natural Sciences and Mathematics

<sup>2</sup>“Meša Selimović” High school Tuzla

<sup>3</sup>University of Tuzla, School of Medicine

<sup>4</sup>Women and pregnant women health protection service, Health centre Tuzla

## ABSTRACT

*The purpose of this work was to develop the percentile growth curves of the term newborns from the Tuzla Canton for birth weight and birth length, according to weeks of gestation, in relation to gender and parity of mother in two time points (1997 and 2007). The study used data from the book of protocols from the Department of Obstetrics and Gynecology-University Clinical Center in Tuzla (OBG-UCC Tuzla). The study includes N=8823 live-born newborns from singleton pregnancies. Of these 5119 newborns were born in 1997 and 3704 newborns were born in 2007. The study excludes: stillborn infants, infants who died immediately after birth, infants who were born from multiple pregnancies (twin and multiple), infants of foreign nationals as well as infants with congenital anomalies and chromosomopathies. Male infants born in 1997 at 40 weeks' gestation had different values for primiparae (3500.00 g) and multiparae (3700.00 g) at 50th percentile. Female infants born in 1997 at 40 weeks' gestation had different values for primiparae (3400.00 g) and multiparae (3550.00 g) at 50th percentile. Values of birth weight in male infants born in 2007 at 40 weeks' gestation at 50th percentile were 3600.00 g in primiparae and 3750.00 g in multiparae. Values of birth weight in female infants born in 2007 at 40 weeks' gestation at 50th percentile were 3450.00 g in primiparae and 3550.00 g in multiparae. The mean birth weight of the total sample was 3384.94±524.03 g and of birth length 52.89±3.03 cm. Statistically significant increases in mean values of birth weight in 2007, compared to 1997, were identified in 38th, 39th, 40th and 41st week of gestation, which is a confirmation of need to develop reference tables of growth of newborns, as well as the necessity for their constant revision.*

**Key words:** percentile growth curve, newborns/infants, birth weight, birth length Tuzla Canton

## Introduction

The percentile fetal growth curves compare the birth weight of newborns with gestational age to evaluate fetal growth performance. The basis for generating percentile growth curves are data on birth weight in each completed gestation week from which a longitudinal fetal growth pattern for a given population is derived. When talking about child growth curves, it is necessary to emphasize the difference between »standard curves« and »reference« curves. While the »standard« describes how children should grow, ie achieve maximum genetic potential in optimal environmental conditions, the »reference« describes the growth of certain age groups of children living in a given space at a given time, so these values do not necessarily have to describe »optimum« growth. Usually, the reference values include standards, which is not true. As mentioned by

Garza and Onis the reference values can be used for comparative purposes, but not for longitudinal monitoring<sup>1</sup>.

By the late 1970s different growth curves for infants and children were used. During 1977, the National Center for Health Statistics (NCHS- National Center for Health Statistics) has published a table of growth for children under the age of 18. World Health Organization (WHO) recommended then to the countries that do not have their own national standards, such as us, to use in their daily work the data of the National center for health statistics – NCHS, but also to design their own reference tables that are specific and different for each local population<sup>2</sup>.

After that, the Center for Disease Control and Prevention (CDC) in 2002 made growth curves for children younger than 24 months, and for children and adolescents from 2 to 19 years of age. The CDC tables are the reference tables that describe child growth in the United States in

the 30 year period, from 1963 to 1994<sup>3</sup>. These tables were in use around the world, and the most common objections to these curves were a limited sample of children only to US caucasians, a long three-month interval in which anthropometric measurements and the choice of statistical methods used to make them were performed.

In 1997, WHO launched the Multicentre Growth Reference Study (MGRS) study to collect data for the assessment of growth and development of infants and small children worldwide. The study was attended by pediatricians, nutritionists, biologists, epidemiologists and statisticians, who developed a detailed protocol for this international study. Data from 8440 healthy children were collected from 1997 to 2003 at six locations in six countries around the world: Pelotas, Brazil; Accra, Ghana; Delhi, India; Oslo, Norway; Muscat, Oman and Davis, California<sup>4</sup>.

Many panel discussions and conferences were held when asked which table should be used in practice, whether standards of the WHO or CDC. However, the fact that race and ethnicity have an important impact on the growth of the fetus should be an incentive for the development of national growth curve.

Most developed countries have developed national standards (percentile tables) to monitor the growth and development of infants. They reflect the characteristics of a particular population. Because of the differences arising from the socio-economic conditions of life, ethnic and racial groups but also differences within the same population groups, because of the different impacts of genetic potential for growth and development, it is difficult to make a uniform standard growth curves. Also, due to the existence of the secular trend of anthropometric parameters the national percentile tables should be reviewed continuously. In some countries the audit of these parameters is done every five years.

The development of percentile fetal growth curves as a basis for determining premature and disturbed fetal growth is more problematic and more uncertain. Among the first doubts is whether to create tables for both sexes together or separated. As far as they are made together, the problems arise because of the fact that male newborns are born on average »bigger« than female. Then, they are challenged by different definitions of neonatal hypotrophy and eutrophy. By some definitions, hypotrophy is classified as infant below the 3rd percentile, but others under the 5th and the most commonly used is below 10th percentile. The same is with the hypertrophy, i.e. different authors classify hypertrophic newborns differently (above 90th, 95th or 97th percentile). In addition, additional doubts are imposed on the mother's ethnicity and parity.

In the neighbouring countries the development of the percentile tables has recently been done by Roje and associates<sup>5</sup> and Prpić and associates<sup>6</sup>. Muratović<sup>7</sup> presented in BiH the percentile growth curves of living newborns for the population of Bosnia and Herzegovina in her doctoral dissertation.

Despite this research in Bosnia and Herzegovina and so in Tuzla Canton there are no generally accepted tables and standard growth and development curves of infants.

Creating their own percentile tables and analyzing the standard birth weight and length of newborns in each institution or community provides the optimal prerequisites for proper detection of fetal growth disorders. The estimates of fetal growth at birth are best suited to the standards of the same population, from the same geographical climate and similar socioeconomic conditions of life, especially considering the consequences of the secular trend detected in this area<sup>8-11</sup>.

The aim of this study was to develop a percentile growth curve of term newborns for birth weight and length, according to weeks of gestation, with respect to gender parity and mothers in two time points (1997 and 2007) from Tuzla Canton.

## Subjects and Methods

The study is a retrospective study in which the data from the book of protocol of the Department of Gynecology and Obstetrics, University Clinical Center in Tuzla (OBG-UCC Tuzla). The sample is composed of two sub-samples of infants of both sexes, as follows: sub-samples of newborns in 1997 and 2007. The study included N=8823 live born infants from singleton pregnancies. Of these 5119 infants were born during 1997 and 3704 newborns in 2007. Excluded from the study were: stillborn infants; infants who died immediately after birth; infants who were born of multiple pregnancies (twin and multiple), infants of foreign nationals as well as newborns with congenital anomalies and chromosomalopathies. Statistical analysis was performed by standard methods of descriptive and inference statistics. The research was conducted in the area of Tuzla Canton (TC), the administrative-territorial unit of the Federation of Bosnia and Herzegovina (FBiH) incurred during the war in Bosnia and Herzegovina, by the Washington Agreement of 1994.

## Results

### *Percentile growth curves (tables) of live newborns for population of Tuzla Canton:*

We have calculated the percentile growth curves for a live newborns from singleton pregnancies for birth weight and body length of newborns born in 1997 and 2007. Results were separated by sex, gestational age (from 36 to 42 weeks) and the order of delivery. Because of the small sample of newborns, when divided by sex and age of gestation, percentiles were not calculated for infants born before 36th gestation week as the results obtained were unreliable. According to the order of birth, samples were divided into first-born and multiple-born.

### *Percentile growth curves (table) of male liveborn infants for birth weight in 1997:*

The percentile growth curves of live newborns were calculated for male and female newborns from 36th to 42nd week of gestation during 1997. Male infants had at the third percentile the lowest values with primiparas at

**TABLE 1**  
PERCENTILE BIRTH WEIGHT TABLES (g) FOR MALE NEWBORNS BORN IN 1997 BY GESTATIONAL AGE

Week of gestation	Parity	N	Percentiles								
			3	5	10	25	50	75	90	95	97
36	I	58	1963	2050	2144	2600	2825	3237.5	3415	3607.5	3650
	II and more	69	2100	2140	2540	2850	3120	3400	3730	3980	4144
37	I	113	2400	2540	2656	2900	3150	3400	3650	3900	3964
	II and more	107	2575.4	2644	2750	3025	3230	3475	3770	3900	3982
38	I	219	2680	2700	2850	3100	3300	3600	3860	4050	4100
	II and more	287	2700	2765	2900	3125	3480	3750	4100	4300	4442
39	I	353	2628	2830	2950	3200	3500	3750	3950	4050	4100
	II and more	440	2800	2899	3000	3300	3550	3850	4200	4300	4400
40	I	385	2765.6	2850	2950	3250	3500	3800	4100	4250	4400
	II and more	432	2946.5	3000	3200	3400	3700	3950	4200	4300	4400
41	I	91	2850	2900	3000	3300	3500	3900	4100	4200	4545
	II and more	82	2850	3000	3100	3400	3715	4000	4300	4597.5	4685.5
42	I	22	2783.5	2960	3150	3200	3575	3815	3990	4047.5	4087
	II and more	19	2866	3010	3090	3350	3700	4075	4360	4500	4860

36th week (1963 g), while the highest values on the 3rd percentile were 2946.50 g, in the secundiparas and multiparas in 40th gestation week. The values of 50th percentile for birth weight of male infants born in 1997 in primiparas were 3500.00 g in primiparas and in multiparas 3700.00 g. Looking at the values obtained at the 50th percentile of primiparas we can conclude that with the increase of gestational age the birth weight of newborns continuously increases. This continued growth in multiparas is noted up to 41th week, where as in the 42th gestation week there is a slight reduction in birth weight.

The highest values of birth weight were found in the 97th percentile in multiparas in the 42th week and it amounted to 4860.00 g. (Table 1, Figures 1 and 2)

**Percentile growth curves (table) of male liveborn infants for birth length in 1997:**

Percentile values for birth length of male infants born during 1997 are shown in Table 22. From the shown percentile tables it can be concluded that the minimum value of birth length of newborns were on the third percentile in

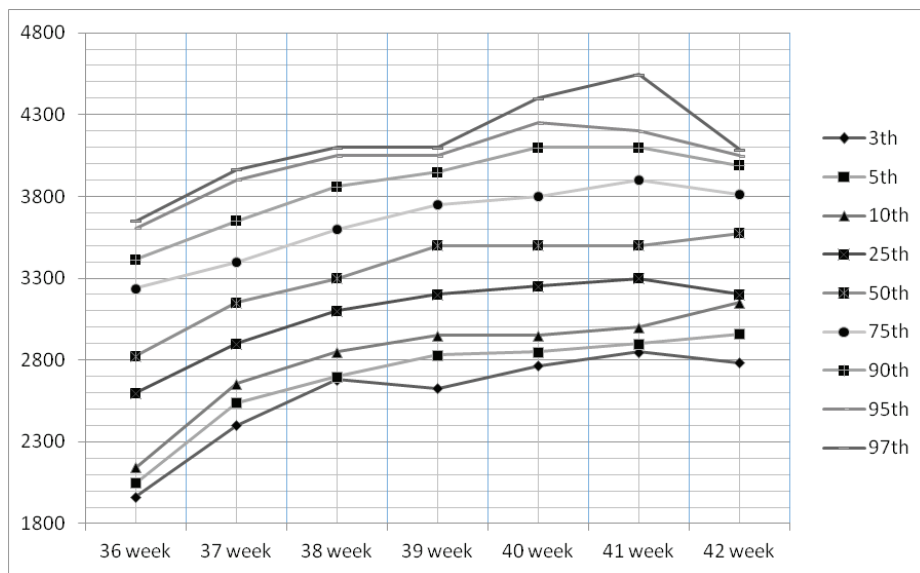


Fig. 1. Percentile birth weight curves of male newborns – primiparas 1997

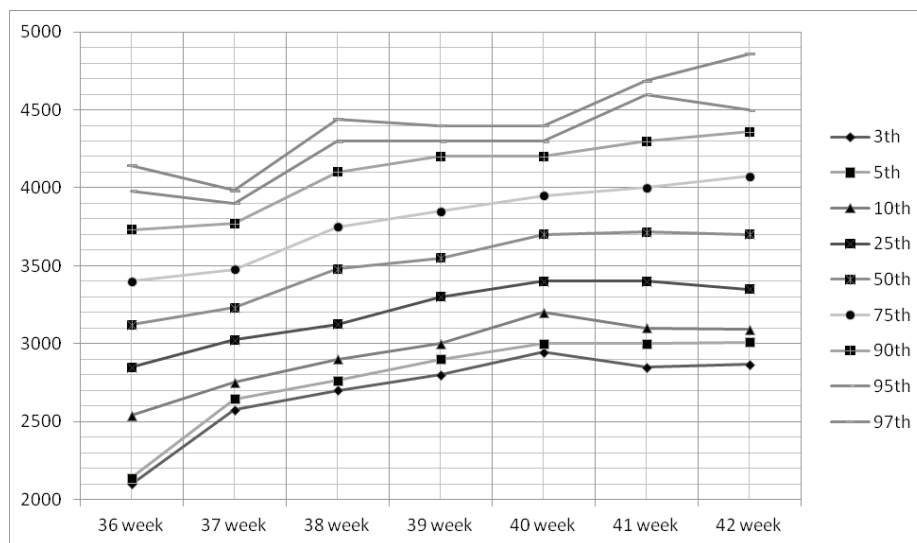


Fig. 2: Percentile birth weight curves of male newborns – multiparas of 1997

primiparas in the 36th week 45.00 cm. On the 3rd percentile the largest ascertained values were 50.00 cm, and were found in primiparas and multiparas in 39th, 40th and 41st week. The values of birth length at the 50th percentile in the 40th gestation week and in primiparas with secundiparas were 54.00 cm. At the 50th percentile continuous increase in birth length with increasing gestational age up to 41st week can be observed, after which there is a small drop in the value in the 42nd gestation week. At the 97th percentile in the 40th week gestation,

birth length of newborns in primiparas is 58.00 cm and 59.00 cm in multiparas. The highest values of the 97th percentile were found in multiparas in 41st gestation week (Table 2, Figure 3 and 4).

**Percentile growth curves (tables) of female live borns for birth weight in 1997**

It appears from the percentile tables (Table 3) that the minimum values of birth weight of female infants were in

**TABLE 2**  
PERCENTILE BIRTH LENGTH TABLES (cm) FOR MALE NEWBORNS BORN IN 1997 BY GESTATIONAL AGE

Week of gestation	Parity	N	Percentiles								
			3 <sup>th</sup>	5 <sup>th</sup>	10 <sup>th</sup>	25 <sup>th</sup>	50 <sup>th</sup>	75 <sup>th</sup>	90 <sup>th</sup>	95 <sup>th</sup>	97 <sup>th</sup>
36	I	58	45	45.85	46.7	49	50	52	55.3	56	56
	II and more	69	46	46.4	48	50	52	54	56	57	57.96
37	I	113	48	48.6	49	50	52	53	55	56	56.64
	II and more	107	47.18	48	49.6	51	52	54	55	56	56.82
38	I	219	49	49	50	51	53	55	56	58	58
	II and more	287	49	50	50	51.5	53	55	57	58	58.42
39	I	353	50	50	51	52	54	55	57	58	58
	II and more	440	50	50	51	52	54	56	57	58	59
40	I	385	50	50	51	52	54	56	57	58	58
	II and more	432	50	50	51	53	54	56	58	58	59
41	I	91	50	50	51	53	55	56	57	58	58.3
	II and more	82	50	50	50.1	52.25	55	56	58.9	59.95	60
42	I	22	48.52	50.05	51	52.25	53.5	55	56	56	56.37
	II and more	19	49.54	49.9	50.8	52	54	56	57.2	58.1	58.46

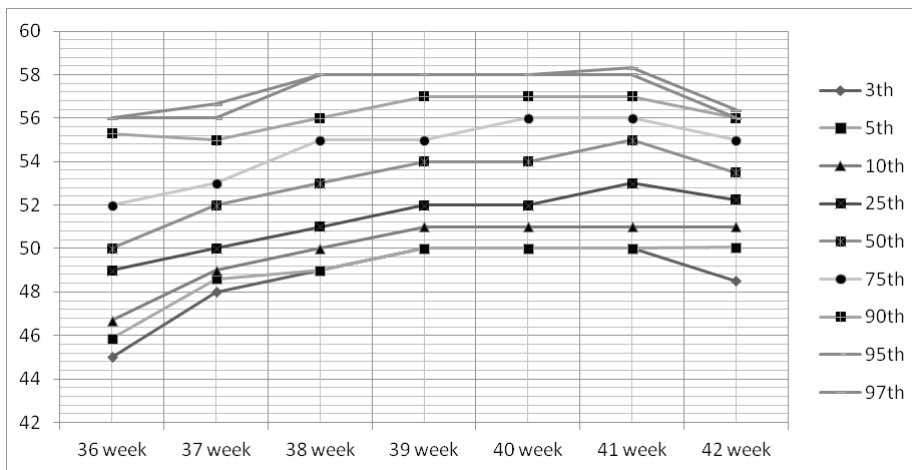


Fig. 3: Percentile birth length curves of male newborns – primiparas 1997

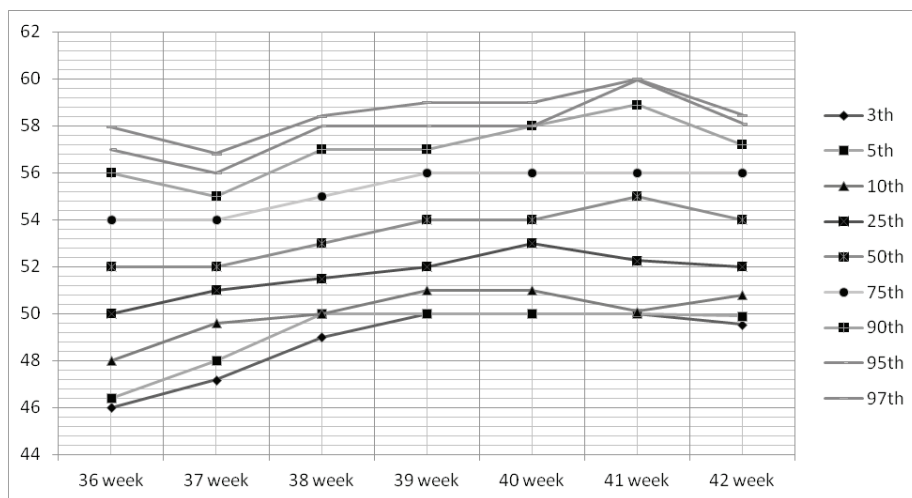


Fig. 4: Percentile birth length curves of male newborns – multiparas 1997

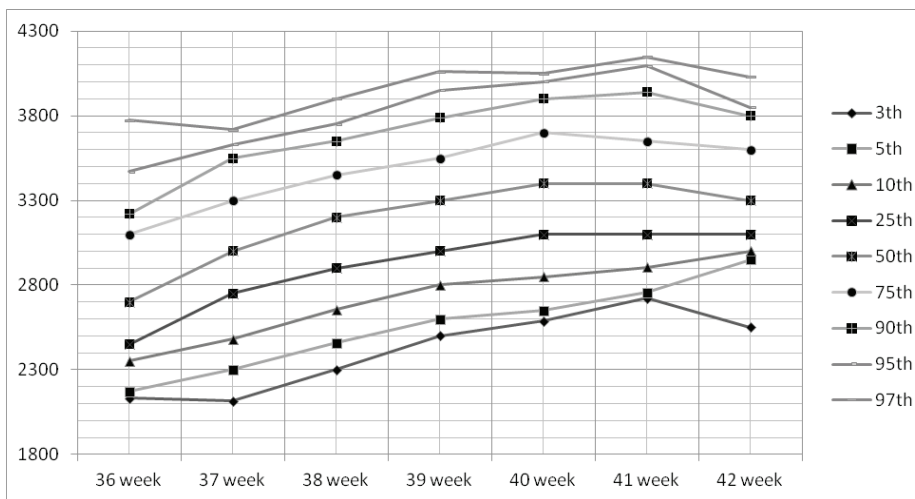


Fig. 5: Percentile birth weight curves of female newborns – primiparas 1997

**TABLE 3**  
PERCENTILE BIRTH WEIGHT TABLES (g) FOR FEMALE NEWBORNS BORN IN 1997 BY GESTATIONAL AGE

Week of gestation	Parity	N	Percentiles								
			3 <sup>th</sup>	5 <sup>th</sup>	10 <sup>th</sup>	25 <sup>th</sup>	50 <sup>th</sup>	75 <sup>th</sup>	90 <sup>th</sup>	95 <sup>th</sup>	97 <sup>th</sup>
36	I	49	2133.2	2170	2350	2450	2700	3100	3220	3470	3774
	II and more	64	1689	1937.5	2250	2587.5	2975	3250	3550	3692.5	3850
37	I	89	2114	2300	2480	2750	3000	3300	3550	3630	3718
	II and more	95	2291	2314	2520	2800	3100	3450	3780	3850	3950
38	I	184	2300	2457.5	2656	2900	3200	3450	3650	3750	3900
	II and more	215	2621	2735	2862	3100	3300	3550	3800	3950	4000
39	I	327	2500	2600	2800	3000	3300	3550	3788	3950	4061
	II and more	416	2650	2742.5	2900	3200	3450	3707.5	4000	4150	4245.5
40	I	378	2586.2	2650	2850	3100	3400	3700	3900	4000	4050
	II and more	383	2700	2900	3050	3300	3550	3800	4050	4200	4277
41	I	103	2721.8	2755	2906	3100	3400	3650	3940	4095	4147
	II and more	97	2800	2990	3100	3250	3600	3900	4170	4260	4356
42	I	21	2550	2950	3000	3100	3300	3600	3800	3850	4030
	II and more	21	2520	2800	2950	3150	3500	4050	4250	4350	4450

the 3rd percentile in multiparas and were 1689.00 g, while the maximum values on the 3rd percentile were in multiparas at the 41st week. At the 50th percentile in the 40th gestation week newborns of primiparas had a birth weight 3400.00 g and in multiparas 3550.00 g. The values of birth weight at the 50th percentile continuously increase to the 41st week, after which the values decline in the 42nd week. In the 40th week the values at the 97th percentile were 4050.00 g in primiparas and 4277.00 g in multiparas. The highest values on the 97th percentile had newborns of multiparas in the 42nd week (Table 3, Figure 5 and 6).

**Percentile growth curves (tables) of female live borns for birth length in 1997:**

The lowest values of birth length of female infants were on the 3rd percentile in primiparas and were 46.44 cm, while the highest values ascertained in the 42nd week in primiparas (51.00 cm). At the median, the 50th percentile, the values in the 40th gestation week were 53.00 cm in primiparas and 54.00cm in multiparas. In the 40th week on the 97th percentile the values were 57.00 cm in primiparas and 58.00 cm in multiparas (Table 4, Figure 7 and 8).

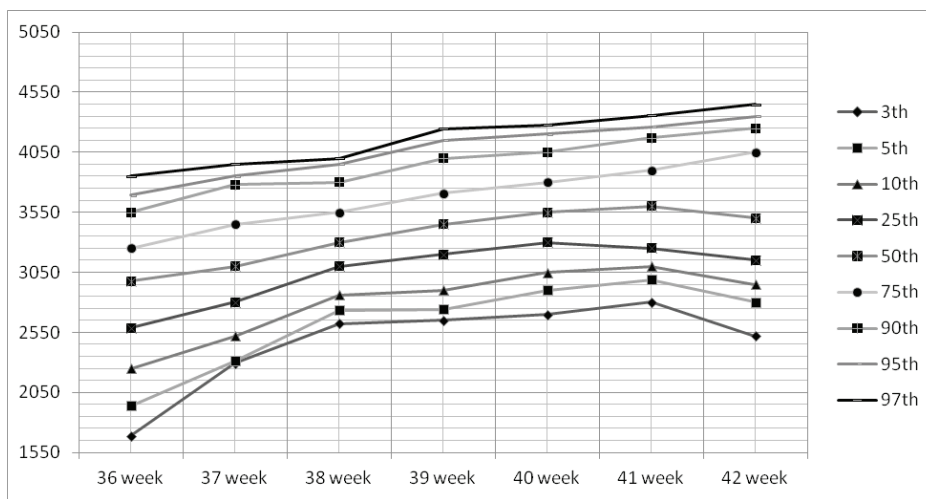


Fig. 6. Percentile birth weight curves of female newborns – multiparas 1997

**TABLE 4**  
PERCENTILE BIRTH LENGHT TABLES (cm) FOR FEMALE NEWBORNS BORN IN 1997 BY GESTATIONAL AGE

Week of gestation	Parity	N	Percentiles								
			3 <sup>th</sup>	5 <sup>th</sup>	10 <sup>th</sup>	25 <sup>th</sup>	50 <sup>th</sup>	75 <sup>th</sup>	90 <sup>th</sup>	95 <sup>th</sup>	97 <sup>th</sup>
36	I	49	46.44	47	47	49	50	52	54	54	55.12
	II and more	64	46.86	47	47.2	49	51	53	54	54.9	55
37	I	89	47.64	48	49	50	51	53	54.2	55	56
	II and more	95	47	47	49	50	52	53.75	55	56	56
38	I	184	47	48	49	50	52	54	55	56	57
	II and more	215	48	49	50	51	53	55	56	57	57
39	I	327	48	49	50	51	53	54	56	57	58
	II and more	416	49	49	50	52	53	55	56	57	57.55
40	I	378	47	49	50	51	53	55	56	57	57
	II and more	383	49	50	51	53	54	56	57	58	58
41	I	103	49	50	50	52	54	55.5	57	58	58
	II and more	97	50	50	50.6	52	54	56	57	58	58.12
42	I	21	51	51	52	52	54	55	56	56	56.4
	II and more	21	50	50	50	51	53	55	57	57	59

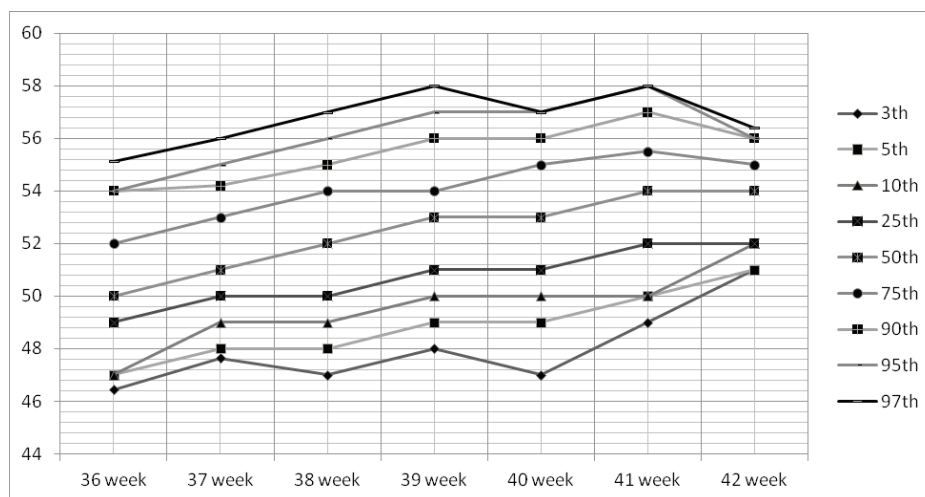


Fig. 7: Percentile birth length curves of female newborns – primiparas 1997

### ***Percentile growth curves (tables) of male live born infants for birth weight in 2007:***

The percentile values for birth weight of male newborns during 2007 are shown in Table 25. For shown percentile tables it can be concluded that the minimum values of birth weight in male infants were on the 3rd percentile in primiparas 1717.00 g, the highest in multiparas in the 42nd gestation week and were 3275.20 g. The median, of the 50th percentile in the 40th gestation week in male newborns of primiparas were 3600.00 g and in multiparas 3750.00 g. From median values it can be concluded that

the infants of multiparas had a higher birth weight of newborns of primiparas in each gestation week. Male infants born in 2007 in the 40th gestation week had birth weight 4450.00 g in primiparas and 4535.50 g in multiparas (Table 5, Figure 9 and 10).

### ***Percentile growth curves (tables) of male live born infants for birth length in 2007:***

It can be concluded from the tables percentile for birth length of male newborns (Table 6) that the lowest values of the birth length of male newborns were on the 3rd per-

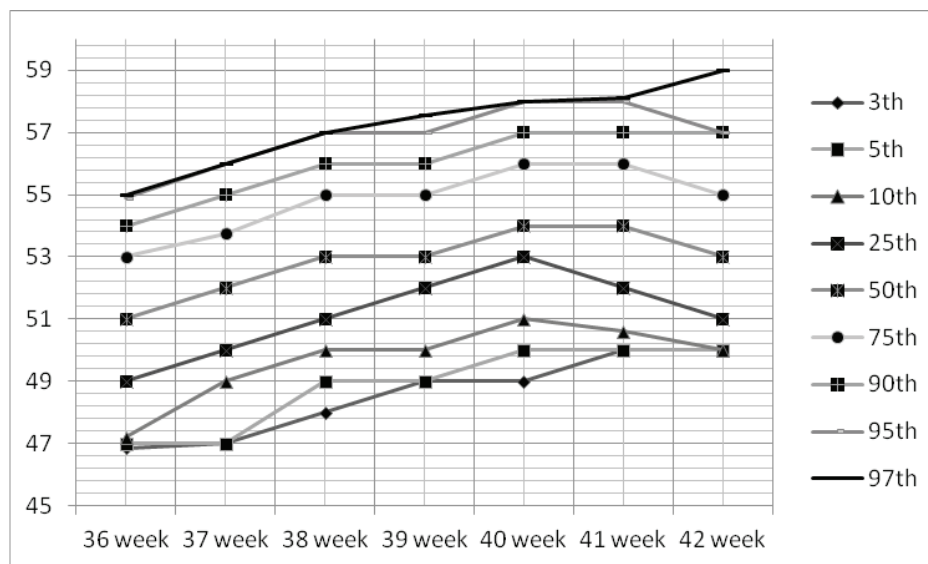


Fig. 8: Percentile birth length curves of female newborns – multiparas 1997

**TABLE 5**  
PERCENTILE BIRTH WEIGHT TABLES (g) FOR MALE NEWBORNS BORN IN 2007 BY GESTATIONAL AGE

Week of gestation	Parity	N	Percentiles								
			3 <sup>th</sup>	5 <sup>th</sup>	10 <sup>th</sup>	25 <sup>th</sup>	50 <sup>th</sup>	75 <sup>th</sup>	90 <sup>th</sup>	95 <sup>th</sup>	97 <sup>th</sup>
36	I	36	1717	1815	2075	2512.5	2850	3112.5	3375	3450	3450
	II and more	24	2120.8	2232	2345	2737.5	3050	3250	3685	3742.5	3858.5
37	I	82	2500	2633.5	2755	2950	3100	3300	3500	3692.5	3717.1
	II and more	75	2550	2564	2720	3025	3250	3490	3700	3850	3850
38	I	204	2550	2657.5	2800	3100	3400	3650	3900	4000	4100
	II and more	155	2781	2821	2970	3225	3500	3750	4000	4100	4381.4
39	I	338	2700	2800	3030	3265	3550	3800	4080	4200	4265
	II and more	316	2863.5	2950	3050	3300	3600	3900	4110	4300	4427.5
40	I	366	2900	3000	3100	3350	3600	3900	4100	4300	4450
	II and more	244	2928.7	3007.5	3200	3400	3750	3950	4200	4392.5	4535.5
41	I	44	3187.7	3283	3415	3550	3750	4085	4185	4292.5	4371
	II and more	29	3275.2	3336	3444	3600	3900	4150	4434	4618	4650

centile in the 36th gestation week in primiparas and the highest in infants born in the 41st week were 51.00 cm both in primiparas and multiparas. The median birth length in the 40th gestation week both in primiparas and multiparas was 54.00 cm. Similar results were noted in the 39th gestation week. The highest values of the median have infants born in the 41st week and in multiparas it was 55.00 cm. At the 97th percentile in the 40th week of gestation both the first born and multiparous infants had a length of 58.00 cm. Here, as in the 50th percentile, the same values were noted in the 39th week of gestation (Table 6, Figure 11 and 12).

**Percentile growth curves (tables) of female live born infants for birth weight in 2007:**

Percentile values for birth weight of female infants born during 2007 are shown in Table 27. The lowest values of birth weight of female newborns were on the 3rd percentile in the 36th week of gestation in primiparas and the highest in infants born to multiparas in the 41st week and were 3150.00 g. The median birth weight in the 40th week of gestation in primiparas was 3450.00 g and with multiparas 3550.00 g. The highest values of the median have infants born after the 41st week in multiparas and it was



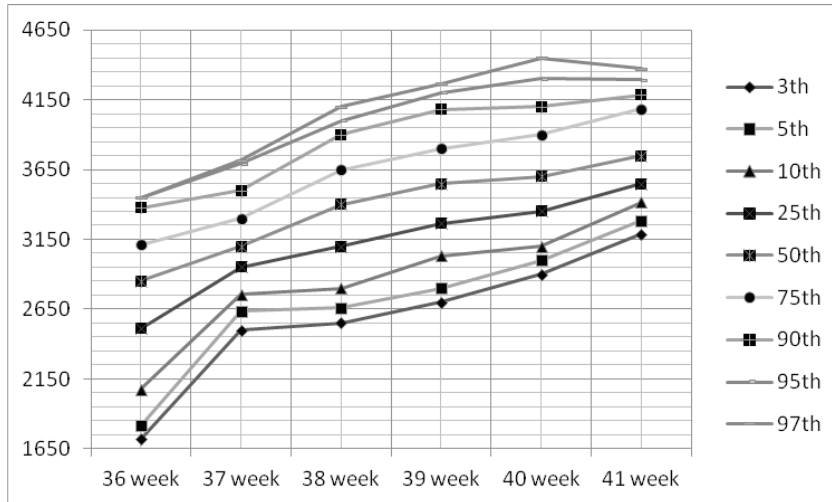


Fig. 9. Percentile birth weight curves of male newborns – primiparas 2007

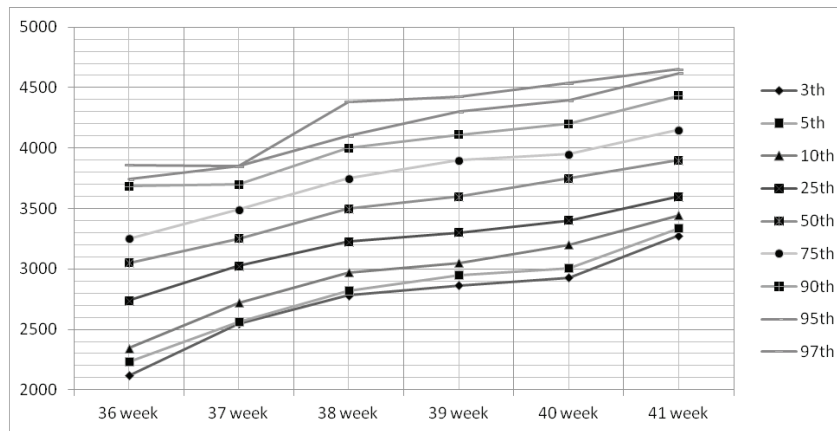


Fig. 10. Percentile birth weight curves of male newborns – multiparas of 2007

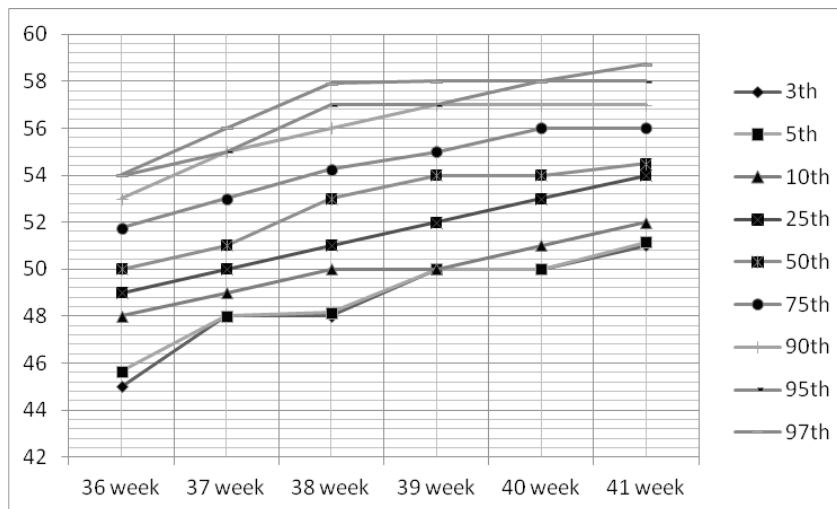


Fig. 11. Percentile birth length curves of male newborns – primiparas 2007

**TABLE 6**  
PERCENTILE BIRTH LENGHT TABLES (cm) FOR MALE NEWBORNS BORN IN 2007 BY GESTATIONAL AGE

Week of gestation	Parity	N	Percentiles								
			3 <sup>th</sup>	5 <sup>th</sup>	10 <sup>th</sup>	25 <sup>th</sup>	50 <sup>th</sup>	75 <sup>th</sup>	90 <sup>th</sup>	95 <sup>th</sup>	97 <sup>th</sup>
36	I	36	45	45.65	48	49	50	51.75	53	54	54.01
	II and more	24	47.69	48	48	49.75	52	53	54	54	54.31
37	I	82	48	48	49	50	51	53	55	55	56
	II and more	75	47.19	48	49	51	52.5	54	54	55	55
38	I	204	48	48.15	50	51	53	54.25	56	57	57.91
	II and more	155	49	50	50	52	54	55	56	58	58
39	I	338	50	50	50	52	54	55	57	57	58
	II and more	316	49	50	51	52	54	55	57	58	58
40	I	366	50	50	51	53	54	56	57	58	58
	II and more	244	50	50	51	53	54	56	57	58	58
41	I	44	51	51.15	52	54	54.5	56	57	58	58.71
	II and more	29	51	51	51.8	53	55	57	58.4	61.2	62

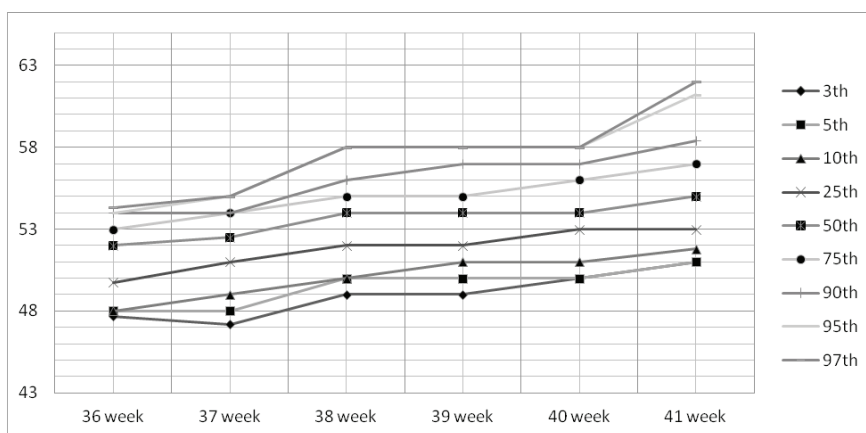


Fig. 12. Percentile birth length curves of male newborns – multiparas 2007

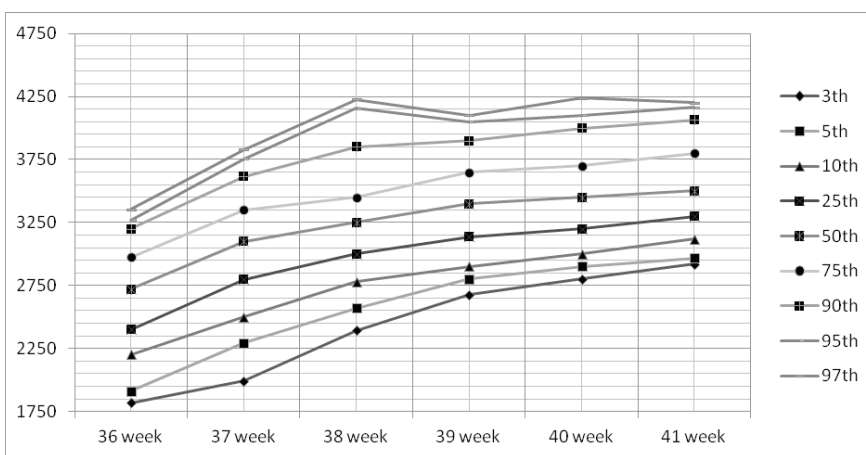


Fig. 13. Percentile birth length curves of female newborns – primiparas 2007

**TABLE 7**  
PERCENTILE BIRTH WEIGHT TABLES (g) FOR FEMALE NEWBORNS BORN IN 2007 BY GESTATIONAL AGE

Week of gestation	Parity	N	Percentiles								
			3 <sup>th</sup>	5 <sup>th</sup>	10 <sup>th</sup>	25 <sup>th</sup>	50 <sup>th</sup>	75 <sup>th</sup>	90 <sup>th</sup>	95 <sup>th</sup>	97 <sup>th</sup>
36	I	27	1820.2	1912	2200	2400	2720	2975	3200	3270	3355
	II and more	28	2274	2385	2485	2722.5	2940	3150	3245	3577.5	3719
37	I	76	1992.5	2292.5	2500	2797.5	3100	3350	3615	3755	3830
	II and more	70	2314	2545	2698	2950	3100	3400	3523	3727.5	3843
38	I	149	2394	2570	2780	3000	3250	3450	3850	4156	4228
	II and more	171	2750	2800	2900	3150	3400	3700	3900	4060	4243
39	I	299	2678.2	2800	2900	3135	3400	3650	3900	4050	4100
	II and more	275	2700	2800	3000	3200	3500	3740	4050	4200	4300
40	I	343	2800	2900	3000	3200	3450	3700	4000	4100	4237
	II and more	257	2750	2850	2950	3250	3550	3810	4150	4400	4450
41	I	48	2920.5	2967.5	3120	3300	3500	3800	4065	4165	4200
	II and more	30	3150	3172.5	3200	3470	3700	4000	4115	4250	4308.5

**TABLE 8**  
PERCENTILE BIRTH LENGTH TABLES (cm) FOR FEMALE NEWBORNS BORN IN 2007 BY GESTATIONAL AGE

Week of gestation	Parity	N	Percentiles								
			3 <sup>th</sup>	5 <sup>th</sup>	10 <sup>th</sup>	25 <sup>th</sup>	50 <sup>th</sup>	75 <sup>th</sup>	90 <sup>th</sup>	95 <sup>th</sup>	97 <sup>th</sup>
36	I	27	44	44.6	46	47	50	52	53	53	53.22
	II and more	28	45.81	46.35	47.7	48.75	50	52	54	54	54.19
37	I	76	47	47	48	49.75	51	53.25	55	55	55
	II and more	70	48	48.45	49	51	51	53	55	55.55	56
38	I	149	48	48.4	50	51	52	54	56	57	57
	II and more	171	49	49	50	51	53	54	55	56	56
39	I	299	49	49	50	52	53	54.5	56	56	57
	II and more	275	49	50	50	51	53	54	56	57	57
40	I	343	49	50	50	52	53	55	56	57	57
	II and more	257	49	50	50	52	54	55	57	58	59
41	I	48	50.41	51	51.7	52	54	56	57	57	57
	II and more	30	50.87	51	51	53	55	56	56.1	57.55	58

3700.00 g. At the 97th percentile in the 40th week of gestation first-born infants had birth weight of 4237.00 g and in multiparas 4450.00 g. The highest values of birth weight in the 97th percentile were found in infants born after the 41st week in multiparas (Table 27, Figure 26 and 27).

***Percentile growth curves (tables) of female live born infants for birth length in 2007:***

It can be concluded from the percentile tables for birth length of newborns (Table 8) that the lowest values of birth length of newborns were on the 3rd percentile in the 36th gestation week in primiparas and the highest in infants born in the 41st week and were 50.97 cm in multiparas.

The median birth length in the 40th week of gestation in primiparas was 53.00 cm while infants of multiparas were 1 cm longer. The highest values of the median have female infants born in the 41st week in multiparas and it is 55.00 cm. At the 97th percentile in the 40th week of gestation first-born infants have a length of 57.00 cm and multiparous infants are 2 cm longer, which is the largest ascertained value of the percentiles (Table 8, Figure 15 and 16).

**Discussion and Conclusion**

This paper presents the percentile growth curve of term newborns for birth weight and length after weeks of

**TABLE 9**  
VALUES OF BIRTH WEIGHT AT THE 5th, 50th AND 95th PERCENTILE FOUND IN CROATIA, SERBIA AND BIH

Place of study	Sex	Birth order	Percentiles			Source
			5 <sup>th</sup>	50 <sup>th</sup>	95 <sup>th</sup>	
Rijeka	♂♂	Primiparous	2940	3590	4300	6
		Multiparous	3100	3720	4450	
	♀♀	Primiparous	2840	3450	4110	
		Multiparous	2929	3550	4290	
Five Croatian counties	♂♂	Primiparous	2850	3450	4100	18
		Multiparous	2870	3590	4400	
	♀♀	Primiparous	2730	3370	4000	
		Multiparous	2750	3480	4160	
Split	♂♂	Primiparous	2900	3600	4300	5
		Multiparous	3000	3750	4550	
	♀♀	Primiparous	2800	3450	4100	
		Multiparous	2850	3600	4350	
Zagreb	♂♂	Primiparous	2668.9	3428.9	4188.9	19
		Multiparous	2809.1	3551.3	4293.6	
	♀♀	Primiparous	2538.9	3305.7	4072.6	
		Multiparous	2643.5	3399.9	4156.2	
Novi Sad	♂♂	Primiparous	2740	3440	4266	20
		Multiparous	2840	3580	4340	
	♀♀	Primiparous	2620	3320	4050	
		Multiparous	2700	3440	4125	
Tuzla Canotn 1997	♂♂	Primiparous	2850	3500	4250	This study
		Multiparous	3000	3700	4300	
	♀♀	Primiparous	2650	3400	4000	
		Multiparous	2900	3550	4200	
Tuzla Canton 2007.	♂♂	Primiparous	3000	3600	4300	This study
		Multiparous	3007.5	3750	4392.5	
	♀♀	Primiparous	2900	3450	4100	
		Multiparous	2850	3550	4400	

gestation in relation to gender and parity of mothers in two time points (1997 and 2007) from Tuzla Canton.

From the results presented, we can conclude that during 1997 and 2007, male infants of primiparas at all observed percentiles had higher values for both birth weight and length than the infants of multiparas. If we compare the results obtained in 1997 with the results from 2007, we can conclude that there has been an increase in percentile values in time. Increase of percentile values in time is noted by Arbuckle and Sherman<sup>12</sup> in Canada when making percentile values for birth weight in 1972 and 1986.

According to the revised tables from 2000 of the Center for Disease Control and Prevention and the National Cen-

ter for Health Statistics of the United States (CDC table) birth weight of male newborns at birth has the following values: on the 3rd percentile 2355.451 g, at the 50th percentile 3530.203 g, on the 97th percentile 4446.488 g. According to these tables birth length of male infants at the 3rd percentile is 44.9251 cm, at the 50th percentile 49.98888 cm, 97th percentile 54.919 cm<sup>3</sup>.

The female infant birth weight at birth had following values: at the 3rd percentile 2414.112 g, at the 50th percentile 3399.186 g and 97th percentile 4254.922 g. The birth length of female infants at birth was on the 3rd percentile 45.09488 cm, at the 50th percentile 49.2864 cm, 97th percentile 54.49527 cm.

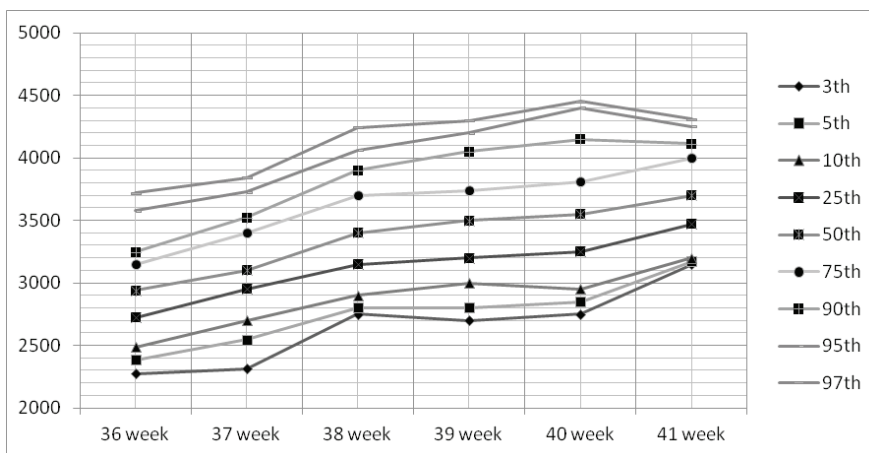


Fig.14. Percentile birth weight curves of female newborns – multiparas of 2007

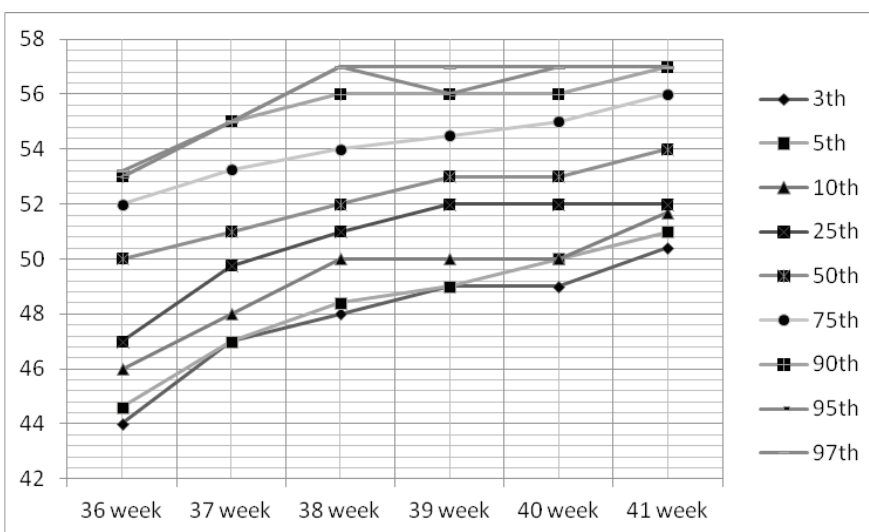


Fig.15. Percentile birth length curves of female newborns – primiparas 2007

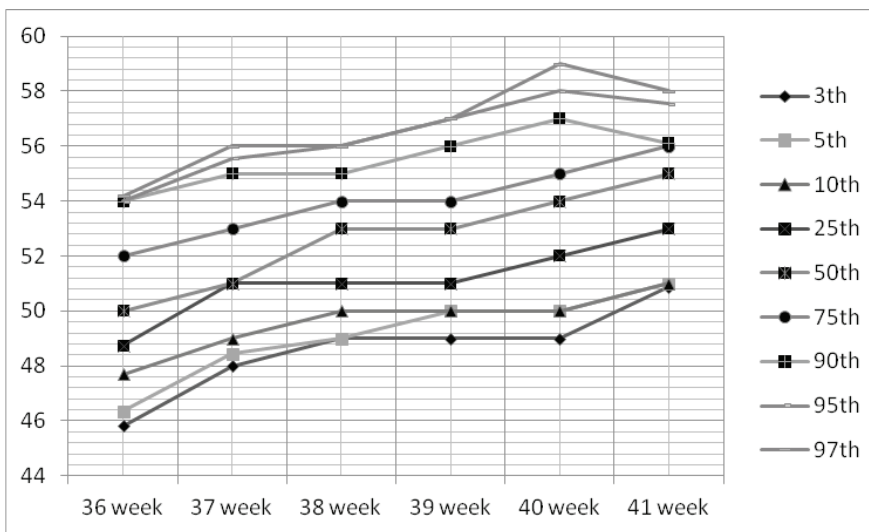


Fig.16. Percentile birth length curves of female newborns – multiparas 2007

By comparing the data we received for newborns from Tuzla Canton with the data from the CDC table, we can conclude that there are significant deviations. If we compare the percentile values we found in 1997 with the percentiles from the CDC table, we can see that male newborns in the United States have a higher birth weight at the 97th percentile and approximately the same values at the 50th percentile. On all the other percentiles in 1997 and 2007, both for birth weight and birth length, both sexes of newborns in Tuzla Canton are »longer« and »heavier« than the newborns of the US.

The same conclusion can be derived if we compare our results with the results that Olsen and her associates<sup>13</sup> got for the US.

Newborns from Tuzla Canton have a lot higher percentile values of birth weight and length than the newborns in Africa<sup>14</sup>, Scotland<sup>15</sup> and Canada<sup>12</sup>.

In Botswana (Africa) Matthews and colleagues<sup>14</sup> have made the percentile growth curve of infants born to mothers who are HIV negative. Their values obtained in comparison with the percentiles values of newborns in Tuzla Canton from 2007 are much lower.

In Scotland, the percentile tables of birth weight are created by Bonellia and associates<sup>15</sup> in which they used data collected from 1998 to 2003. Comparing their results with our 2007 results both primiparous and multiparous newborns of both sexes in Tuzla Canton are quite »heavier« than the Scottish newborns.

In Canada, percentile birth weight values for 1972 and 1986 were performed by Arbuckle and Sherman<sup>12</sup>. Their results confirm the existence of differences in percentile values over a period of 14 years. Their values in both sexes were lower in relation to the values obtained from Tuzla Canton in 1997.

Approximately the same percentile birth weight values found in the Tuzla Canton population were obtained by Dobbins and associates<sup>16</sup> for birth weight of newborns in the period from 1998 to 2007 in Australia. In countries where fetal growth has been monitored for a long time, increased median birth weight values were observed in the 40th week of gestation<sup>17</sup>.

Table 9 shows data for the birth weight at the 5th, 50th and 95th percentile levels found in Croatia, Serbia and BiH. When we compare our results in the 40th week of gestation with the results of our neighboring countries, Croatia and Serbia, we can draw the following conclusions.

Newborns from Croatia (Rijeka, Zagreb, Split and five Croatian counties) are »lighter« than newborn babies born in 2007.

Male newborns from Rijeka have the same birth weight values as newborn babies from Tuzla Canton only at the 95th percentile in primiparas. For other percentile values, male newborns from Rijeka are 10 g »lighter« (at the 5th

percentile of primiparas) up to 100 g (5th percentile of multiparas). Unlike male newborns, female newborns from Rijeka have the same or higher birth weight values. Thus, at the 50th percentile female newborns from Rijeka and Tuzla Canton have the same values for birth weight. At the 3rd percentile of primiparas and at the 95th percentile of primiparas and multiparas, female newborns from Rijeka are »heavier« than the newborns from Tuzla Canton.

If we compare our values to the results obtained by Misir-Galić<sup>18</sup> for five Croatian counties, we can conclude that male and female newborns from Tuzla Canton are »heavier« than newborns from Croatia. In male sex, the difference ranges from 150 g at the 50th percentile to 200 g at the 95th percentile in primiparas. In female infants, the difference in birth weight is from 70g at the 50th percentile to 240g at the 95th percentile in multiparas.

A fairly uniform birth weight value is given to newborns from Tuzla Canton and Split. According to the results provided by Roy et al.<sup>5</sup>, newborns of Split and Tuzla Canton have the same birth weight values at the 50th percentile of primiparas in the male sex and at the 50th percentile of primiparas in the females, while the multiparous female newborns are 50 g »heavier« in Tuzla Canton than in Split. The same values were also found at the 95th percentile of primiparas in both sexes and the 5th percentile of multiparas of both sexes. The differences are at the 95th percentile of multiparous females and the 5th percentile of firstborns of both sexes where newborns from Tuzla Canton are »heavier« than newborns from Split. Male multiparous newborns from Split have higher values only at the 95th percentile of newborn babies from Tuzla Canton.

Primiparous and multiparous newborns of both sexes born in Zagreb are »lighter« than newborns from Tuzla Canton. According to the results obtained by Količić et al.<sup>19</sup>, in the 40th week of gestation, newborns from Tuzla Canton are »heavier« than newborns in Zagreb from 30 g in primiparas to 250 g in multiparous newborns at the 95th percentile.

When we look at the summary results obtained by authors for Croatian cities and counties, we can conclude that the biggest differences are between newborns from Tuzla Canton and newborns from Zagreb. The lowest differences in birth weight are between newborns from Tuzla Canton and newborns from Split.

As far as our results obtained for 1997 are compared with the results obtained by Nikolić-Dovat in Serbia for newborns from Novi Sad<sup>20</sup>, we can conclude that newborns from Tuzla Canton are »heavier« than newborns from Serbia in both sexes at the 5th and 50th percentile. The exception are male newborns at the 95th percentile from Novi Sad, which are slightly »heavier« than newborns from Tuzla Canton.

## REFERENCES

1. NENADIĆ N, GRGURIĆ J, Paediatr Croat, 52 (2008). – 2. WORLD HEALTH ORGANISATION, Expert Committee, The use and interpretation of antropometry (Geneva: WHO Tech. Rep. Ser: 854, 1995). – 3. KUCZMARSKI RJ, OGDEN CL, GUO SS, ET AL, National Center for Health Statistics, Vital Health Stat, 11 (2002). – 4. WORLD HEALTH ORGANISATION, Acta Paediatrica, 450 (2006). – 5. ROJE D, TADINI I, MARUŠIĆ J, VULIĆ M, ARAČIĆ N, VUČINOVIĆ M, ET AL, Gynaecol Perinatol, 14 (2005) 69. – 6. PRPIĆ I, KRAJINA R, RADIĆ J, PETROVIĆ O, MAMULA O, HALLER H, BAŽDARIĆ K, VUKELIĆ-ŠARUNIĆ A, Gynaecol Perinatol, 16 (2007) 136. – 7. MURATOVIĆ S, Percentilne krivulje rasta žive novorođenčadi za populaciju Bosne i Hercegovine. Doktorska disertacija. (Medicinski fakultet, Univerzitet u Tuzli, 2011). – 8. BEGIĆ A, Sekularne promjene porođajne težine i dužine tijela novorođenčadi sa područja tuzlanskog kantona u period od 1976. do 2007. godine. Magistarski rad. (Prirodno-matematički fakultet Univerziteta u Sarajevu, 2010). – 9. HADŽIHALILOVIĆ J, HALILOVIĆ S, BRAHIMAJ F, BEGIĆ A, TUPKUŠIĆ R, MEŠALIĆ L, Med Arh, 63 (2009) 267. – 10. HALILOVIĆ JH, BEGIĆ A, Coll Antropol, 39 (2015) 345. – 11. BEGIĆ A, HALILOVIĆ JH. Coll Antropol, 39 (2015) 353. – 12. ARBUCKLE TE, SHERMAN GJ, Pediatric and Perinatal Epidemiology, 3 (1989) 115. DOI: 10.1111/j.1365-3016.1989.tb00503.x. – 13. OLSEN EI, GROVE-MAN AS, LAWSON ML, CLARK H, <http://pediatrics.aappublications.org/search?author1=Reese+H.+Clark&sortspec=date&submit=Submit> ZEMEL SB, Pediatrics, 125 (2010) e214. DOI: 10.1542/peds.2009-0913. – 14. MATTHEWS TL, RIBAUDDO JH, PAREKH NK, CHEN YJ, BINDA K, ET AL, BMC Pediatrics, 11 (2011) 115. DOI: 10.1186/1471-2431-11-115. – 15. BONELLIE S, CHALMERS J, GRAY R, ET AL, BMC Pregnancy Childbirth, 8 (2008) 5. DOI: 10.1186/1471-2393-8-5. – 16. DOBINS AT, SULLIVAN AE, ROBERTS LC, SIMPSON MJ, Med J Aust, 197 (2012) 291. DOI: 10.5694/mja11.11331. – 17. AMINI SB, CATALANO PM, HIRSCH V, MANN LI, Obstet Gynecol, 83 (1994) 342. – 18. MISIR-GALIĆ L, Usporedba porodne mase djece rođene u pet hrvatskih županija. Magistarski rad. (Medicinski fakultet, Sveučilište Zagreb, 2006). – 19. KOLČIĆ I, POLAŠEK O, PFEIFER D, SMOLEJ-NARANČIĆ N, ILJIĆ M, BLJAJIĆ D, BILOGLAV Z, IVANIŠEVIĆ M, DELMIŠ J, Coll Antropol, 29 (2005) 257. – 20. NIKOLIĆ-DOVAT V, Somatski razvoj i razvoj djeteta. (Institut za zdravstvenu zaštitu majke i djeteta, Novi Sad, 1978).

A. Begić

Faculty of Science and Mathematics, Biology Department, University of Tuzla, and  
Meša Selimović High school, Tuzla  
e-mail: amelabegicgms@gmail.com

## PERCENTILNE KRIVULJE RASTA ŽIVOROĐENE NOVOROĐENČADI ROĐENE TIJEKOM 1997. I 2007. GODINE S PODRUČJA TUZLANSKOG KANTONA (BIH)

### SAŽETAK

Cilj ovoga rada bio je izrada percentilnih krivulja rasta terminske novorođenčadi za porođajnu masu i dužinu tijela, po tjednima gestacije, u odnosu na spol i paritet majke u dvije vremenske tačke (1997. i 2007. godina) sa područja TK-a. U istraživanju su korišteni podaci iz knjige protokola sa Klinike za ginekologiju i akušerstvo Univerzitetsko-kliničkog centra u Tuzli (GAK UKC Tuzla). U istraživanje je uključeno N=8823 živorođene novorođenčadi iz jednooplođnih trudnoća. Od toga 5119 novorođenčadi rođene tokom 1997. godine i 3704 novorođenčadi rođene tokom 2007. godine. Iz istraživanju su isključena: mrtvorodena novorođenčad; novorođenčad koja su umrla odma nakon poroda; novorođenčad koja su rođena iz višeplođnih trudnoća (blizanačke i višeplođne), novorođenčad stranih državljana kao i novorođenčad sa kongenitalnim anomalijama i hromosopatijama. *Muška novorođenčad rođena u 1997. godini imala je vrijednosti porođajne mase u 40. sedmici gestacije na 50. percentilu kod prvoročki 3500,00 g, a kod višeročki 3700,00 g. Ženska novorođenčad rođena u 1997. godini imala je vrijednosti porođajne mase u 40. sedmici gestacije na 50. percentilu kod prvoročki 3400,00 g, a kod višeročki 3550,00 g. Muška novorođenčad rođena u 2007. godini imala je vrijednosti porođajne mase u 40. sedmici gestacije na 50. percentilu kod prvoročki 3600,00 g, a kod višeročki 3750,00 g. Ženska novorođenčad rođena u 2007. godini imala je vrijednosti porođajne mase u 40. sedmici gestacije na 50. percentilu kod prvoročki 3450,00 g, a kod višeročki 3550,00 g. Statistički značajna povećanja srednjih vrijednosti porođajne mase u 2007. godini u odnosu na 1997. godinu uočena su u 38., 39., 40. i 41. sedmici gestacije što predstavlja potvrdu neophodnosti izrade vlastitih referentnih tablica rasta novorođenčadi, kao i potrebu njihovog stalnog revidiranja.*

