

Secular trend of anthropometric parameters of newborns in municipalities of Tuzla Canton (1976 – 2007)

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ABSTRACT

Aim To determine the acceleration of birth weight and birth length of newborns in the municipalities of Tuzla Canton in the last four decades. Tuzla Canton (TC) as an administrative territorial unit of the FBiH includes 13 municipalities.

Methods In this retrospective study data from the Protocol Book of Gynecology and Obstetrics Clinic, University Clinical Center, from 1976 to 2007 were used. The sample of live-born infants by municipalities was divided into four sub-samples: a subsample of infants born in 1976, 1987, 1997 and 2007. During the monitored years there were 19,312 live births in Tuzla Canton (TC), but the study included 17,907 newborns of both sexes. Statistical data processing was performed using standard methods, descriptive and inference statistics.

Results Ascertained results of the secular trend for birth weight showed that this parameter had positive values in seven municipalities, but in six municipalities it was negative. The highest values of increasing birth length of newborns, which were statistically significant, were found in the municipalities of Srebrenik and this increase was 0.06 cm per year. **Conclusion** Different values of the secular trend in the monitored TC are result of different socio-economic and ecological conditions in these municipalities, as well as of violent mass population migration that occurred as a result of the war in BiH in the period from 1992 to 1995.

Keywords: acceleration, birth length, birth weight

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INTRODUCTION

The word acceleration originates from the Latin word *acceleratio* meaning acceleration. This term was introduced in literature by the German scientist Koh E.V. in the thirties of the twentieth century. The term "secular trend" ("centuries-long tendency") has also been widely used in literature. The phenomenon of secular trend represents the long-term systematic changes in a wide range of anthropological variables in subsequent generations of the population living in the same territory (1).

The phenomenon can be viewed in the size of newborns, during childhood and early youth, but also at the level of the entire population. Secular trend marks not only acceleration of the development of forthcoming generations, but also acceleration of fetal growth, extension of the reproductive period, shortening the length of premenarchal periods in girls, increase in the proportion of adult body, changes of mental development, increase in certain organs, increase of the length of life etc. (1-4). It is known that somatic status of a newborn depends on a whole range of factors as confirmed by many studies. They studied birth weight, birth length and head circumference of infants in relation to different endogenous and exogenous factors such as the impact of villages and towns, socio-economic status, climatic and geographical factors, the impact of polluted environment, birth height and weight of both parents, physical activity of pregnant women, pregnancy and birth order, maternal smoking, taking drugs and narcotics, age of both parents, nutrition during pregnancy (2-4). Secular changes in birth weight and birth length of newborns were monitored in many countries (5-13). According to the latest available literature largest secular changes were recorded by Schack-Nielsen and colleagues in Denmark showing positive secular trends in birth weight, birth length and ponderal index of the newborns in all the tested categories: birth weight in the examined period 1973-2003 increased by 160 g (≈ 5 g/year), and birth length had a negligible increase of 2.4 mm and ponderal index increased to $0.8\text{kg}/\text{m}^3$ (12).

Acceleration of body size of newborns in Sweden was recorded by Odlind et al. (14), in Norway by Skjærven et al. (13), in Canada by Wen et al. (15). In these countries the secular trend of birth

weight was ≈ 3 g/year. In the USA, Ananth and Wen (5) reported an increase in birth weight in white infants for ≈ 0.7 g year and the black ones for ≈ 2.1 g/year.

In Croatia, the secular changes of newborns before, during and after the Homeland War (1983 to 2003) were investigated by Bralić et al (7): secular trend of birth weight of infants was positive in the 3500-3999 g, 4000-4999 g and ≥ 4500 g categories of newborns, and negative secular trend was recorded in the 1000-1499 g, 2500-2999 g, and 3000-3499 g categories of newborns.

The secular change of anthropological parameters of infants, followed by a longer period of time in the area of BiH has not been studied. Surveys were conducted only for the municipality of Gračanica in the ten-year period (18). Due to the lack of data on this phenomenon, as well as the need for constant monitoring of anthropometric parameters at birth, we decided to investigate this phenomenon.

The aim of this study was to determine the acceleration of birth weight and birth length of newborns in the last four decades, and to compare secular trend in municipalities of Tuzla Canton in four time points (1976, 1987, 1997 and 2007).

EXAMINEES AND METHODS

Characteristics of test areas

Tuzla Canton (TC) is an administrative-territorial unit of the Federation of Bosnia and Herzegovina (FBiH) that was created after the war in Bosnia and Herzegovina by the Dayton Agreement in 1995. It was formed out of the parts of the former area of north-eastern Bosnia, and Tuzla district. Its territory covers complete or parts of thirteen municipalities: Banovici, Doboju-Istok, Gradačac, Gračanica, Kladanj, Kalesija, Čelice, Lukavac, Srebrenik, Teočak, Sapna, Živinice and Tuzla.

Tuzla Canton occupies an area of 2.908 km^2 , or 11.1% of the territory of the Federation of Bosnia and Herzegovina, or 5.7% of the territory of Bosnia and Herzegovina. According to estimations from 1996, there were 611.500 inhabitants, out of which 35% of displaced persons and refugees. In the population of the Federation of Bosnia and Herzegovina, Tuzla Canton participates with 26.2%. In the former Tuzla region, according to the 1991 Census, there were 949.621 inha-

bitants, of which 525,427 Bosniaks (55.33%), 268,581 Serbs (28.28%), 83,320 Croats (8.78%) and 72,293 (or 7.61%) residents who identified themselves as others. Today Bosniaks make up about 90% of the population in the area of this Canton, after all demographic migrations caused by the aggression on B&H.

Climatically, the Tuzla area has a moderate continental climate. The average annual temperature is relatively high at 10.2 to 11.4°C, with clearly distinguished seasons of a year. There used to be some fluctuations in temperature in the spring and fall. The coldest month is January with an average temperature between -0.2 and 2°C, and the warmest is July with an average temperature between 20- 22°C. Maximum rainfall is in spring in May-June, and the minimum rainfall is in February or in March. The number of precipitation days is 90-115 in average during the year. Annual average of sunshine hours is 1772-1972. In this area summers are warm and winters cold, causing very large annual fluctuations as a result of the influence of moderate continental climate (11).

Study design and sample

In this retrospective study the data from the Book of Protocols from the Gynecology and Obstetrics Clinic, University Clinical Centre in Tuzla (GOC UCC Tuzla) were used: birth weight, birth length of newborns, parents' place of residence. The sample is composed of four sub-samples of infants of both sexes, newborns from 1976, 1987, 1997 and 2007. In the observed calendar years at Obstetrics and Gynecology Clinic there were 19.312 newborns, of which 10037 boys and 9275 girls, 233 stillbirths (129 boys and 104 girls). All stillbirths as well as newborns for which data related to parents' residential place were missing in the protocol books have been excluded resulting in the total of 17,907 newborns included in this research.

The sample in relation to the municipality affiliation of the Tuzla Canton was divided to municipalities in all the experimental years (Table 1). Secular trend was observed in thirteen municipalities: Banovici, Doboj-Istok, Gradačac, Gračanica, Kladanj, Kalesija, Čelic, Lukavac, Srebrenik, Teočak, Sapna, Živinice and Tuzla.

Also in 1976 due to lack of data for the location of housing (residence) a special category of unread municipalities was set. In 1976 and 1987,

Table 1. Distribution of newborns per municipalities of Tuzla Canton

Municipalities	No of newborns				
	Year				Total
	1976	1987	1997	2007	
Tuzla	1743	1819	1400	1094	6056
Živinice	376	885	804	697	2762
Kalesija	351	598	511	372	1832
Lukavac	566	874	572	362	2374
Srebrenik	209	549	517	384	1659
Kladanj	64	176	200	145	585
Gračanica	29	127	215	138	509
Banovići	117	254	284	259	914
Gradačac	-	-	243	291	534
Sapna	-	-	31	117	148
D.Istok	-	-	49	24	73
Teočak	-	-	67	61	128
Other municipalities	36	128	17	152	333
				Total	17907

the municipality of Lopare was included. This is because in those years in GOC UCC Tuzla there were many births in this municipality that belong to Republika Srpska at the current regional divisions of Bosnia and Herzegovina.

Methods

Measurements of birth weight are carried out on a special scale with stand, vessel, or by Weiner and Louie (16). The measured values are rounded to the nearest 10-gram value. The birth length of newborns was measured in supine position. The measurement was performed in Pirket's bed or on horizontal board with two verticals (one fixed and one movable base) and fixed metal centimeter by the side. Units and categories used to express the results of measurements and the corresponding observations were standardized and acceptable (17).

Statistical analysis

The descriptive statistics for all taken parameters was calculated as follows: mean (XSR), the standard mean error (+/- s), ranges of variation of each parameter are determined (X min -; Xmax), standard deviation (SD) and the median value for each parameter. The statistical significance of differences between the mean values (t-test) of birth weight and birth length were determined in the municipalities of TC.

Temporal differences (acceleration trend) of changes in the average birth length and birth

weight of newborns for the thirty-year period was done comparing the obtained results with appropriate data available in the literature.

RESULTS

Secular trend of birth weight in the total sample of newborns in the municipalities of Tuzla Canton from 1976 to 2007

Secular trend of birth weight in different municipalities of Tuzla Canton was positive for seven municipalities and negative in six. The highest values of the secular trend were in Kalesija (2.06 g/year), and the lowest one, with a negative value, in the municipality of Kladanj (-4.57 g/year). High values of secular trends were discovered in the municipality of Gradačac (16.04 g/year), but it was monitored only in the last ten years as well as in the municipality of Dobož Istok (-25.33 g/year), where it appeared in very low values (Figure 1).

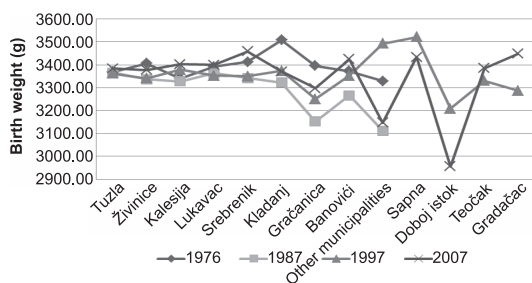


Figure 1. Secular changes in birth weight of infants born alive in the total sample in the municipalities of Tuzla Canton

Tuzla Municipality. The average value of birth weight of the newborns in Tuzla Municipality ranged from 3369.41g in 1976, then the monitored parameter decreased to 3361.9 g in 1997 and it increased again and then, the highest average value was recorded in 2007 (3384.51 g). Secular trend in this municipality in the monitored period from 1976 to 2007 was 15.1g (or 5.03 g per decades or 0.5 g/year) (Table 2).

Živinice Municipality. The average value of birth weight in infants in the municipality of Živinice reached maximum of 3,405.61g in 1976, decreased rapidly to 3,341.37 g in 1987 and increased again in 2007 to 3,377.52 g. The secular trend was negative (-28.09 g) in the last thirty years, e.g. decreased to 9.36 g dec, i.e. 0.936 g/year. Statistically significant differences were found only in the comparison between 1976 and 1987 (p=0.03) (Table 2).

Table 2. Statistically significant differences in compared birth weight by calendar years in the total sample of newborns from the municipalities of Tuzla Canton

Municipalities	Compared years	Birth weight (g)		p (<0,05)
		\bar{X}_1	\bar{X}_2	
Tuzla	1976-1987	3,369.41	3,365.70	0.84
	1976-1997	3,369.41	3,361.90	0.70
	1976-2007	3,369.41	3,384.51	0.47
	1987-1997	3,365.70	3,361.90	0.84
	1987-2007	3,365.70	3,384.51	0.34
Živinice	1997-2007	3,361.90	3,384.51	0.29
	1976-1987	3,405.61	3,336.25	0.03
	1976-1997	3,405.61	3,341.37	0.06
	1976-2007	3,405.61	3,377.52	0.42
	1987-1997	3,336.25	3,341.37	0.84
Kalesija	1987-2007	3,336.25	3,377.52	0.13
	1997-2007	3,341.37	3,377.52	0.20
	1976-1987	3,340.41	3,327.54	0.72
	1976-1997	3,340.41	3,378.94	0.27
	1976-2007	3,340.41	3,402.42	0.12
Lukavac	1987-1997	3,327.54	3,378.94	0.10
	1987-2007	3,327.54	3,402.42	0.04
	1997-2007	3,378.94	3,402.42	0.51
	1976-1987	3,391.80	3,362.85	0.31
	1976-1997	3,391.80	3,352.99	0.21
Srebrenik	1976-2007	3,391.80	3,400.08	0.80
	1987-1997	3,362.85	3,352.99	0.74
	1987-2007	3,362.85	3,400.08	0.26
	1997-2007	3,352.99	3,400.08	0.17
	1976-1987	3,413.06	3,341.77	0.12
Kladanj	1976-1997	3,413.06	3,349.44	0.15
	1976-2007	3,413.06	3,458.96	0.30
	1987-1997	3,341.77	3,349.44	0.82
	1987-2007	3,341.77	3,458.96	0.00
	1997-2007	3,349.44	3,458.96	0.00
Gračanica	1976-1987	3,508.44	3,322.27	0.03
	1976-1997	3,508.44	3,372.85	0.08
	1976-2007	3,508.44	3,371.45	0.08
	1987-1997	3,322.27	3,372.85	0.38
	1987-2007	3,322.27	3,371.45	0.44
Banovići	1997-2007	3,372.85	3,371.45	0.98
	1976-1987	3,395.17	3,152.83	0.11
	1976-1997	3,395.17	3,250.33	0.23
	1976-2007	3,395.17	3,298.12	0.49
	1987-1997	3,152.83	3,250.33	0.18
Gradačac	1987-2007	3,152.83	3,298.12	0.10
	1997-2007	3,250.33	3,298.12	0.49
	1976-1987	3,372.65	3,266.73	0.14
	1976-1997	3,372.65	3,352.78	0.76
	1976-2007	3,372.65	3,424.98	0.42
Dobož East	1987-1997	3,266.73	3,352.78	0.10
	1987-2007	3,266.73	3,424.98	0.00
	1997-2007	3,352.78	3,424.98	0.13
	1997-2007	3,287.20	3,447.63	0.002
	1997-2007	3,521.94	3,434.19	0.39
Teočak	1997-2007	3,208.78	2,955.42	0.14
	1997-2007	3,330.60	3,384.92	0.60
	1976-1987	3,329.17	3,111.64	0.11
	1976-1997	3,329.17	3,492.94	0.30
	1976-2007	3,329.17	3,147.17	0.18
Other municipalities	1987-1997	3,111.64	3,492.94	0.04
	1987-2007	3,111.64	3,147.17	0.70
	1997-2007	3,492.94	3,147.17	0.07

Kalesija Municipality. The average value of birth weight of infants in Kalesija was 3,340.41g in 1976. The analyzed parameter slightly fell to 3,327.54 g in 1987, when it had the lowest values too. After 1987 the average value of birth weight gradually grew, so in 2007 it was 3,3402.42 g. The highest values of the secular trend were recorded in Kalesija in relation to all other municipalities of TC (total of 62.01g in the last thirty years, or 20.67 g/dec, ie. 2.06 g/year). It was found that only infants delivered in 2007 were significantly “heavier” in relation to the newborns in 1987, while there is no statistically significant difference among others tested (Table 2).

Lukavac Municipality. The average value of birth weight of infants in the municipality of Lukavac in 1976 had a value of 3,391.8 g. The monitored parameter fell in 1987 to 3,362.85 g and 1997 it was 3352.99 g. The average birth weight value gradually increased until 2007, when it amounted to 3,400.08 g. Minimal values of the secular trend in relation to the municipalities with a positive trend were recorded in Lukavac Municipality. It was 8.28 g in the last thirty years. Decade value is 2.76 g, i.e. 0.276 g/year. Comparing the results obtained on average values of birth weight by analyzed years by t-test there was no statistical significance between the examined years (Table 2).

Srebrenik Municipality. The average value of birth weight of infants in the municipality of Srebrenik in 1976 was 3413.06 g. The monitored parameter fell in 1987 to 3,341.77 g, and from 1997 it began gradually to increase, so it was 3,458.96 g in 2007. The reported values of the secular trend in Srebrenik were 45.09 g in the last thirty years. The decade value is 15.03 g, or 1.503 g/year. Comparing the results obtained on average values of birth weight overviewed by years by t-test showed statistical significance between 1987 and 2007 ($p=0.03$) and between 1997 and 2007 ($p=0.00$) (Table 2).

Kladanj Municipality. The average value of birth weight of infants from Kladanj reached a maximum of 3508.44g in 1976. The monitored parameter decreased rapidly to 3,322.27 g in 1987 and grew again in 2007 up to 3,371.45 g. Secular trend of the Municipality of Kladanj in the reporting period was negative and its value was -136.99 g throughout the last thirty years. Its decade value is -45.66 -4.57g or g/year. A com-

parison of the results on average values of birth weight by the analyzed years by t-test showed statistical significance only between 1976 and 1987 ($p=0.03$) (Table 2).

Gračanica Municipality. Average birth weight of infants in the Municipality of Gračanica had a maximum value of 3,395.17 g in 1976. This parameter decreased rapidly to 3152.83 g in 1987 and gradually increased again in 2007, when it amounted to 3,298.12g. Secular trend in Gračanica in the reporting period was negative and its value was -97.05 g in the last thirty years. Its decade value is -32.35 g or -3.34 g/year. Comparison of the results obtained from average values of birth weight analyzing annual data by t-test did not show statistical significance among the examined years (Table 2).

Banovići Municipality. The average value of birth weight of infants in the Municipality of Banovići in 1976 was 3,372.65 g then it fell to 3266.73 g in 1987 and increased again, so the highest value of 3,424.98 g was recorded in 2007. Secular trend in this municipality in the reporting period from 1976 to 2007 was 52.33 g. Its decade value is 17.44 g, or 1.74g/year. Comparing the results obtained on average values of birth weight through the tested years by t-test showed statistical significance only for the period between 1987 and 2007 ($p=0.02$) (Table 2).

Municipalities of Gradačac, Sapna, Doboj Istok and Teočak. The average value of birth weight of infants in the municipalities of Gradačac, Sapna, Doboj Istok and Teočak was monitored only in 1997 and 2007 because deliveries in those four municipalities happened only in those years. In the municipalities of Sapna and Doboj Istok negative values of the secular trend were found. In the municipality of Sapna its decade value is -87.75 g, or -8.78 g/year. Decade value of the secular trend in the municipality of Doboj Istok is -253.33 g, or -25.33 g/year. Gradačac and Teočak municipalities had a positive secular trend. In the municipality of Gradačac its decade value is 160.43g, or 16.04 g/year, in the Municipality of Teočak 54.32 g or 5.43 g/year. Comparing the results obtained on average values of birth weight through the analyzed years by t-test showed statistical significance in the compared results of this parameter only in Gradačac ($p=0.002$) (Table 2).

Other municipalities of Bosnia and Herzegovina. The average value of birth weight of infants whose parents are from other municipalities in BiH in 1976 amounted to 3,329.17 g, then the monitored parameter fell to 3,111.64g in 1987, and increased again, so the highest value was recorded in 1997, 3,492.94 g. Since 1997 the monitored parameter had declined again and its lowest value was in 2007, when it amounted to 3,147.17g. Secular trend in birth weight of infants whose parents are not from the area of TC, in the reporting period from 1976 to 2007 was negative and amounted to -182.00 g. Its decade value is -60.67 g, or 6.07 g/year. Comparing the results obtained on average values of birth weight in the tested years by t-test showed statistical significance of this parameter only between 1987 and 1997 ($p=0.04$) (Table 2).

Secular trend of birth length in the total sample of newborns in the municipalities of Tuzla Canton from 1976 to 2007

Secular trend of birth length in the total sample of infants in TC in all the monitored municipalities in the time points of 1976 and 2007 showed a positive trend. The negative trend in those time points was confirmed in a sample of infants whose parents were originally from other municipalities in BiH. In the municipalities where the secular trend was monitored throughout ten years (from 1997 to 2007) such as the municipalities of Gradačac and Sapna, it was positive and in Doboj Istok and Teočak it was negative (Figure 2).

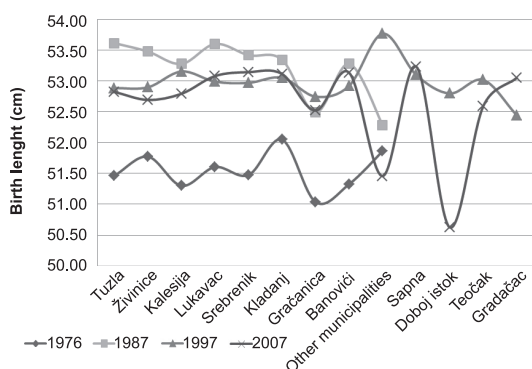


Figure 2. Secular changes in birth length of live-born infants in the total sample in the municipalities of Tuzla Canton

Tuzla Municipality. The average value of birth length of live-born infants in Tuzla Municipality was 51.46 cm in 1976, then this parameter grew up to 53.61 cm in 1987, when its highest values

Table 3. Statistical significance of differences in compared birth length by calendar year in the total sample of newborns from the municipalities of Tuzla Canton

Municipalities	Compared years	Birth length (cm)		p(<0,05)
		\bar{X}_1	\bar{X}_2	
Tuzla	1976-1987	51.46	53.61	-
	1976-1997	51.46	52.88	-
	1976-2007	51.46	52.82	-
	1987-1997	53.61	52.88	0.00
	1987-2007	53.61	52.82	0.00
	1997-2007	52.88	52.82	0.62
Živinice	1976-1987	51.77	53.48	0.00
	1976-1997	51.77	52.90	0.00
	1976-2007	51.77	52.69	0.00
	1987-1997	53.48	52.90	0.00
	1987-2007	53.48	52.69	0.00
	1997-2007	52.90	52.69	0.23
Kalesija	1976-1987	51.30	53.27	0.00
	1976-1997	51.30	53.15	0.00
	1976-2007	51.30	52.79	0.00
	1987-1997	53.27	53.15	0.49
	1987-2007	53.27	52.79	0.02
	1997-2007	53.15	52.79	0.07
Lukavac	1976-1987	51.60	53.60	-
	1976-1997	51.60	52.99	0.00
	1976-2007	51.60	53.08	0.00
	1987-1997	53.60	52.99	0.00
	1987-2007	53.60	53.08	0.01
	1997-2007	52.99	53.08	0.65
Srebrenik	1976-1987	51.47	53.42	0.00
	1976-1997	51.47	52.97	0.00
	1976-2007	51.47	53.14	0.00
	1987-1997	53.42	52.97	0.03
	1987-2007	53.42	53.14	0.18
	1997-2007	52.97	53.14	0.40
Kladanj	1976-1987	52.05	53.34	0.01
	1976-1997	52.05	53.05	0.02
	1976-2007	52.05	53.11	0.01
	1987-1997	53.34	53.05	0.37
	1987-2007	53.34	53.11	0.50
	1997-2007	53.05	53.11	0.85
Gračanica	1976-1987	51.03	52.49	0.12
	1976-1997	51.03	52.74	0.01
	1976-2007	51.03	52.52	0.06
	1987-1997	52.49	52.74	0.57
	1987-2007	52.49	52.52	0.96
	1997-2007	52.74	52.52	0.58
Banovići	1976-1987	51.32	53.28	0.00
	1976-1997	51.32	52.92	0.00
	1976-2007	51.32	53.13	0.00
	1987-1997	53.28	52.92	0.30
	1987-2007	53.28	53.13	0.60
	1997-2007	52.92	53.13	0.40
Gradačac	1997-2007	52.44	53.05	0.04
Sapna	1997-2007	53.10	53.23	0.81
Doboj east	1997-2007	52.80	50.63	0.04
Teočak	1997-2007	53.01	52.59	0.48
Other municipalities	1976-1987	51.86	52.28	0.60
	1976-1997	51.86	53.76	0.02
	1976-2007	51.86	51.46	0.61
	1987-1997	52.28	53.76	0.19
	1987-2007	52.28	51.46	0.13
	1997-2007	53.76	51.46	0.04

were recorded. After 1987 the monitored parameter slowly decreased in 2007, so its value was 52.82 cm. Secular trend in this municipality in the period from 1976 to 2007 was 1.36 cm. Its decade value was 0.5cm and 0.05 cm/year. Comparison of the results on average values of birth length per year showed statistical significance in mutual comparison of the monitored years, except in the comparison of 1997 and 2007 (Table 3).

Živinice Municipality. In the municipality of Živinice the average value of birth length of live-born infants was 51.77 cm in 1976, then this parameter grew up to 53.48 cm in 1987, when we noted its maximal values. After 1987 this parameter slowly declined, so its value was 52.69 cm in 2007. Secular trend in the monitored points from 1976 to 2007 was 0.92 cm (or 0.31 cm/dec; or 0.03 cm/year). Comparison of the results obtained on average values of birth length per year showed statistical significance, as well as in Tuzla, in the mutual comparison of all years, except for the comparison of 1997 with 2007 (Table 3).

Kalesija Municipality In Kalesija the average value of birth length of live-born infants was 51.30 cm in 1976, then this parameter increased and in 1987 it amounted to 53.27 cm. After that period the parameter slowly decreased, and in 2007 its value was 52.79 cm. Secular trend in the monitored points from 1976 to 2007 was 1.49 cm (or 0.5 cm/dec; or 0.05 cm/year). Comparison of the results on average values of birth length through the years has shown no statistical significance for the periods 1987-1997 and 1997-2007. In all other comparisons $p < 0.05$ was found (Table 3).

Lukavac Municipality. The average birth length of live-born infants in the municipality of Lukavac in 1976 was the lowest value of 51.60 cm. The highest values of this parameter in the amount of 53.60 cm were found in other municipalities of TC too in 1987. After 1987, the monitored parameter slowly decreased, and in 2007 it was 53.08 cm. Secular trend in this municipality in the monitored period from 1976 to 2007 had the same values as in Kalesija Municipality. It amounted to 1.48cm (or 0.5 cm/dec, or 0.05 cm/year) in the course of the thirty-year period. Comparison of the results obtained on average values of birth length per year did not show statistical significance only in the comparison with 1997–2007 (Table 3).

Srebrenik Municipality. The average value of birth length in live-born infants in the municipality of Srebrenik in 1976 had the lowest value of 51.47 cm. The highest values of this parameter were also found in other municipalities of TC in 1987 in the amount of 53.42 cm. Secular trend in this municipality in the monitored period of thirty years, 1976-2007 had the value of 1.67 cm (or 0.56 cm/dec; or 0.06 cm/year). Comparison of the results obtained on average values of birth length per year showed statistical significance between 1976 and the years 1987, 1997, 2007, and between 1987 - 1997, respectively (Table 3).

Kladanj Municipality. The average value of birth length of live-born infants in the municipality of Kladanj had a minimum value in 1976 52.05 cm. The highest values of this parameter were also found in other municipalities of TC in 1987 and they amounted to 53.34 cm. After 1987 year, the monitored parameter slowly decreases, so in 2007 it is 53.11 cm. Secular trend in the Municipality of Kladanj in the monitored points, 1976 – 2007 year (thirty-year period), had a value of 1.06 cm, or 0.35 cm/dec (or 0.04 cm/year). Comparison the results obtained on average values of birth length per year showed statistical significance between 1976 with the three years 1987, 1997and 2007, respectively (Table 3).

Gračanica Municipality. Average birth length of live-born infants in the municipality of Gračanica was the lowest in 1976, 51.03 cm. The highest value of this parameter was found in 1997 in the amount of 52.74 cm, but in 2007 it was 52.52 cm. Secular trend in this municipality in the period from 1976-2007 had the same value as in Kalesija, and in the thirty-year period it amounts 1.49 cm (or 0.5 cm/dec; or 0.05 cm/year). Comparison of the results obtained on average values of birth length per year showed statistical significance only between 1976 and 1997. In all the other comparisons $p > 0.05$ was found (Table 3).

Banovići Municipality Average birth length of live-born infants in the municipality of Banovići had the lowest value in 1976, 51.32 cm. The highest values of this parameter were found in other municipalities of TC too, in 1987 in the amount of 53.28 cm. After 1987 the monitored parameter slowly decreased and in 2007 it was 53.13 cm. Secular trend in the municipality of Banovići in the monitored time points, 1976 to 2007, in

thirty-year period valued 1.81 cm and 0.6 cm/dec; (or 0.06 cm/year). Comparing the results obtained on average values of birth length per year showed statistical significance between 1976 and 1987, 1997 and 2007, respectively (Table 3).

Municipalities Gradačac, Sapna, Doboj Istok i Teočak. In the municipalities of Teočak and Doboj Istok negative values of the secular trend were found, but ten-year value in Teočak was -0.42 cm, or -0.04 cm/year. Ten-year value of the secular trend in the municipality of Doboj Istok was -2.17 cm (or -0.22 cm/year). Municipalities of Gradačac and Sapna had positive secular trend. Ten-year value in Gradačac was 0.61 cm, or 0.06 cm/year, but in Sapna it was 0.13 cm/dec (or 0.01 cm/year). Comparing the average values of birth length according to years, statistically significant differences in the results obtained for this parameter in the municipality of Gradačac and Doboj Istok were found (Table 3).

Other municipalities of Bosnia and Herzegovina. The average value of birth length of newborns whose parents were from other municipalities in BiH was 51.86 cm in 1976. After 1976 this parameter increased and had the highest average value of 53.76 cm in 1997. In 2007 year, the value of the monitored parameter declined rapidly to its smallest value ($\bar{X} = 51.46$ cm). Secular trend of birth length of newborns whose parents were not from territory of TC in the reporting period, from 1976 to 2007, had a negative value of -0.4cm (or -0.13cm/dec; or -0.01cm/year). Comparison of the results obtained on average values of birth length per year showed statistical significance between the results obtained in 1976 and 1997 ($p=0.02$), 1997 and 2007, and 1997 and 2007 ($p=0.02$) (Table 3).

Ten-year secular changes

Seven municipalities of TC had positive values and six municipalities had negative values in the ten-year period (1997-2007), resulting in positive secular changes and increase in infant birth weight in Gradačac (160.43 g/dec), Teočak (54.32 g/dec), Kalesija (20.67 g/dec), Banovići (17.44 g/dec), Srebrenik (15.03 g/dec), Tuzla (5.3 g/dec), and Lukavac (2.76 g/dec). Negative secular changes and the reduction in birth weight were recorded in the municipalities of Doboj East (-253.3 g/dec), Sapna (-87.75 g/dec), other muni-

cipalities (-60.67 g/dec), Kladanj (-45.66 g/dec), Gračanica (-32.35 g/dec), and Živinice (-9.36 g/dec). Analyzing secular changes in birth length over the ten-year period (1997-2007) positive values were recorded in ten municipalities and negative values in three. Increase of birth length and positive secular changes were recorded in the municipalities of Gradačac (0.61 cm/dec), Banovići (0.60 cm/dec), Srebrenik (0.56 cm/dec), Kalesija (0.50 cm/dec), Lukavac (0.50 cm/dec), Gračanica (0.50 cm/dec), Tuzla (0.45 cm/dec), Kladanj (0.35 cm/dec), Živinice (0.31 cm / dec), Sapna (0.13 cm/dec). Reduction in birth length and negative secular changes were recorded in the municipalities of Doboj East (-2.17 cm/dec), and other municipalities of Bosnia and Herzegovina (-0.13 cm/dec) and Teočak (-0.42 cm/dec).

DISCUSSION

This research contains considerations related to secular trend in Tuzla Canton municipalities, Bosnia and Herzegovina. Ascertained trend had different values during the period of thirty years. Statistically significant increase or decrease in birth weight in the monitored time points 1976-2007 was not recorded. Statistically insignificant increase of birth weight was noted in the municipalities of Tuzla, Kalesija, Lukavac, Srebrenik and Banovići, while in Živinice, Kladanj and Gračanica statistically insignificant decrease in birth weight was recorded. In four municipalities (Gradačac, Sapna, Doboj Istok and Teočak) secular changes were monitored only in the last decade. In this period, a statistically significant increase in birth weight was found only in mothers coming from Gradačac municipality.

Comparing the recognized secular trend of birth weight and birth length for the municipality of Gračanica with the trend recorded previously (2009) by Hadžihalilović et al. (18) thirty-year period secular trend of birth weight has had negative values (-32.35g/year). However, an analysis of the last decade only (1997-2007) showed that the trend was positive and amounted to 47.79 g, which is much lower compared to 84.96 g/dec reported by Hadžihalilović et al. (18). The reason for such a large difference between these two reports is probably the fact that in presented study data on births were used from the Book of Protocol of Gynecology and Obstetrics Clinic,

University Clinical Centre (GOC, UCC) Tuzla, and Hadžihalilović et al. used data from the Book of Protocol of Department of Newborn Babies, Gynecology and Obstetrics Department, General Hospital "Dr. M. Beganović" in Gračanica. Because of the long distance of Gračanica from Tuzla, usually only a small number of mothers, only with high-risk and twin pregnancies, were sent to give birth in GOC, UCC Tuzla.

A statistically significant increase in birth length of newborns in the monitored time points 1976-2007 was identified in most municipalities of TC (Gradačac, Banovići, Srebrenik, Kalesija, Lukavac, Tuzla, Kladanj and Živinice). In the same period, statistically significant increases or decreases in the monitored parameter in newborns from Gračanica, Sapna, Teočak, as well as from other municipalities of Bosnia and Herzegovina were not monitored. Statistically significant reduction in birth length monitored in the time points 1997-2007 was found only in the newborns from the Municipality of Dobož Istok. This large decline in birth weight (of -253.33g) and birth length (of -2.17g) was probably due to the relatively small number of deliveries from this municipality performed in GOC, UCC Tuzla. Namely, out of the total number of newborns from Dobož Istok Municipality only about 30% were born in this hospital during the monitored years (19).

Secular trend is recorded in other countries around the world as well. High values of acceleration were recorded for immigrants in the USA (10), the UK (9), Sweden (14,20), Scotland (6), England (21).

The highest values of acceleration in birth weight of newborns were found in immigrants from South-East Asia to the United States (10). The authors believe that the monitored increase in birth weight is a result of improved economic and health status of immigrants considering that most of them originated from underdeveloped parts of the country they came from (10). In Great Britain secular trend of birth weight was monitored from 1975 to 1988, in the local population and in immigrants from South Asia to the city of Leicester. The ascertained acceleration in a thirteen-year period had higher values in the domicile population (9).

The large increase in the mean birth weight of about 5g/year was noted in the region of Gothenburg in Sweden, and also refers to the period

in the past 13 years, showing that the mean birth weight rose from 3.440g to 3.507 g during 1973-1986 periods (20). In England, Spencer et al. (21) recorded an increase in average birth weight of 34 g in the city of Sheffield between 1985 and 1994. In the period from 1980 to 1992, the average birth weight of live births from singleton pregnancies in Scotland increased from 3326 g to 3382 g (6). As in Gračanica, such high values of acceleration can be associated with the short time period in which the survey was conducted (18).

High values of the secular trend for a longer period were found in Denmark (12), Sweden (14) and Canada (15).

Thus, the largest recorded acceleration over an extended period was measured in Denmark, where in the period from 1973 to 2003 the mean birth weight increased by about 160 g, corresponding to the equivalent of 5 g/year. The mean birth length had a small increase of 0.24cm/year. The monitored increase in birth weight and birth length was greater for boys than for girls (12). Also, according to the research conducted by Odland et al. (14) for the entire population of Sweden in the period from 1973 to 2000, the average birth weight was increased by 75 g (2.7 g/year).

Secular trend found in Canada (15) for the period from 1981- 1983, 1995 - 1997 amounted to 35 g (2.2 g/year).

Unlike Lithuania, which is a country in transition like Bosnia and Herzegovina, the increase in birth weight and birth length of newborns in B&H was higher: in Lithuania birth length increased, and birth weight remained on the same level through the thirty-year period (from 1974 to 2004) (22). Comparing our results with data from the US (8,10), Great Britain (9), Denmark (12), England (9,21), Sweden (14,20), Scotland (6) and Canada (15), the secular trend in Tuzla Canton is much lower.

Tuzla Canton has higher values of the secular trend in relation to the trend in birth weight ascertained in Region Campinas (Brazil) (23) and Adais Ababa (Ethiopia) (11) where negative values of the secular trend were found.

Acceleration in birth weight and birth length by gender were surveyed in Russia (24), Brazil (25), Illinois (8) (USA) and Gračanica town (18). Comparing the secular trend with these countries

es (cities), the monitored parameters had lower values in TC compared to Saratov and Moscow (Russia) (24), Illinois (8) (USA) and Gračanica (Bosnia and Herzegovina) (18). Acceleration in birth weight and birth length of male and female newborns was higher in TC in relation to Khvalynsk (Russia) (24) and Ribeirao Preto (Brazil) (25), where these parameters had negative values.

Tretyak et al. (24) identifying secular trend in Russia found that in the last 100 years, periods of increase and decrease of anthropometric parameters at birth were recorded as a result of the socio-economic changes. The biggest decrease in these parameters was recorded during the Second World War and the maximal values were noted in the mid eighties, which was the period of maximal birth rate, as well (24).

An increase in the average value of birth weight was noted among parents and children in Illinois (USA) in the periods 1956-1976 and 1989-1991. The ascertained increase has a greater value for the whites (74g) than for the blacks (33 g), and in girls in relation to boys (8). In Ribeirao Preto and Campinas cities (Brazil) in the 1978-1994 period negative secular trend of birth weight in both sexes was recorded. The ascertained trend had a greater decrease in girls than in boys (23,25,26). Statistically significant differences were found in secular trend of birth weight, birth length and

head circumference monitored by the weeks of gestation in infants in China in the period between 1982-1986, and from 2000 to 2001 (27). Secular trend of birth weight, before, during, and after the Homeland War (1983-2003) in Croatia monitored by Bralić et al. (7) showed a statistically significant increase in the number of live-born infants in the weight groups of 500-999 g, 3500-3999 g, 4000-4499 g, and in the group greater than 4500 g, while in the groups of 1000-1499 g, 2500-2999 g, and 3000-3499 g negative trend was noticed.

In conclusion, general tendencies of change of anthropometric parameters at birth were diagnosed in the municipalities of TC. The identified changes are yet another indication that the long-term and systematic monitoring of these parameters is necessary in order to inform its own population. This study contributes to the field of population anthropology and pediatric population of TC it is a confirmation of the necessary need to create its own (national) percentile growth curves for newborns among the TC population and entire BiH.

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Sekularni trend antropoloških parametara novorođenčadi u općinama Tuzlanskog kantona (1976-2007)

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SAŽETAK

Cilj Utvrditi akceleraciju porođajne mase i dužine tijela novorođenčadi po općinama Tuzlanskog kantona u posljednje četiri decenije. Tuzlanski kanton (TK), kao administrativno-teritorijalna jedinica u FBiH, uključuje 13 općina.

Metode Ovo istraživanje predstavlja retrospektivnu studiju u kojoj su korišteni podaci iz knjige protokola Ginekološko-akušerske klinike Univerzitetskog kliničkog centra Tuzla, u periodu od 1976. do 2007. godine. Uzorak živorođene novorođenčadi po općinama podijeljen je u četiri poduzorka: poduzorak novorođenčadi rođene 1976, 1987, 1997. i 2007. godine. Tokom promatranih godina u Tuzlanskom kantonu (TK) bilo je 19.312 živorođenih, ali je u istraživanje uključeno 17.907 novorođenčadi oba spola. Statistička obrada podataka izvršena je standardnim postupcima deskriptivne i inferentne statistike.

Rezultati Konstatovane vrijednosti sekularnog trenda za porođajnu masu pokazuju da je taj parametar u sedam općina imao pozitivne vrijednosti, dok je u šest općina bio negativan. Najveće vrijednosti povećanja porođajne dužine tijela novorođenčeta, koje su bile statistički značajne, konstatovane su u općini Srebrenik i to je povećanje iznosilo 0,06 cm godišnje.

Zaključak Različite vrijednosti sekularnog trenda u promatranim općinama TK-a rezultat su različitih socioekonomskih i ekoloških uvjeta u tim općinama, kao i nasilnih migracija stanovništva koje su se dešavale kao posljedica rata u BiH u razdoblju od 1992. do 1995. godine.

Ključne riječi: akceleracija, porođajna dužina, porođajna masa.