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Prognostic Significance of Anthropometric and Bioimpedance Parameters of Yakut Women for Birth of Newborns with High Body Weight

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Abstract

The aim of this study was to identify the prognostically significant anthropometric and bioimpedance indicators for the birth of a child with a high BW in Yakut women.

The study included 220 women of Yakut nationality with physiological pregnancy and childbirth who were examined on the third and fourth days after delivery. The parameters of anthropometry and bioimpedancemetry in parturient women and the anthropometric indices of newborns were investigated. Anthropometric measurements were carried out according to the method of V.V. Bunak. Body composition was assessed based on bioimpedance analysis using the ABC-01 MEDASS device (Medass, Russia). The conducted research revealed that the anthropometric and bioimpedance indices of Yakut women in the postpartum period (3-4 days after delivery) were significantly different from general population indicators. The parameters of body weight and body mass index of the puerperal women were significantly higher, and phase angle and Xc50 - significantly lower. PCA revealed anthropometric and bioimpedance indices predicting a high birth weight. The obtained data in combination with other indicators can be used to predict the birth of a child with a high birth weight in Yakut women. **(International Journal of Biomedicine. 2018;8(3):224-227.)**

Key Words: anthropometry • bioimpedance • puerperal women • fetal macrosomia

Abbreviations

BIA, bioimpedance analysis; **BW**, body weight; **BMI**, body mass index; **BC**, buttock circumference; **BL**, body length; **CC**, chest circumference; **CE**, conjugata externa; **DS**, distantia spinarum; **DC**, distantia cristarum; **DT**, distantia trochanterica; **HC**, head circumference; **HBW**, high birth weight; **PhA**, phase angle; **TCD**, transverse chest diameter; **TBW**, total body water; **VEF**, volume of extracellular fluid; **VCF**, volume of cellular fluid; **WC**, waist circumference.

Introduction

Fetal macrosomia (FM) can be caused by many factors, including genetic predisposition, elevated BMI of the women, overdue pregnancy, iatrogenic causes (use of a number of drugs), presence of diabetes mellitus, obesity, and others.[(1)] Prenatal diagnosis of FM is of great importance in obstetric practice to determine the tactics of labor, prevent maternal and perinatal morbidity and mortality, and assess the long-term negative consequences for the health of the mother and newborn.[(2-8)]

Identifying available methods for FM diagnosis is an important practical task.[(9-10)] One such method is anthropometry, which is an accessible and non-invasive approach.[(11)] In the scientific literature there are data on the dependence of the anthropometric indicators of the newborn on the constitution, height and size of the mother's pelvis. The definition of a mother's BMI is also of great importance for predicting the morphofunctional parameters of a newborn.

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The aim of this study was to identify the prognostically significant anthropometric and bioimpedance indicators for the birth of a child with a high BW in Yakut women.

Materials and Methods

The study included 220 women of Yakut nationality with physiological pregnancy and childbirth who were examined on the third and fourth days after delivery. We investigated the parameters of anthropometry and bioimpedancemetry in parturient women and the anthropometric indices of newborns. All examined women (all primiparous) without chronic diseases and complications of the pregnancy and childbirth were born and permanently resided in the city of Yakutsk and the central regions of Yakutia. The mean age of the examined women was 26.0 [23.0; 31.0] years.

The ethnicity of the study participants was determined based on personal data. The parameters of 220 newborns (birth weight, BL, CC, and HC) were collected from neonatal records. The examined women were students, employees, workers and homemakers.

Anthropometric measurements were carried out according to the method of V.V. Bunak.[12] BL was measured using a Martin metal anthropometer with an accuracy of 0.1cm. BW was measured without clothing using medical scales with an accuracy of 50 g. The circumference dimensions of waist and buttocks were determined using centimetric tape. P*elvic* (pelvis major) measurements (distantia spinarum, distantia cristarum, distantia throchanterica, and conjugata externa) were performed with a large caliber compass with an accuracy of 1 mm. The accuracy of the instruments used was verified after every 100 measurements, using a special calibration block.

Body composition was assessed based on BIA using the ABC-01 MEDASS device (Medass, Russia). The principle of operation of this device is based on the relationship between the electrical resistance of the body tissues measured at different frequencies and the volume of the fluid compartments of the body. The accuracy of impedance measurements was 2%. Bioimpedancemetry was performed by the tetrapolar method using a sinusoidal current with a constant frequency of 50 kHz with no more than 1mA in the range of measured impedance values up to 1000 Ohm. Recording was performed for 5min after fixing 4 paired silver-silver chloride (Ag-AgCl) electrodes (Schiller Biotabs) (current and potential) on the wrist and shin (on the right side). The distance between injecting and reading electrodes was 5 cm. The impedancemeter and computer were used to measure and calculate the main fluid volumes of the body (TBW, VEF, VCF), as well as the lean body weight and body fat mass. The subjects were asked not to move when the instrument was measuring the bioelectrical impedance. The data processing software developed by the device manufacturer (Medass, Russia) was used for all calculations. The accuracy of the device used was verified after every 50 measurements, using a Dummy Simulator.

BIA uses body resistance (R) and reactance (Xc) to a flow of alternating electrical current to determine impedance and estimates body composition parameters from regression equations derived against a reference method. Phase angle (PhA) was calculated (at 50 kHz) as the arctangent of the ratio of Xc to R (converted to degrees) with values for the majority of people lying between 3° to 15°.[13] O. Selberg and D. Selberg [14] suggest classifying phase angles greater than 5.4° as normal, in the range 4.4°–5.4° as borderline, and less than 4.4 as abnormal. 6.6 (5.4-7.8)°. According to R. Baumgartner et al.,[15] the mean phase angle for women is 6.3 (4.9-7.7)°.

Statistical analysis was performed using statistical software package SPSS version 17.0 (SPSS Inc, Chicago, IL). The normality of distribution of continuous variables was tested by one-sample Kolmogorov-Smirnov test. Continuous variables with normal distribution were presented as mean (standard deviation [SD]); non-normal variables were reported as median (interquartile range [IQR]) (Me[25-75]). Means of 2 continuous normally distributed variables were compared by independent samples Student's t test. Mann-Whitney U test was used to compare means of 2 groups of variables not normally distributed. PCA (Principal Component Analysis) was used to determine which anthropometric and bioimpedance indicators explained the majority of the observed variations in HBW. The risk coefficients were determined by Bayesian method in modification by Genkin-Gubler for studied indicators.[16] A value of $P<0.05$ was considered significant.

Results and Discussion

Among the study participants, 12 anthropometric and 21 bioimpedance parameters were evaluated. By PCA, from among the measured parameters, 7 were selected as predictors of a HBW. There were 5 anthropometric parameters (BMI, TCD, CC, BC, DT) and 2 bioimpedance parameters (PhA, Xc50).

BMI was calculated according to length and body weight, which averaged 159.0 [156.0; 165.0] cm and 66.7 [59.7; 73.5] kg, respectively. The BMI values of the examined women were 26.20 [23.20; 28.40] kg/m^2. In accordance with BMI, normal weight was found in 39.1% of cases. Excess body weight was determined in 47.3% of women and obesity in 13.6% of cases. We did not find women who were underweight.

The values of TCD, CC and BC were 26.0 [25.0; 27.0] cm, 90.0 [87.0; 94.0] cm, and 98.0 [93.0; 104.0] cm, respectively. Pelvic measurements revealed that DS, DC, DT, and CE were 26.0 [25.0; 28.0] cm, 28.5 [27.0; 30.0] cm, 32.0 [31.0; 34.0] cm, and 21.0 [20.0; 23.0] cm, respectively.

BIA determined that PhA was 5.9 [5.5; 6.2]° and Xc50 – 60.8 [53.2; 67.7] Ohm.

The indicators of the physical development of newborns were as follows: BL– 52.0 [50.0; 54.0] cm, BW – 3,520.0 [3,000.0; 3,750.0] g, CC - 34.0 [33.0; 34.0] cm, and HC – 35.0 [34.0; 35.0] cm.

It should be noted that parameters of BW and BMI in parturient women significantly differed from parameters of the general Yakut female population of the same age group. According to the anatomical and anthropological studies (population research) conducted in the region, BW and BMI of Yakut women (aged between 21 and 35 years) in a non-pregnant state were 59.0±0.6 kg and 23.2±0.2 kg/m^2, respectively.[17] BMI and BW of women in the postpartum period were significantly higher, which is the physiological norm because during pregnancy BW increases due to an increase in the uterus, mammary glands, fatty tissue, etc.[18]

Bioimpedance parameters (PhA, Xc50) also had significant differences from general population indicators. Significantly lower values of Xc50 in puerperal women are probably associated with physiological hydration during pregnancy and in the postpartum period. Thus, TBW in these women was significantly higher than in women in a non-pregnant state: 31.3 [30.0; 34.8] kg vs. 28.2 [26.4; 30.5] kg (P<0.05).[19] The magnitude of PA in puerperal women was also significantly lower, but was within the normal range.

Pelvic (pelvis major) dimensions allow predicting the favorable course of the delivery. Bony pelvis dimensions of all the women we examined corresponded to the standards adopted in obstetrics.[20]

Based on the centile analysis, it was established that for the group of Yakut women that we examined, the mass of the newborn from 3,000 g to 3,750 g was considered normal. The birth weights <3,000 g and >3,750 g were considered as a low birth weight and a high birth weight, respectively.

The most important morphometric and bioimpedance parameters that have prognostic significance for the birth of a child with a high weight (Table 1), have been identified using PCA. Two components were selected. The first component had a calculated weight of 54.828% and included 5 anthropometric parameters. The most significant parameter was BMI, which had a factor load of 0.914. This component included also TDC, CB, CC (factor load from 0.824 to 0.875). Of all the measured pelvic dimensions, DT with a factor load of 0.693 was significant. The second component had a calculated weight of 25.090. It included 2 bioimpedance indices: PhA and Xc50. The listed morphometric and bioimpedancec indicators have prognostic value for FM in Yakut women.

Table 1.

The morphometric and bioimpedance parameters, which have prognostic significance for HBW (PCA)

Component	Eigenvalues		Variable	Factor loadings
	percentage of variance	cumulative percentage		
Component 1	54.828	54.828	BMI	0.914
			TCD	0.875
			BC	0.867
			CC	0.824
			DT	0.693
Component 2	25.090	79.918	PhA	0.984
			Xc50	0.934

On the next stage, we constructed a prognostic table for determining the risk of high birth weight (Table 2). For all the selected parameters, the corresponding prognostic coefficients were computed. The prognostic coefficients with the sign "+" testified in favor of HBW, and with the sign "-" - the opposite.

Prenatal prognosis of the risk of high birth weight was calculated by converting the parameters of the 7 prognostic signs into prognostic factors in accordance with Table 2: the higher the sum of the prognostic factors - the greater the risk of HBW.

Table 2.

Prognostic table for determining the risk of high birth weight

№	Prognostic criteria	Scale	Prognostic coefficients
1	BMI, kg/m^2	1) <18.5	0
		2) 18.5-25.0	-5
		3) 25.0-30.0	+3
		4) >30.0	+2
2	TCD, cm	1) <25.0	-4
		2) 25.0-27.0	-2
		3) >27.0	-6
3	BC, cm	1) <94.0	-3
		2) 94.0 -104.0	0
		3) >104.0	+1
4	CC, cm	1) <86,5	-11
		2) 86,5 – 94,0	0
		3) >94,0	-5
5	DT, cm	1) <30.5	- 2
		2) 30.5 – 34.0	0
		3) >34.0	+5
6	PhA	1) <5.5	+5
		2) 5.5 – 6.5	-2
		3) >6.5	+4
7	Xc50, Ohm	1) <53.6	-3
		2) 53.6 – 69.2	-1
		3) >69.2	+3

The next stage consisted of checking and evaluating the effectiveness of the developed method. The results of a survey of 25 puerperal women and their newborns were analyzed. The expert evaluation showed a reliable prognosis in 23(92%) women.

The conducted research revealed that the anthropometric and bioimpedance indices of Yakut women in the postpartum period (3-4 days after delivery) were significantly different from general population indicators. The parameters of BW and BMI of the puerperal women were significantly higher, and PA and Xc - significantly lower. PCA revealed 7 parameters predicting a HBW: five anthropometric parameters (BMI, TCD, CC, BC, and DT) and two bioimpedance parameters (PhA and Xc50). The obtained data in combination with other indicators can be used to predict the birth of a child with a HBW in Yakut women.

Competing interests

The authors declare that they have no competing interests.

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