PRELIMINARY REPORT

UDC: 616-053.31/.32-071.3
https://doi.org/10.2298/VSP181205027S

Reference charts of birth weight and birth length by gestational age in the southeast Serbian newborns – preliminary results

Neonatalne antropometrijske karte novorođenčadi u jugoistočnoj Srbiji – preliminarni rezultati

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Abstract

Background/Aim. To date, there has been no population-based neonatal anthropometric chart published in Serbia. Charts based on infants born in a single hospital (hospital-based) in the 1990s are still widely used in our country, as well as the Alexander chart. The aim of this study was to construct population-based centile, gender-specific charts for birth weight and length for singleton infants born in Southeast Serbia from 24 to 42 weeks of gestation and to compare them with other previously published charts. **Methods.** Data on 39,842 singleton live infants, delivered from 2006 to 2015 in three maternity wards in Southeast Serbia (Niš, Prokuplje, and Aleksinac), were analyzed. **Results.** The inclusion criteria met 37,169 newborns. Preterm births were relatively uncommon (5.25%). Estimated centile charts for male and female birth weights and lengths were constructed showing the 3rd, 10th, 25th, 50th, 75th, 90th, and 97th centiles. **Conclusion.** Our birth weight percentiles provide a population norm for singleton infants adjusted for gender, born in Southeast Serbia. These references are both of epidemiological and clinical use. There is a need for large-scale research that will include a larger number of preterm newborns which were represented in limited numbers in our study. There is also a need for setting up the gold standard method for the precise determination of the gestational age, i.e. the use of the early fetal ultrasound.

Key words:
infant; serbia; anthropometry; fetal development; reference values.

Apstrakt

Uvod/Cilj. U Srbiji do sada nije objavljena populaciona neonatalna antropometrijska karta. U svakodnevnom radu se još uvek široko koriste antropometrijske karte napravljene na osnovu merenja u jednom porodilištu u našoj zemlji ili karte stranih autora kao što je Alexander-ova karta. Cilj ove studije bio je izrada populacionih antropometrijskih karti za dužinu i masu na rođenju za novorođenčad rođenu od 24. do 42. nedelje gestacije iz jednoplodnih trudnoća u jugoistočnoj Srbiji i poređenje sa drugim ranije objavljenim kartama. **Metode.** Analizirani su podaci za 39 842 novorođenčadi rođenih iz jednoplodnih trudnoća u periodu od 2006. to 2016. godine u tri porodilišta u jugoistočnoj Srbiji (Niš, Prokuplje i Aleksinac). **Rezultati.** Kriterijume za ulazak u studiju je ispunilo 37 169 novorođenčadi. Prevremeno rođene dece bilo je 5,25%. Napravljeni su percentili za dužinu i masu na rođenju za mušku i žensku novorođenčad pokazujući 3., 10., 25., 50., 75., 90. i 97. percentil. **Zaključak.** Ovim istraživanjem dobijene su prve populacione antropometrijske, polno-specifične neonatalne karte za novorođenčad iz jugositočne Srbije. Dobijeni rezultati imaju klinički i epidemiološki značaj. Zbog ograničenog broja prevremeno rođenih beba postoji potreba za dodatnim istraživanjem na većem uzorku kako bi se preciznije odredili percentili za ovu grupu novorođenčadi. Takođe, potrebno je uspostaviti zlatni standard za precizno određivanje gestacijske dobi, tj. ranu upotrebu fetalnog ultrazvuka.

Ključne reči:
novorođenče; srbija; antropometrija; trudnoća, razvoj fetusa; referentne vrednosti.

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Introduction

Birth weight and length are quite sensitive indicators of children's health. Small-for-gestational-age (SGA) neonates have a long-term risk of short stature [1], neurocognitive impairment [2], metabolic disorders [3] , and cardiovascular diseases [4, 5]. Similarly, the large-for-gestational-age (LGA) are also at increased risk of short and long-term health problems [6, 7]. The values that identify infants at high and low risk cannot be clinically defined. Therefore, the adoption of statistical definitions instead of using clinical ones is advised [8]. By this, a neonate is defined as SGA when his or her weight and/or length is below the 10th, 5th, or 3rd centile of the neonatal chart, and LGA when his or her anthropometric values are above the 90th centile [9, 10].

These observations justify the use of neonatal charts. For more than fifty years, clinicians and investigators have proposed reference data for assessing birth weight and length for gestational age. Currently used neonatal charts are different regarding exclusion and inclusion criteria, instruments of measurement, methods of assessing gestational age and calculating centiles. There are several proposed characteristics that a reliable neonatal chart should have [8].

To date, there has been no population-based neonatal anthropometric chart published in Serbia. Charts based on infants born in a single hospital (hospital-based) in the 1990s [11] are still widely used in our country, as well as the Alexander chart [12].

Previously, comparative anthropometric data of Roma and non-Roma newborns, born between the 36th and 42nd gestational week, were published [13]. The aim of this study was to construct gender-specific charts for birth weight and length for singleton infants born in Southeast Serbia from 24 to 42 weeks of gestation and compare them with other previously published charts.

Methods

Data on 39,842 infants were analyzed. The study included all live singleton newborns delivered from 2006 to 2015 in three maternity wards in Southeast Serbia (Niš, Prokuplje, and Aleksinac).

Data were obtained from the computerized birth files of the National Institute of Health. The gestational age had been calculated in completed weeks based on the last menstrual period, and/or early date ultrasound, and/or neonatal examination. The weight was measured by a mechanical scale with 10 g precision. The length was measured using a non-stretch plastic tape from crown to heel.

Infants with major congenital anomalies and those with uncertain gestational age were excluded.

The LMS method was used to estimate the birth weight centimes. The L (Box-Cox power), M (median), and S (coefficient of variation) parameters were estimated [13]. This method uses smoothed values of L, M, and S to transform the observed distribution of birth weights and lengths to a standard normal distribution. This allows the calculation of centiles by using the appropriate SD score [14]. The scatter data plots and *Z* scores obtained from the LMS method were used to identify the outliers. Observations lying beyond ± 3 *Z* score were deleted.

Centiles were calculated using the LMS Chart Maker Light 2.54 version software, and the other analysis was carried out using SPSS, version 16.

Ethical approval to proceed without individual consent was given based upon the fact that this was retrospective anonymous clinical research.

Results

The inclusion criteria met 37,169 newborns. Tables 1 and 2 summarize the number of infants born in each gestational week and estimated values of L, M, and S by gender and gestational week. Preterm births were relatively uncommon (5.25%). Estimated centile charts for male and female birth weights (Figure 1) and lengths (Figure 2) were constructed showing the 3rd, 10th, 25th, 50th, 75th, 90th and 97th centiles. Female infants were lighter and shorter than the male infants, especially from 36 weeks onwards.

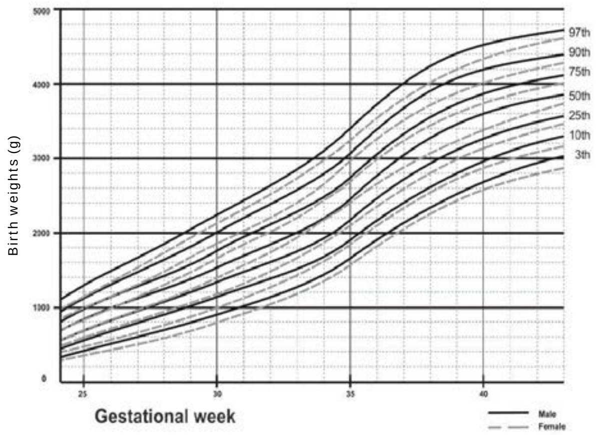

Fig. 1 – Estimated 3rd, 5th, 10th, 50th, 75th, 90th and 97th centiles for male and female birth weights.

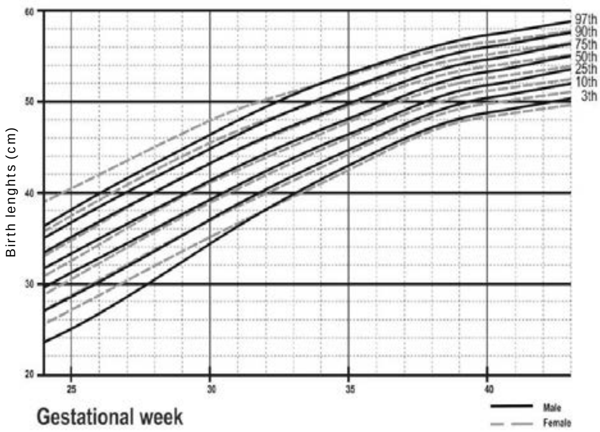

Fig. 2 – Estimated 3rd, 5th, 10th, 50th, 75th, 90th, and 97th centiles for male and female birth lengths.

Table 1

Number of infants and estimated values for L, M, and S for the birth weight*

Gestation (week)	Male				Female			
	n	L	M	S	n	L	M	S
24	7	1.78	627.32	0.16	10	1.56	615.12	0.20
25	12	1.76	833.74	0.16	10	1.54	730.82	0.19
26	7	1.76	965.92	0.16	12	1.53	852.41	0.19
27	15	1.75	1,083,85	0.16	15	1.51	993.17	0.19
28	20	1.73	1,230.88	0.16	10	1.50	1,134.35	0.19
29	23	1.71	1,379.96	0.16	9	1.51	1,314.08	0.18
30	38	1.68	1,553.15	0.16	24	1.52	1,514.76	0.18
31	21	1.66	1,753.11	0.16	24	1.54	1,690.01	0.17
32	63	1.62	1,947.16	0.16	51	1.56	1,882.12	0.17
33	73	1.59	2,068.48	0.16	45	1.56	2,049.68	0.16
34	109	1.52	2,270.82	0.16	98	1.49	2,302.78	0.16
35	189	1.33	2,540.79	0.15	171	1.28	2,539.93	0.15
36	472	1.02	2,804.59	0.15	425	0.96	2,779.62	0.14
37	1073	0.71	3,107.31	0.14	948	0.67	3,007.74	0.14
38	2618	0.57	3,297.06	0.13	2340	0.53	3,153.91	0.13
39	4838	0.49	3,463.48	0.13	4369	0.42	3,322.90	0.12
40	8508	0.46	3,602.50	0.12	8147	0.36	3,443.87	0.12
41	2226	0.45	3,725,22	0.12	2239	0.32	3,532.73	0.12
42	294	0.44	3,802.69	0.12	270	0.29	3,602.39	0.12

***LMS – method for the birth weight centimes [L (Box-Cox power), M (median), S (coefficient of variation)]**

Table 2

Number of infants and estimated values for L, M, and S for the birth length*

Gestation (week)	Male				Female			
	n	L	M	S	n	L	M	S
24	8	0.10	31.69	0.08	9	-1.04	30.68	0.08
25	13	0.54	33.55	0.08	11	-0.64	32.17	0.08
26	7	0.96	35.31	0.07	13	-0.24	33.77	0.08
27	15	1.34	37.01	0.07	15	0.15	35.54	0.07
28	20	1.69	38.71	0.07	10	0.54	37.43	0.07
29	22	1.99	40.34	0.06	9	0.91	39.32	0.07
30	42	2.24	41.84	0.06	32	1.29	41.01	0.06
31	19	2.43	43.12	0.06	24	1.65	42.35	0.06
32	54	2.57	44.23	0.05	39	1.98	43.52	0.06
33	67	2.67	45.27	0.05	42	2.25	44.72	0.05
34	88	2.72	46.47	0.05	76	2.44	46.08	0.05
35	190	2.71	47.93	0.05	169	2.52	47.62	0.05
36	521	2.64	49.52	0.05	497	2.50	49.22	0.05
37	1,158	2.55	51.01	0.04	1,027	2.41	50.53	0.04
38	2,653	2.47	52.01	0.04	2,332	2.30	51.31	0.04
39	4,873	2.41	52.72	0.04	4,393	2.19	52.02	0.04
40	8,434	2.36	53.31	0.04	8,107	2.09	52.55	0.04
41	2,192	2.32	53.95	0.04	2,231	1.97	53.05	0.04
42	290	2.28	54.52	0.04	267	1.83	53.38	0.04

***For abbreviations see under Table 1.**

Discussion

Our birth weight centiles provide a population norm for singleton infants adjusted for gender, born in Southeast Serbia. These references are both of epidemiological and clinical use, and they may have applicability as a tool for epidemiological comparisons between geographic locations and cultures. Data from an entire population were used and they provided a more valid standard than those based on hospital data. Hospital-based studies are often prescriptive, mostly based on a small number of infants without known risk factors for intrauterine growth retardation, and thus, may have limited usage in populations with mixed low and high-risk pregnancies. Population-based studies are more descriptive. In the absence of criteria regarding risk factors for fetal growth, these studies describe "what growth is actually like" in examined population [8].

The study cohort was stratified for gender. The known larger birth weight and length for gestational age in male versus female infants were shown.

Our measurements were quite similar to those of Abrahamowicz et al. [15], Fenton and Kim [16] , and Roberts and Lancaster [17]. On the other hand, clear differences between our measurements and those made in Brasil [18] and Israel [19] justify the fact that each specific population group should have its own neonatal anthropometric charts developed.

There are several limitations to our study. Our data were provided from the routine care, hence measurements were not standardized. The measurements were done by different members of staff, and this may have contributed to the inter-observer difference. Infants were not adjusted for parity. The secular trend has not been taken into account, having in mind a long period of data acquisition, even though there are plenty of studies with a similar disadvantage. The study was limited by the small size of the sample of 24 to 33 weeks gestation (50 male, 32 female). Therefore, using results from significant international experience in the large-scale population-based studies in the developed countries [15, 20] might be the best way to estimate the fetal growth and centiles of preterm infants in our population.

The other problem is the calculation of the exact gestational age, which is very important considering the fact that the fetus describes the fastest human growth. In our country, the gestational age is calculated by the last menstrual period, or by the neonatal examination more frequently than by the early fetal ultrasound, which is considered the gold standard [19]. Although menstrual dating is generally accurate for term neonates (± 7 days of the ultrasound estimate), the error rises with prematurity and postmaturity.

Conclusion

Thorough neonatal anthropometric data obtained in this study and centile charts of the Serbian population were constructed and made available for the first time. Consequently, it will improve assessing the growth and nutritional status of newborn infants during the perinatal period, classifying them as small, appropriate, or large for gestational age.

There is a need for large-scale research that will include a larger number of preterm newborns which were represented in limited numbers in our study. There is also a need for setting up the gold standard method for the precise determination of the gestational age, i.e. the use of the early fetal ultrasound.

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Received on December 5, 2018.
Revised on February 10, 2019.
Accepted on February 21, 2019.
Online First March, 2019.