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Comparative Assessment of Basic Anthropometric Features in Normal and Low Birth Weight Newborns (preliminary results)

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The aim is to characterize the anthropometric and nutritional status of Bulgarian neonates with normal and low birth weight and to assess sexual differences. The data of 3086 neonates (1587 boys, 1499 girls) born in 2010 are gathered from the birth registry of Ist Obstetrics and Gynecology Hospital “St. Sofia” in Sofia. Newborns are classified as Normal Birth Weight (birth weight \geq 2500 g to 4499 g) and Low Birth Weight (birth weight from 1500 g to 2499 g). Data of birth weight, length and BMI are analyzed, sexual differences in both groups are assessed. The neonates with NBW have significantly higher values of investigated features compared to LBW newborns. Sexual differences in LBW group are slightly expressed while in NBW group they are statistically significant. The results are valuable and could serve as a basis for development of national sex specific reference values for weight, length and BMI at birth in NBW and LBW newborns.

Key words: newborns, normal birth weight, low birth weight, birth length, sex differences

Introduction

Newborn sizes reflect fetal growth and development and are predictor of health throughout its life course [6]. Impaired fetal growth is associated with structural and functional anomalies that predispose individuals to cardiovascular and metabolic diseases at different stages of postnatal life [5, 13]. The assessment of weight and length as indicators of the health status of the newborn is essential for planning appropriate, timely interventions especially in neonates born preterm or with low birth weight. Preterm and low birth weight infants have a 2- to 10-fold higher risk of mortality than infants born at term and with normal birth weight [15]. In our country investigations of newborns are scarce and very rare they include data about low birth weight infants. The **aim** of the study is to characterize the anthropometric and nutritional status of Bulgarian neonates with normal and low birth weight and to assess sexual differences.

Material and Methods

The data used are gathered from the birth registry of First Obstetrics and Gynecology Hospital “St. Sofia” on the territory of Sofia and include all life births in the hospital for 2010. The birth weight and length are measured immediately after birth by professional obstetrics.

Data about 3086 newborns (1587 boys and 1499 girls) are included in the analysis. According to their birth weight newborns are classified as Normal Birth Weight (NBW) – weight range from 2500 g to 4499 g and Low Birth Weight (LBW) – 1500 g – 2499 g.

We exclude infants with very low (under 1500 g), extremely low (under 1000 g) and high birth weight (over 4500 g), newborns from multiple pregnancies and infants with syndromic and congenital anomalies affecting in utero growth (**Table 1**).

Table 1. Characteristic of the sample before the analysis

Sex	Newborns from multiple pregnancies*	Extremely low birth weight*	Very low birth weight*	Low birth weight	Normal birth weight	High birth weight*
		< 1000g	1000-1500g	1500-2499g	2500-4499g	≥ 4500g
Male	67	2	1	97	1490	10
Female	60	2	4	119	1380	3
Total	127	4	5	216	2870	13

*Data excluded from the analysis

BMI is calculated by the formula: $BMI = \text{weight (kg)} \div \text{height}^2 \text{ (meters)}$

The sexual differences are evaluated in absolute differences and in relative index units (IU) by the formula of Wolanski for inter-group comparisons, called for the purposes of this study Index of Sexual Differences (ISD):

$$ISD = \frac{2 \times (\text{mean boys} - \text{mean girls})}{(\text{mean boys} + \text{mean girls})} \times 100$$

The index gives a quantitative assessment of the sexual differences, allowing comparisons between features of different dimensions, such as body weight (kg) and body length (cm). Sexual differences are assessed in index units (IU), which positive values show priority for boys and negative ones – priority for girls.

The statistical analyses are performed using SPSS 16.0. The significance of absolute sexual differences is assessed by Student's t-test ($p \leq 0.05$).

The study was conducted in accordance with the principles of Declaration of Helzinki (World Medical Association, Declaration of Helsinki. Ethical Principles for Medical Research Involving Human Subjects. WMJ. 2008; 54(4):122-125.) and after approval by the Ethical Committee of Institute of Experimental Morphology, Pathology and Anthropology with Museum – Bulgarian Academy of Sciences.

Results and Discussion

The anthropometric characteristic of NBW and LBW newborns from Sofia is made on the basis of three main anthropometric variables (body weight, body length and BMI), assessing their physical development and nutritional status. Differences between NBW and LBW newborns are discussed as well as sexual differences in both investigated groups.

Differences in anthropometric characteristic of NBW and LBW newborns

Values of investigated features in NBW and LBW newborns are presented on Table 2. As expected, means are significantly lower in LBW than those in NBW ($p \leq 0.05$). Normal birth weight male and female infants are heavier with 1039.3 g and 921.4 g, compared to low birth weight male and female infants. Similar results are established in regard to birth length, which mean values are higher in male and female newborns from NBW group, compared to those of LBW infants with/by 4.5 cm and 3.9 cm, respectively (**Table 2; Fig. 1**).

It is interesting to be noted that differences in birth weight and length between LBW and NBW male infants are quite bigger than that established between girls from different weight groups. This could be related to the reported in other studies evidences that male LBW newborns are less stable after birth and are more vulnerable to perinatal and postnatal mortality and morbidity [11, 2].

Table 2. Statistical data of investigated features in neonates with normal and low birth weight

Sex	Normal birth weight (2499-4999g)					Low birth weight (1500-2499g)					Differences NBW/LBW	
											Male	Female
Birth weight (g)												
	N	mean	SD	min	max	N	mean	SD	min	max		
Male	1490	3326.9	381.8	2550.0	4550.0	97	2287.6	225.6	1550	2490	1039.3*	921.4*
Female	1380	3228.1	369.8	2500.0	4450.0	119	2306.7	208.4	1650	2480		
Birth length (cm)												
Male	1490	50.1	1.7	45.0	57.0	97	45.6	2.2	34	50	4.5*	3.9*
Female	1380	49.6	1.6	45.0	55.0	119	45.7	1.7	40	51		
BMI (kg/m²)												
Male	1490	13.2	1.0	10.0	17.2	97	11.0	1.0	8.1	13.8	2.2	2.1
Female	1380	13.1	1.0	10.6	16.5	119	11.0	0.9	8.5	12.8		

*Statistically significant differences at $p \leq 0.05$; NBW – normal birth weight; LBW – low birth weight

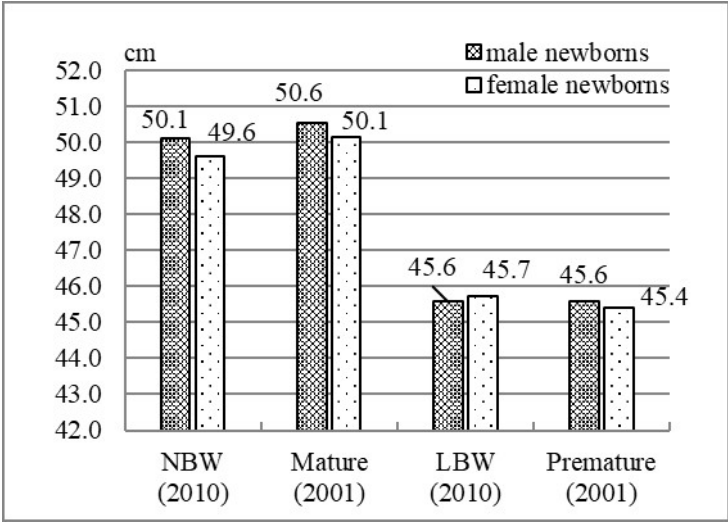


Fig. 1. Birth length in neonates with normal and low birth weight – comparison with 2001 data

Assessing the relationship between birth weight and length, BMI is accepted as appropriate measure of the nutritional status and adiposity during pediatric years [14, 12].

BMI mean values are very similar in both sexes, also showing significantly higher values (with 2 kg/m²) for NBW infants than LBW ones. Significantly higher

values in NBW newborns compared to LBW newborns are also reported by other authors [7, 8, 17].

Table 3. Sex differences in neonates with normal and low birth weight

	Normal birth weight (2499-4999g)		Low birth weight (1500-2499g)	
	Absolute differences	ISD (IU)	Absolute differences	ISD (IU)
Birth weight	98.8g*	3.0	19.10g	-0.8
Birth length	0.5cm*	1.0	0.1cm	-0.2
BMI	0.1 kg/m ²	0.8	0.0 kg/m ²	-0.1

*Statistically significant differences at $p \leq 0.05$

Sexual differences in NBW and LBW groups – comparative assessment

In NBW newborns sexual differences are clearly expressed both in body weight and body length and are statistically significant ($p \leq 0.05$) as male infants show priority over girls. Concerning body nutritional status assessed by the BMI, statistically significant differences are not established, the mean of the index is 13.2 kg/m² and 13.1 kg/m² in male and female newborns respectively (**Table 3, Figs. 1, 2, 3**). Our results are similar to those reported by other authors in national and international studies [3, 16]. A study of Bulgarian newborns from Smolyan shows no significant differences depending on sex in body length and body weight at birth [10].

In LBW group sexual differences are slightly expressed and are not statistically significant for all three examined variables. The smallest differences are established for BMI.

While in NBW group the values of the anthropometric features are significantly greater in male newborns, in the LBW group, although small, the established differences are found to be with priority for girls (**Table 3, Figs. 1, 2, 3**). Similar results were found in an earlier study of newborns from Sofia [16], which demonstrated minimal priority of LBW female neonates for body weight, BMI, as well as in a number of other investigated anthropometric features. Data about body length shows that LBW male newborns are slightly, insignificantly longer than LBW females.

Most of the studies in the specialized literature do not establish similar advantage of the female sex in LBW infants [1, 4], which could be due to the use of different classification of neonates at birth – on gestational age or on birth weight. Both are considered to be helpful for counseling, clinical management and research [9], but the use of different classification makes the comparison between studies difficult and even impossible giving not accurate, biased results.

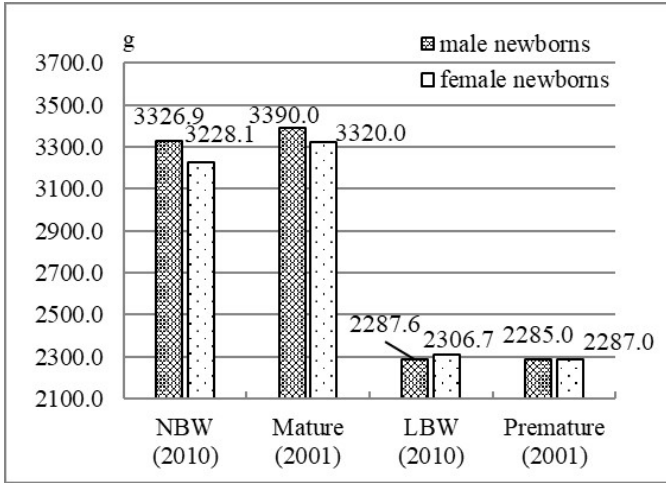


Fig. 2. Birth weight in neonates with normal and low birth weight – comparison with 2001 data

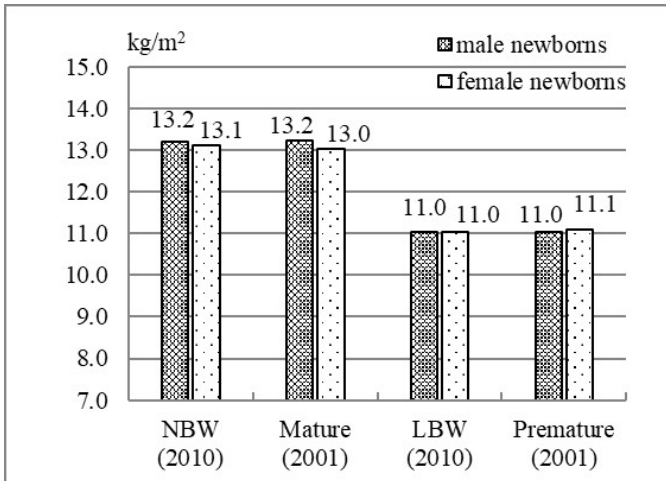


Fig. 3. BMI in neonates with normal and low birth weight – comparison with 2001 data

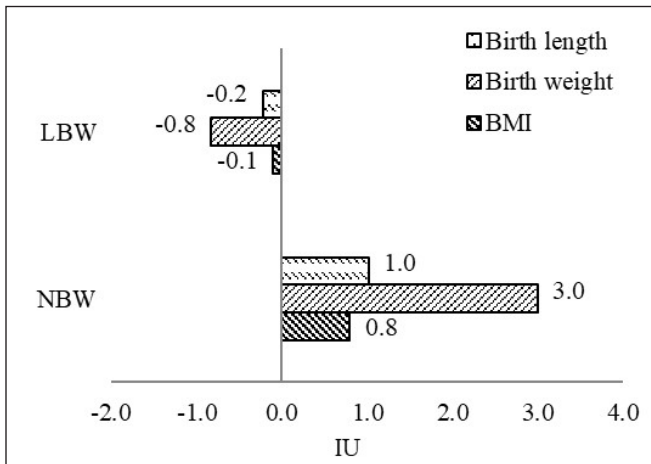


Fig. 4. Sex differences assessed by the ISD

The use of the ISD allows the comparison between the three investigated features, and expresses sexual differences in IU. Data are presented on **Fig. 4**. It is clearly observed that in both examined groups – NBW and LBW, differences between sexes are most pronounced in birth weight, followed by birth length and in the least extent sex is related to the BMI (**Table 3, Fig. 4**).

We compared our results with results from a study of newborns conducted in 2001 in Sofia [16], which used the same methodic and births are classified according to body weight as “preterm” (birth weight < 2500 g) and “mature” (birth weight \geq 2500 g) corresponding to LBW and NBW groups respectively in our study. The comparison between NBW group in present study and “mature” newborns from 2001 as well as between LBW group and premature newborns study demonstrates similar means of the investigated features. However it should be noted that in NBW (mature) group mean values of birth weight and birth length in 2010 born neonates are lower. Male and female newborns are lighter with 63,1 g and with 91,9 g, respectively and shorter with 0,5 cm.

Lower values of birth weight are also observed in LBW (premature) neonates born in 2010 but the difference is insignificant (2,6 g in boys and 19,7 g in girls). Concerning length at birth, a minimal change of -0.3 cm is found, only in female newborns.

Mean values of BMI are similar in both investigated years – approximately 13.0 kg/m² in NBW (mature) group and 11.0 kg/m² in LBW (premature) group.

Conclusion

The data presented characterize anthropometrically the physical development and nutritional status of neonates with NBW and LBW born in 2010. NBW infants have significantly higher values of investigated features compared to LBW newborns. Sex specific differences in anthropometric characteristic in both NBW and LBW groups are established. Sexual differences in neonates with low birth weight are slightly expressed while in NBW newborns they are statistically significant. The peculiarities of LBW newborns are described adding a new knowledge about this specific population group.

Compared to mature and premature neonates born in 2001, mean values of the three investigated variables are lower in NBW neonates born in 2010, in LBW group differences are not observed. The results obtained are valuable and could serve as a basis for development of national sex specific reference values for weight, length and BMI at birth in NBW and LBW newborns.

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