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SOMATIC DIFFERENCES AMONG THE CATEGORIES OF WOMEN DETERMINED THROUGH CLUSTER ANALYSIS OF THE PELVIC DIMENSIONS

ABSTRACT — *Clinical anthropology (in obstetrics) concentrates on the study of external somatic characters of the mother and her newborn child, on prenatal development and on influencing this development. In line with this orientation of clinical anthropology have arisen a more or less independent sub-discipline, the so-called anthropology of maternity (see Doležal, Gutwirth, 1977). Within its framework we made an attempt to apply the somatic characteristics of the woman in the auxiliary diagnostics of pregnancy and delivery. We paid special attention to the pelvic region. From several possible approaches we have chosen a method based on the typologization (categorization) of women according to their somatic characters.*

According to the external pelvic dimensions we determined three categories of women through cluster analysis. Of great importance for the above categorization are the direct and transverse diameter of the pelvic passage, length of the sacrum and conjugata externa (respectively the distance between the anterior and posterior spine).

Women in the individual categories differ not only in the configuration of pelvis (namely in pelvic height determined by the length of os sacrum and with the relative proportions of the diameters of the pelvic passage), but they differ also in body height, mass, length, width and girth dimensions of the trunk and limbs. Among the categories there were important differences in the weight of newborn children and differences in various parameters were recorded also in the course of gravidity and delivery.

KEY WORDS: *Pelvis — Anthropometry — Cluster analysis — Pregnancy and delivery.*

INTRODUCTION

The bodily and psychical health of the adult are greatly influenced during the first months and years following his birth, and before, during his intrauterine life, and even earlier, where various genetic influences start to bear their influence. The most important research branches and the scholars active in these branches are well aware of these facts. One of the basic problems in this field is the prenatal development of man and the influencing of this development (Houšťek et al. 1982 and others). Besides the related medical branches (especially obstetrics) also other scientific disciplines must take their share in studying these problems. One of these branches is clinical anthropology and its more or less independent part

the so-called anthropology of maternity or reproduction anthropology.

This paper comprises the results of our research into "healthy" or "normal" pregnancy, up to recently the main subject of interest of the anthropology of maternity. We tried to make use of the anthropological methods also in obstetrics, namely we tried to apply the somatic characters in the auxiliary diagnostics in the course of pregnancy and delivery. We paid special attention in these studies to the pelvic region.

The relation of somatic characters and of obstetrical variables can be studied in various ways (correlation of the individual characters, method of combination squares, discriminative analysis in selected groups, typological methods — for more details

see Blažek, 1981; Blažek et al., in print). We analysed the suitability of these ways and chose the method based on the categorization (typologization) of women according to their somatic characters.

THE METHOD AND THE SAMPLE

The research covered 178 Prague women in the 18–42 years age bracket. Their mean age was 25.8 years. All women we examined completed the 36th week of their pregnancy. No other criteria were used for the selection of probands.

32 anthropometric characters were measured, 10 of them regarding the pelvis (see below) and a number of indices and correlations were calculated. The selection of the most important diameters and indices can be seen in Tables 1 and 2 (for more details see Blažek, 1981). A total of other health characteristics and hints on the state of health and on the conduct of life before pregnancy, during pregnancy and delivery were taken from the personal histories, obstetric records and pregnant women's passes.

A critical analysis of the applied somatological methods (for a brief survey see e.g. Correnti, 1979; Blažek, 1985) on the basis of the conception of so-called natural (real) partial types (Vácha, 1980), and the experience with the categorization of the human stature (Doležal et al., 1976, 1977; Titlbachová et al., 1979) have brought us to the application of the methods of numerical taxonomy and to the categorization of women according to their external pelvic dimensions (further pelvic category). The categorization was realized with the method of cluster analysis, checked with discriminative analysis according to the library of the BMDP programmes (Dixon, Brown, 1977). As input variables nine external pelvic dimensions were used: the bi-cristal (ic-ic), bi-spinal (is-is) and bi-trochanteral (tro-tro) width, the distance between anterior and posterior spines (is-isp) and the distance between both posterior spines (isp-isp), conjugata externa (lu-sy), direct and transverse diameter of the pelvic passage and the length of os sacrum, measured as the distance between the first spine-like process and the connection between os sacrum and coccyx; and also the pelvic inclination measured by a clinometer.

Of decisive importance for this categorization are the following characters: the distance between the anterior and posterior spines, length of the os sacrum, transverse and direct diameter of the pelvic passage. (For detailed description see Blažek, 1981; Blažek et al., in print.) Finally the probands were divided into three groups, marked as pelvic category A (64 women, i.e. 36.0 % of the sample), category B (22 women, 12.4 %) and category C (79 women, 44.4 %). The rest of the examined mothers (i.e. 13 women) were not attached to any of the above categories.

In the further phase the basic statistic data for all metric characters, indices and combined personal histories, obstetric data, frequency of the occurrence of alternative characters of the A, B, and C categories were calculated. Then we studied the importance of differences with the help of T-test, according to the character of the variables.

DESCRIPTION OF THE PELVIC CATEGORIES

Women belonging to pelvic category A reached the lowest body height, while those belonging to category C are the tallest. Women in category B are closer to category C (see Table 1). The length of lower limbs (expressed by the height of the upper edge of the symphysis above the ground) does not show big differences — categories A and C differ minimally. The lower limbs of the woman of category B are shorter. The length of the front wall of the trunk decreases by 1 cm differences in the order of B, C and A categories, while the probands belonging to the last group (A) differ considerably from the first two; the difference between categories B and C is also significant.

Bi-acromial breadth is smallest in category A, significantly differing from category C. Both chest diameters are significantly the smallest in the A category. Women of the B category have the deepest abdomen depths, followed by category C, while women of the A category have the smallest abdomen depths; all these differences are statistically rather significant.

With the exception of the distance of posterior spines, but including the inclination of the pelvis, they differ at least significantly (but in most cases highly significantly). This holds for women of the A and B categories, and without exception the women of the A and C categories. The women of the B and C categories differ highly significantly in the dimensions of conjugata externa, transverse passage of the pelvic passage and the length of os sacrum, and significantly in the direct pelvic passage. Women of category A have the smallest pelvic breadth and depth dimensions, the os sacrum is somewhat longer than is the case with women in category B. Their pelvic inclination is smaller. The question is, to what extent are influenced the smaller pelvic dimensions of this group by the smaller body height and to what extent are they a typical character? Categories B and C differ irregularly: the bi-cristal breadth, distance of the posterior spines and the distance between the anterior and posterior spine are practically identical, the bi-spinal and bi-trochanteric breadth, conjugata externa and the transverse diameter of the pelvic passage are only slightly smaller than in category C; the latter differs with the smaller direct diameter of the pelvic passage, and even more significantly with the longer os sacrum.

The differences between the values of the arch of the front wall of the trunk are considerable: the smallest differences are in women of the A category, the largest in B category (the difference amounts to 6.5 cm). There are mostly highly significant differences also in the girth dimensions, and it holds also here that the lowest values are reached by the women of the A category, while women in category B boast the largest values. In line with the girth dimensions the women belonging to category A have the lowest body mass among the three categories both before pregnancy and also before delivery and the lowest weight increase was measured also in this group. The highest values are reached in women of category B. As to mass data

TABLE 1. Values of selected somatic characters of the group as a whole and the individual pelvic categories

Body dimension	The group as a whole (n = 178)		Category A (n = 64)		Category B (n = 22)		Category C (n = 79)	
	X	s	X	s	X	s	X	s
Body height	164.03	6.72	162.83	6.97	164.23	6.63	165.13	6.72
Bi-cristal breadth (ic—ic)	27.25	1.63	26.72	1.74	27.64	1.82	27.59	1.35
Bi-spinal breadth (is—is)	24.99	1.74	24.54	1.88	25.70	1.49	25.12	1.46
Bi-trochanteral breadth (tro—tro)	33.13	1.92	32.42	1.74	33.84	1.71	33.43	1.85
Distance between posterior spines (isp—isp)	9.81	0.92	9.51	0.82	9.94	1.14	9.94	0.83
Distance between anterior and posterior spine (is—isp)	17.44	1.26	16.78	0.86	17.88	1.20	17.69	1.21
Conjugata externa (lu—sy)	21.08	1.07	20.60	0.91	21.86	0.83	21.25	1.09
Direct diameter of the pelvic passage	16.19	1.49	15.61	1.26	17.10	1.70	16.25	1.26
Transverse diameter of the pelvic passage	10.34	0.83	9.89	0.59	10.33	0.44	10.72	0.70
Length of os sacrum	7.56	0.92	6.97	0.60	6.69	0.53	8.21	0.74
Pelvic inclination (in grades)	39.89	3.38	38.73	3.47	40.64	3.27	40.16	3.83
Weight before pregnancy	59.58	8.19	56.41	7.25	63.64	8.69	60.51	7.57
Weight before delivery	73.95	9.02	68.96	8.13	79.75	7.15	75.36	7.73
Length of the upper limb (a—da)	71.89	3.49	71.24	3.51	71.35	3.06	72.59	3.60
Length of the lower limb (height of sy above the ground)	80.25	4.93	80.14	4.99	79.14	3.85	80.87	5.26
Length of the front wall of the trunk (sst—sy)	51.30	2.21	50.52	2.24	52.50	1.80	51.55	1.97
Bi-acromial breadth (a—a)	35.01	1.80	34.68	1.67	35.04	2.06	35.26	1.81
Transverse diameter of the thorax	27.16	1.80	26.62	1.61	27.75	1.69	27.36	1.87
Sagittal diameter of the thorax	19.21	1.46	18.67	1.32	19.78	1.61	19.38	1.39
Depth of the abdomen (lu—om)	29.88	2.10	28.27	1.31	32.17	1.24	30.20	1.38
Bulging of the trunk front wall	63.00	3.43	60.39	2.43	66.98	2.12	63.78	2.40
Thorax girth	89.36	5.14	87.16	5.34	92.32	5.17	89.96	4.29
Umbilical girth	100.37	6.40	96.96	4.48	106.77	5.69	102.66	4.73
Gluteal girth	101.57	6.38	98.36	5.22	105.00	6.23	102.44	5.61
Thigh girth	56.62	4.40	54.75	4.09	58.34	4.05	57.20	4.05
Calf girth	36.18	2.56	35.33	2.36	37.02	2.85	36.45	2.30

there are highly significant statistical differences between category A on the one side, and the two other categories, on the other; the latter differ significantly only in pre-delivery weight.

As regards Rohrer's index of body fullness, the first place is occupied by category B, the women in the other two categories differ only minimally. There is significant difference between categories A and B. All three groups of Prague mothers differ significantly in the values of Fetter's index of abdomen bulging and in the thoracic index, with the lowest values measured in women of category B, the highest in category A. Significant differences were detected also in other indices expressing the relative proportions of the stature as a whole. Women of category A differ more from women of category B, the difference is smaller between categories B and C, and less significant between categories A and C. For detailed results see table 2.

The index of the pelvic passage is lower in women belonging to category B and is highest in women in the C category, and category C differs significantly from the two other categories. The women in category B have a relatively larger direct diameter of the pelvic passage as compared with transverse passage as compared with women of the C category. The length-width index of os sacrum (calculated from the length of os sacrum and from the distance of the posterior spines) is conspicuously the highest in women category C and is lowest in mothers of the B category; however, the differences among all three categories

are statistically highly significant. Women of category C have thus not only absolutely, but also relatively the longest os sacrum.

Other differences among the categories of women according to their external pelvic dimensions were found in the relations between the individual characters, expressed by correlation coefficients. Similarly, in line with the differences at the correlations we found differences in the saturation of the individual factors among the described pelvic categories (for details, including documentation in tables, see Blažek, 1981).

The above pelvic categories were used for finding out the relation among somatic characters and the parameters of the course of pregnancy and delivery, including the conduct of life. From a large number of the followed characters significant differences were discovered in the following ones:

Women of category A, characterized namely by smaller dimensions and relatively broader os sacrum, have the lowest blood pressure before delivery, swellings are very rare in this group the third parturition time is longer, the use of obstetrical forceps in this group is rarer, most frequent is the turning of umbilical cord and the weight of the newborn is lower.

In women of category B (with the highest pelvic passage diameter and conjugata externa values and with lowest index values of the pelvic passage) was the highest occurrence of secundigravidity, lower frequency of racing or intense sporting activities before pregnancy, but higher reaction activity in gra-

TABLE 2. Values of selected indices for the group as a whole and the individual pelvic categories

Index	Group as a whole (n = 178)		Category A (n = 64)		Category B (n = 22)		Category C (n = 79)	
	X	s	X	s	X	s	X	s
Rohrer's index	1.35	0.19	1.31	0.20	1.45	0.26	1.35	0.15
Quetelet's index	2.22	0.28	2.13	0.27	2.37	0.36	2.22	0.22
Thoracic index	70.86	5.24	70.26	4.91	71.37	5.08	71.06	5.64
Fetter's index	81.58	4.18	83.72	3.59	78.42	2.70	80.89	3.18
Index of the length of the trunk's front wall to body height	31.29	1.12	31.04	1.08	31.98	0.83	31.24	0.96
Index—upper limb to body height	43.83	1.24	43.75	1.21	43.46	1.32	43.96	1.28
Index—length of lower limb to body height	48.89	1.51	49.18	1.43	48.18	1.08	48.94	1.64
Index—biacromial breadth to body height	21.36	1.05	21.32	1.04	21.35	1.22	21.37	1.04
Index—gluteal girth to body height	61.99	4.20	60.50	3.87	64.04	4.70	62.10	3.60
Pelvic passage index	64.26	6.63	63.75	6.48	60.99	6.63	66.31	6.05
Length-breadth index of the os sacrum	77.49	10.51	73.68	7.70	68.06	8.58	83.04	8.51

vidity further this group has the highest blood pressure before delivery, higher occurrence of gull-bladder diet, frequent pains during coitus, low frequency of the turning of navel cord, the lowest number of baby-boys.

Among women with typically long os sacrum and higher pelvic passage index value (category C) there is a very high number of primigravids and primipars, higher is the frequency of racing and sporting individuals, more frequent are the pains in the region of os sacrum and of lower abdomen during gravidity, pains of the symphysis to touch, better appetite, less frequency pains during coitus, shorter third parturition time and higher occurrence of the use of obstetrical pincers (Blažek, Doležal, Titlbachová, 1985).

DISCUSSION

We compared the mean values of the results of the tests realized with a group of pregnant women in Prague with similar researches into the same population (Hellerová, 1974, 1976; Doležal et al., 1976; Kozlová, 1978; Brůžek, 1983). Our sample does not show practically any differences in most dimensions (comparable with the character of the sample, since the individual researches cover groups of women after interruption, before delivery, after delivery, after child-bed, etc). The only exception is the upper edge of symphysis, which is the lowest in our case. We hold that it is due to the influences of the detection of certain anthropometric points and also of the values of certain dimensions (Blažek, 1984).

Body weight before gravidity (respectively at its beginning) corresponds to lower data, while the weight before delivery to higher ones. The growth of weight is thus higher. We would like to point out that the weight before gravidity was taken from the personal history or from the cards for gravid women, and this can be the cause of the above differences.

The pelvic categories were determined according to dimensions not used either by the obstetric or by the anthropological practice, e.g. distance between

the anterior and posterior spine, the length of os sacrum, direct and transverse diameter of the pelvic passage. The discriminative analysis used for checking the correctness of the categorization of the individual probands used the Baudelocque diameter instead of the distance between the two spines. We hold that the two dimensions are roughly of the same value as for the description of the pelvis. We would like to stress that the breadth dimensions of the large pelvis were of no importance for the characterization and categorization of the pelvis. According to the results of the discriminative analysis 77.6% of the probands were correctly categorized; this result can be regarded as satisfactory in view of the homogeneity of the group.

The classification of the pelvis on the basis of external pelvic dimensions is evidently the result of the evaluation of two character complexes. The first describes part of the large pelvis (together with the sacroiliac region), the other is characterized by the dimensions of the pelvic passage. It seems that here we have to do with the influence of two relatively independent sub-systems. We can call thus the attention to certain similarity with the top and bottom segment according to Coleman (1969), or with the sacroiliac and ischiopubic segment according to Novotný (1981). The classifications of the pelvis as known from the literature do not enable comparison with our results, since they are based on the morphology of the bony pelvis, often with an emphasis on the pelvic passage (e.g. Caldwell, Moloy, 1933; Morton, Hayden, 1941, etc.).

The size of the group fully sufficed for the anthropometric determination of categories and dimensions characterizing it. The number of probands with an incidence of certain pathological finding or with other characteristic feature were sometimes too small for finding out the relation of the given parameter to the given categories. Application in obstetrics requires checking a substantially larger group. Nevertheless, some characters seem to prove our finds; this applies namely to the body weight of the newborn, to parity, i.e. to the proportion of the two sexes in the newborn children, blood pressure prior to delivery, swellings

and pains during pregnancy. In other differences among the individual categories of the pelvis we have to take into account the influence of the individual oscillations.

CONCLUSIONS

The authors concentrated on studying the possible application of the methods of numerical taxonomy for the categorization of women and with its help they tried to define the relation of somatic characters and characteristics in the course of pregnancy and during delivery, with special regards to the possible application of the methods for diagnosis in obstetrics. With the help of cluster analysis they set up three categories of women according to the external pelvic dimensions. The two diameters of the pelvic passage, the length of the os sacrum and of conjugata externa are essential for the categorization of the pelvis.

Women of pelvic category A have the smallest breadth and depth dimensions of the pelvis and have also the lowest pelvic inclination. These women are of lower body height and have also a number of other lower somatometric characters. The length-breadth index of the os sacrum is the lowest in this group of women (i.e. they have relatively wider os sacrum).

The women of category B have the highest value of the direct diameter of the pelvic passage, but also of the transverse passage and depth. As regards the other pelvic dimensions and some body dimensions, they are closer to category C. However, they have the shortest lower limbs, but the larger girth diameters and body weight. Their pelvic passage index is the lowest.

Women of pelvic category C have conspicuously long os sacrum, they are the tallest among the three groups and have the longest limbs. The other dimensions are between the values of category A and B, or are slightly above the values of category B. The index of pelvic passage, as well as the length-breadth index of the os sacrum is the highest on the average (having relatively broader transverse pelvic diameter and relatively longer os sacrum).

The authors mention also the difference in certain characteristics in the course of delivery and pregnancy (e.g. the weight and sexual parity of the newborn, blood pressure before delivery, swellings and pains during pregnancy).

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