

Anthropometric Characteristics and Sexual Differences in Full-term and Preterm Newborns

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The aim of the present work is to describe the differences in the anthropometric characteristics of full-term and preterm newborns and to compare the manifestations of sexual differences in the studied features. From 2001 through 2003 a total of 219 healthy full-term newborns (110 boys and 109 girls) and 60 conditionally healthy newborns with prematurity of the 1st grade (30 boys and 30 girls) have been studied. The data about 43 anthropological features have been analyzed. The full-term boys display statistically significant bigger body sizes than the full-term girls who, however, have amassed a greater quantity subcutaneous fat tissue on the body and extremities. The preterm newborns of both sexes have statistically significant lower values of all investigated features. No significant sexual differences in their anthropometric characteristics have been established. These results allow for the assumption that the crucial prenatal period during which the sexual differences in the anthropometric characteristics of the fetus is formed at the last two months of pregnancy.

Key words: full-term and preterm newborns, anthropometric characteristics, sexual differences.

Introduction

The investigation of the newborns physical development is a key element in monitoring their health at birth [1, 5]. From a medico-biological point of view it is of interest to gain knowledge about the specificity of the problems accompanying the morphological maturation of the body during the last months of pregnancy when the eco-sensitivity of the organism is expected to be increased. From this standpoint the more in-detail anthropological study of alive born preterm could yield important information adding to the knowledge on this issue.

The aim of the present study is to describe the differences in the anthropometric characteristics of the full-term and preterm newborns, and to compare the manifestations of the sexual differences in the studied features.

Material and Methods

A total of 219 clinically healthy full-term babies (38 – 42 g.w.) – 110 boys and 109 girls and 60 conditionally healthy newborns (30 boys and 30 girls) of the 1st grade prematurity defined by a body weight (between 2500 g and 2000 g) and morphological maturation of 34 – 37 g. w. were studied [5]. The investigation was carried out between 2001 and 2003 in the section of Neonatology at 2nd SOGHAT “Sheynovo” – Sofia.

The program of the entire survey includes a great number of directly measurable and derivative anthropometric features – a total of 60. In the present paper the data about 43 of them both in the inter-group and the sexual aspect were analyzed and evaluated. The list of these features is found in the table 1. The units of measurements of the features numbered from 1 to 31 in the table are centimeters, from 32 to 37 and from 40 to 43 – mm, 38 –kg and 39 – index units (IU).

The inter-group and sexual differences are assessed by Student’s t-test ($P < 0,05$). The Index of sexual differences (ISD) was also calculated, the data from which render a possibility for a quantitative comparative estimation of the metric differences between both sexes. The ISD is calculated after the formula: $ISD = (X\sigma - X\varphi) \times 100 / X\sigma$, where $X\sigma$ is the mean value of the respective features for the boys and $X\varphi$ – is the mean value of the same feature for the girls.

Results and Discussion

The generalized analysis of the data about the anthropometric status of the studied full-term and preterm newborns shows that for all 43 features the full-term boys and girls display significantly greater values than the preterm ones.

As an illustration to this result the metric characteristics in both groups of newborns about some of the main anthropometric features are graphically presented.

The data showed in Fig. 1 and 2 illustrate the differences in the cephalometric features, and in Fig. 3, 4 and 5 the ones in the basic body features in the term and preterm newborns. In all six analyzed features the preterm babies of both sexes display significantly lower values. These graphs are also an illustration of the type of sexual differences in both groups of newborns. In the full-term newborns the type of sexual differences is similar to the one found in adults i.e. individuals of the male sex are with greater body and head sizes than the representatives of the female sex. These differences in the preterm babies are either missing or very slightly manifested.

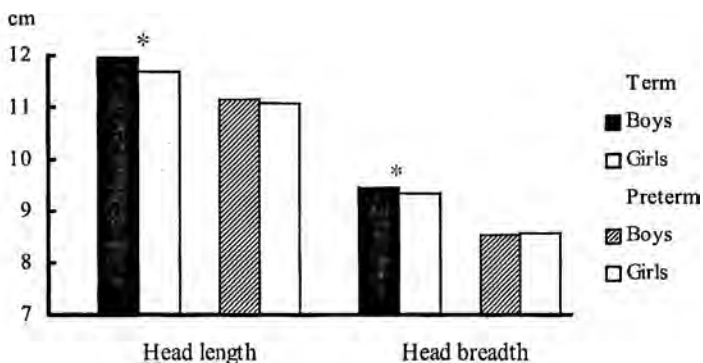


Fig. 1. Head length and breadth

Table 1. Anthropometrical differences between term and preterm newborns

Features	Term				Preterm				T test	
	$\bar{X}\sigma$	$\bar{X}\varphi$	T test	ISD	$\bar{X}\sigma$	$\bar{X}\varphi$	T test	ISD	term σ	term φ
1. Head length	11,97	11,68	5,20*	2,42	11,14	11,08	0,73	0,54	10,48 ^a	7,13*
2. Head breadth	9,46	9,35	2,34*	1,16	8,54	8,56	0,23	-0,23	13,04 ^a	11,61*
3. Head circumference	35,28	34,55	4,57*	2,07	32,31	32,27	0,23	0,12	12,95*	9,96*
4. Stature	50,55	50,13	2,00*	0,83	45,57	45,40	0,44	0,37	16,20 ^a	14,28*
5. Sitting height	34,22	34,06	0,72	0,47	31,75	31,10	2,03*	2,05	8,21 ^b	8,61 ^c
6. Torso length	17,29	17,36	0,56	-0,40	15,34	15,41	0,33	-0,46	10,42 ^a	11,43 ^a
7. Biacromial breadth	11,99	11,80	2,14*	1,58	10,86	10,80	0,39	0,55	8,37 ^b	7,84*
8. Chest breadth	9,41	9,48	0,91	-0,74	8,40	8,51	1,25	-1,31	8,97 ^b	8,93*
9. Chest depth	8,96	8,90	0,84	0,67	7,66	7,71	0,32	-0,65	12,16*	12,65 ^a
10. Waist breadth	10,55	10,53	0,21	0,19	8,51	8,52	0,06	-0,12	14,65*	15,61*
11. Bicristal breadth	8,88	8,76	1,76	1,35	7,61	7,56	0,62	0,66	12,56*	11,40*
12. Bispinal breadth	7,98	7,85	1,91	1,63	7,10	7,08	0,31	0,28	8,56*	9,20*
13. Bitrohanterial breadth	9,37	9,30	0,94	0,75	8,05	8,15	0,95	-1,24	11,85*	11,32*
14. Upper extremity length	21,04	20,72	2,76 ^c	1,52	19,04	18,95	0,57	0,47	11,20 ^c	11,21*
15. Arm length	8,29	8,22	1,00	0,84	7,76	7,82	0,55	-0,77	5,25*	3,82*
16. Forearm length	7,69	7,57	2,10 ^b	1,56	7,05	7,15	0,98	-1,42	7,38*	4,76*
17. Hand length	6,29	6,21	1,55	1,27	5,49	5,49	0,08	0,00	10,14*	9,37*
18. Hand breadth	3,44	3,35	3,84*	2,62	3,04	3,06	0,45	-0,66	10,72*	9,32*
19. Lower extremity length	22,08	22,02	0,60	0,27	19,71	19,68	0,16	0,15	13,79*	14,80*
20. Thigh length	11,16	11,21	0,48	-0,45	9,55	9,67	0,76	-1,26	11,46*	9,72*
21. Calf length	8,34	8,36	0,15	-0,24	7,56	7,70	1,25	-1,85	5,72 ^b	4,69*
22. Foot height	3,30	3,23	2,73*	2,12	3,02	3,02	0,00	0,00	7,41*	4,80*
23. Foot length	7,91	7,80	2,19*	1,39	7,00	7,02	0,28	-0,29	12,91*	9,67*
24. Foot breadth	3,26	3,17	4,11*	2,76	2,86	2,88	0,51	-0,70	12,05*	7,65*
25. Chest circumference	33,44	33,17	1,31	0,81	28,72	29,13	2,00*	-1,43	15,88*	14,30*
26. Waist circumference	32,92	32,75	0,78	0,52	26,99	27,26	0,96	-1,00	18,85*	17,83*
27. Abdomen circumference	29,15	29,13	0,09	0,07	24,45	24,76	1,19	-1,27	13,96*	13,34*
28. Arm circumference	10,66	10,59	0,66	0,66	8,58	8,55	0,35	0,35	13,71*	14,37*
29. Forearm circumference	10,72	10,52	2,19*	1,87	8,78	8,75	0,26	0,34	15,00*	13,65*
30. Thigh circumference	17,18	17,28	0,55	-0,58	13,09	13,57	2,38*	-3,67	15,58*	14,11*
31. Calf circumference	11,68	11,63	0,48	0,43	9,55	9,65	0,93	-1,05	14,58*	12,72*
32. Subscapular SF	4,55	5,00	3,43*	-9,89	3,44	3,57	0,73	-3,78	6,11 ^c	7,35*
33. Triceps SF	4,92	5,19	2,19*	-5,49	3,89	3,97	0,51	-2,06	5,81*	6,55*
34. Forearm SF	5,10	5,27	1,39	-3,33	3,75	4,00	1,55	-6,67	8,31*	7,31*
35. Thigh SF	6,16	6,72	3,48*	-9,09	4,06	4,35	1,69	-7,14	9,23*	10,62*
36. Calf SF	5,80	6,27	3,76*	-8,10	4,21	4,33	0,70	-2,85	8,95*	10,76*
37. Abdomen SF	4,38	4,58	1,88	-4,57	3,40	3,74	2,04*	-10,0	6,51 ^b	5,25*
38. Body weight	3,390	3,290	2,00*	2,95	2,285	2,287	0,06	-0,09	15,51*	13,96*
39. BMI	13,23	13,04	1,35	1,44	11,02	11,10	0,48	-0,73	13,31*	13,30*
40. SFT tors	8,94	9,58	3,04*	-7,28	6,84	7,32	1,69	-7,65	7,24*	9,34*
41. SFT upper extremity	10,02	10,46	1,89	-4,39	7,63	7,97	1,14	-4,59	8,54*	9,42*
42. SFT lower extremity	11,96	12,99	3,78*	-8,61	8,28	8,67	1,40	-5,22	12,69*	14,65*
43. Sum of 6 SF	30,92	33,03	3,17*	-6,82	22,75	23,96	1,51	-5,74	10,21*	12,17*

* Statistically significant differences in $P < 0.05$

The data about the adult population are supplied by the National Anthropological Study on Bulgarian Population carried out by the Department of Anthropology – BAS [2, 3, 4].

The metric data on the thickness of the subcutaneous fat tissue (SFT) are presented in Fig. 6. In these features, the preterm newborns have smaller thickness of all skin folds (SF), and respectively of the total quantity of SFT, compared with the term newborns. In the sexual aspect the full-term girls have significantly thicker skin folds than the boys like in the adults. In the preterm newborns the sexual differences show the same tendency but they are exceptionally slightly expressed.

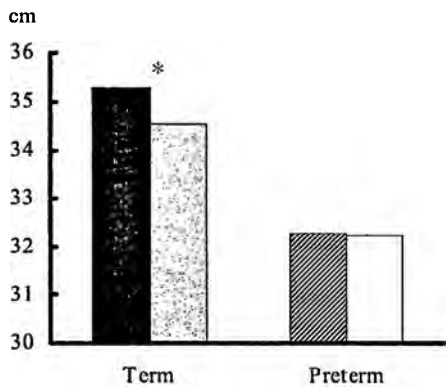


Fig. 2. Head circumference

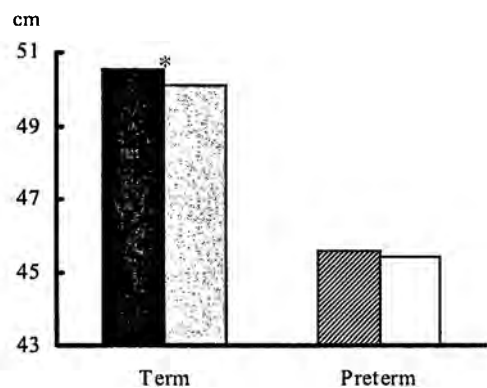


Fig. 3. Stature

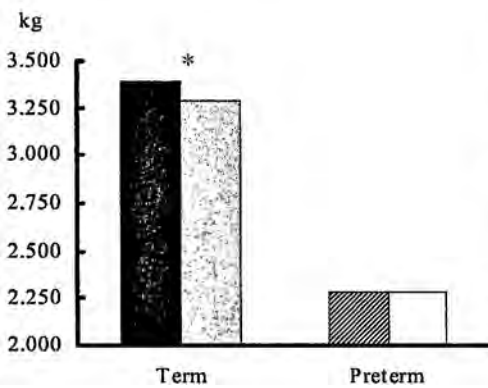


Fig. 4. Body weight

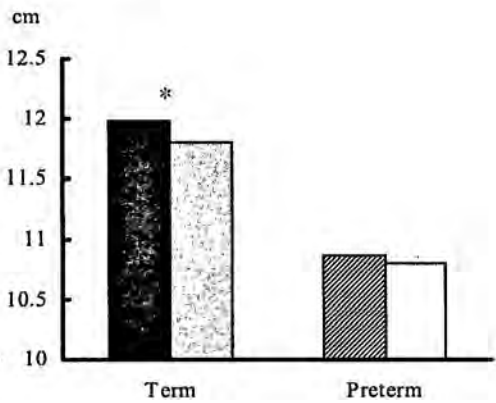


Fig. 5. Biacromial breadth

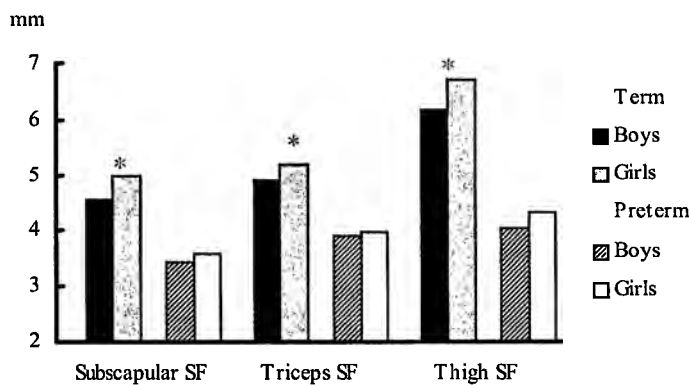


Fig. 6. Skin folds

The main accent in the present work is the quantitative comparative assessment of the anthropometric sexual differences in term and preterm newborns. The general analysis of the data about the statistical significance of the expressed sexual differences demonstrates the strength of these differences emphasizing their biological importance. In the

full-term newborns in 20 out of the 43 features the sexual differences are statistically significant. The full-term boys, compared with the full-term girls display a markedly bigger stature and head size, wider shoulders, more massive hand and foot and less SFT on the body and extremities.

In the preterm newborns the sexual differences are statistically significant only in four features but their biological meaning dose not gives grounds to make conclusions for some regularity at this stage of the study. The anthropometric sexual differences in the preterm babies are minimal or missing in all other features.

The ISD data give a notion of the character of the sexual differences in both groups of newborns and at the same time they illustrate the differences in the size of the manifested sexual differences between the full-term and the preterm newborns.

In the figures with the ISD data the zero value illustrates the absence of sexual differences; the values with a positive sign illustrate the priority of the boys and those with a negative one – for the girls.

The figures 7, 8, 9, 10 and 11 present the quantifying expressed intensity of the sexual differences. In the full-term newborns the sexual differences in the 26 of features are over 1 IU, as in the body nutritional status indexes gain even up to 10 IU. In the preterm newborns, the 20 features are with ISD values over 1 IU. Even in these features the ISD values are significantly lower than those in the full-term newborns.

Figure 7 illustrates the most informative model for a comparative evaluation of the manifestations of the sexual differences in term and preterm newborns. The data from ISD show statistically significant sexual differences for the stature, head sizes and body weight with prevalence for the boys in the full-term newborns. The curve of the sexual differences in the preterm newborns approaches to the zero line.

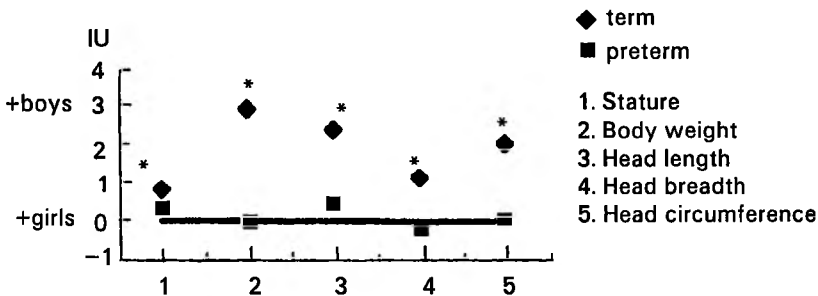


Fig. 7. Sexual differences of basic body and head measurements, according to the ISD data

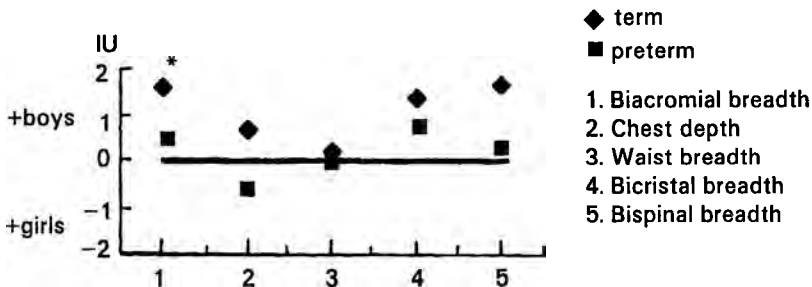


Fig. 8. Sexual differences of body diameters, according to the ISD data

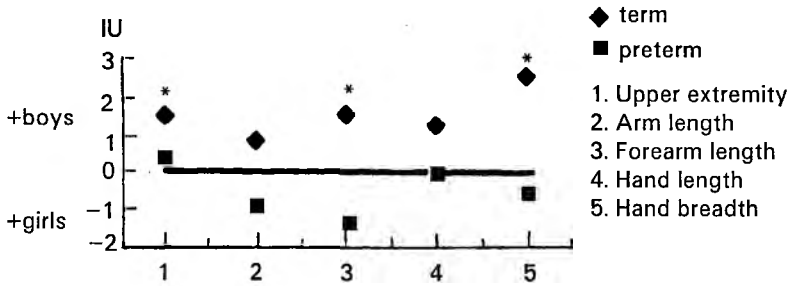


Fig. 9. Sexual differences of upper extremity lengthwise – widewise dimensions, according to the ISD data

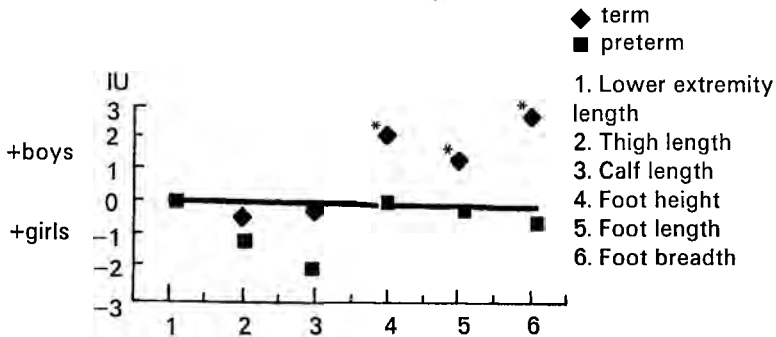


Fig. 10. Sexual differences of lower extremity lengthwise – widewise dimensions, according to the ISD data

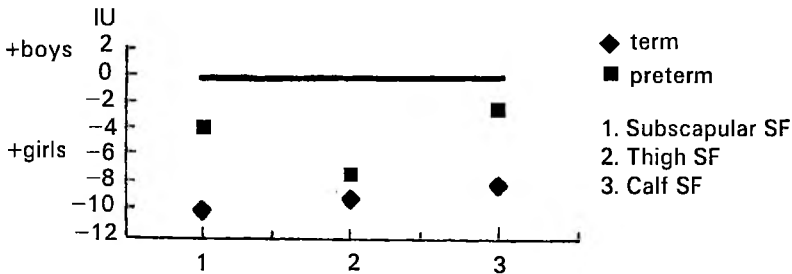


Fig. 11. Sexual differences of skin folds thickness, according to the ISD data

The ISD data about body diameters show that the full-term newborn boys have more massive bones compared with the girls and in the preterm newborns the ISD values are around zero (Fig. 8).

From the length-breadth sizes of the extremities (Fig. 9 and 10) the characteristics of the hand and foot massiveness give more complete information about the specificity of the sexual differences. In the full-term newborns ISD for these features is with values between 1,5 and 3 IU with prevalence for the boys and in the preterm ones ISD is with minimum values – between 0 and 0,5 IU.

In Fig. 11 are presented the sexual differences in three of the studied skin folds which give indirect information about the body nutritional status type too. The full-term girls display a significantly greater SFT than the boys, as the sexual differences in the

adults are. In the preterm newborns the differences between both sexes show the same tendency but it is only slightly outlined without the sexual differences reach statistical significant level.

Conclusions

The results from the present study show that the full-term boys display significantly bigger sizes of the head, of the body features – stature, body weight, shoulder breadth and more massive hand and foot while the full-term girls have greater thickness of SFT on body and extremities.

Even at birth in the full-term newborns are marked the specific characteristics of the male and female type of body constitution.

The preterm newborns of both sexes are with statistically significant lower values for all studied features. Biologically significant sexual differences in their anthropological status have not been found in them. This result show that in the babies born two months before term the main anthropometric criteria for sex related differences in their body constitution are not expressed.

The results obtained in the present study raise the question: Is it correct to assume that the intersexual differences in the features defining the male and female anthropometric status type are formed most intensive mainly in the last two months of pregnancy? This is a question, whose comprehensive answer could be obtained by future complex studies performed by more experts.

References

1. Gerver, W. J. M., R. De Bruin. *Pediatric Morphometrics*. Utrecht, Netherlands, 1996.
2. Nacheva, A., Y. Yordanov. Anthropometrical nutritional status of adult Bulgarian population at the end of the 20th century. – *Acta morphologica et anthropologica*, 8, 2003, 84-90.
3. Yordanov, Y., A. Nacheva, S. Tornyoova. Physical development and blood pressure in adult Bulgarian population at the end of the 20th century. – *Acta morphologica et anthropologica*, 6, 2001, 76-89.
4. Yordanov, Y., A. Nacheva, S. Tornyoova, N. Kondova, Z. Filcheva, Ts. Kazakova, L. Kavgazova, R. Stoev, B. Dimitrova, E. Lazarova, D. Topalova, L. Gelkova. Basic anthropometrical data of Bulgarian people at the end of the 20th century. – *Journal of anthropology*, 2, 1999, 15-28.
5. Бобев, Д., Е. Генев. *Педиатрия*. 2000.