

V. A. Yemialyanchyk

THE MEDIEVAL POPULATION OF POLOTSK ACCORDING TO THE ANTHROPOLOGICAL DATA

The aim of this study was to analyze human skeletal remains from 13th—14th centuries burials discovered in the territory of the Lower Castle in Polotsk, Belarus. The article deals with morphological characteristics of medieval urban population, mortality levels and skeletal stress indicators such as cribra orbitalia.

Keywords: Polotsk, 13th—14th centuries, craniology, paleodemography, cribra orbitalia.

Introduction. Polotsk (Polack) is one of the oldest city of Belarus and eastern Slavs. The first annalistic mention of Polotsk dates back to 862. In the 9th century Polotsk was a tribal center of the Polotsk Krivichi. During this period, Polotsk was well known to the Scandinavians under the name *Pal(l)teskia*, *Pallteskioborg*. In the 10th—11th centuries, Polotsk became the center of the Principality of Polotsk, in which its independent princely dynasty rules. Unlike other Kievan Rus cities, in the 13th century Polotsk did not experience the invasion of the Mongol-Tatars and Crusaders. At the beginning of the 14th century Polotsk became part of the Grand Duchy of Lithuania. For a long time Polotsk became an important outpost in the north of the state, with the help of which the great princes of Lithuania spread their influence to neighboring Russian lands, and also fought against the Livonian Order.

Systematic anthropological studies of the ancient population of Polotsk have been carried out since 2005. In the course of many years of archaeological research which are carried out on the basis of Polotsk State University, a representative osteological collection was obtained, including materials from urban burials, dated mainly from the 17th—18th centuries. The results of a comprehensive anthropological study of these

materials are reflected in a number of publications (Емельянчик 2012; Vorutskaya, Vasilyev, Yemialyanchyk 2015).

In 2014, as a result of archaeological excavations at the foreland of the Lower Castle in Polotsk, which were conducted under the guidance of D. V. Duk and A. L. Kots, for the first time materials on the medieval population of Polotsk dated to the 13th—14th centuries were obtained. An anthropological study of these materials allows us to trace the characteristics of the formation of Polotsk population in the Middle Ages, to determine the nature of the relationship between urban and rural populations, to characterize the living conditions and general health status of Polotsk population in the Middle Ages.

Material and methods. Osteological series of the 13th—14th centuries from the territory of the Lower Castle in Polotsk is characterized by a mixed sex and age composition and is represented by skeletons of various degrees of conservation, which belonged to at least 61 individuals, including 12 subadults and 49 adults (24 males, 12 females, the gender of 13 individuals was not determined due to the fragmentary preservation of the skeletons). Subadults' remains make up about 19.7 % of the total number of those buried, which most likely indicates an underestimation of children's burials, due to the worse preservation of poorly mineralized children's bones.

Sex and age were determined using standard methods. Sex was determined based on an assessment of the structural features of the skull and pelvic bones characteristic of men and women. When determining the adult age estimation, the extent of cranial suture closure combined with the degree of tooth wear was taken into account. The age of subadults skeletons was determined

based on the degree of dental formation according to the Ubelaker's scheme (Ubelaker 1989, p. 64), the degree of ossification of different parts of the skeleton, as well as on the basis of a morphological criterion that takes into account bone size and maturation (Piontek 1996, p. 143). The sex and age determination results were used for paleodemographic analysis. When constructing life tables, the concept of a conditionally stationary population was used. The average age of death was calculated by multiplying the average of each age class by a fraction of this class. The average of the first age category (15—20 years) was taken equal to 17.5 years; the average of senile age was taken equal to 52.5 years respectively.

Measurement of craniological material with subsequent calculation of angles and indices was carried out using a standard technique (Алексеев, Дебец 1964). To evaluate the obtained indicators, tables of craniometric constants were used (Алексеев, Дебец 1964, p. 112—127). The reconstruction of the intravital body length was carried out on the basis of the measurement data of long bones according to the Trotter and Gleser method (Piontek 1996, p. 180—182).

The severity of *cribra orbitalia* (porosity and hyperostosis of the superior wall of the orbit) was estimated according to the Nathan and Haas scale: 1) *porotic type* consisting of isolated small pores on the bone surface; 2) *cribrotic type*, in which the pores are large and conglomerate, but still preserve their individuality; 3) *trabecular type* where the apertures have become confluent, and the bone remaining between them has been converted into a network of trabeculae (Nathan, Haas 1966, p. 351). The statistical significance of the intergroup differences in the occurrence of the trait was checked using the χ^2 test.

Research. Craniological study. Males. The state of skeletal material preservation allowed the measurement of 18 male skulls (table 1). The total series of male skulls is characterized by mesocrany, large longitudinal and average transverse diameter of skull in combination with high brain case. The face is average — in terms of absolute dimensions and upper facial index, orthognathic, well-profiled in horizontal plane with insignificant flattening at the level of orbits. The orbits are of average breadth and low — in terms of absolute dimensions and orbit index. The nose is characterized by average size of piriform aperture and high nose bridge.

As for the individual variations in the brain shape, eight out of 17 male skulls are characterized by dolichocrania, eight have a mesocranic form, and one is brachycranial. Inside the male sample, there are skulls with both a narrow and a wide (in by-zygomatic diameter) face. A variation in the height of the face is also observed: 4 skulls have a high and very high face, 5 skulls have a low face, and the rest are medium in height. According to the upper facial index, 5 skulls belong

to the category of narrow-faced, 2 skulls — to the category of broad-faced; the remaining 7 have a face of medium width. According to the face profile index, most skulls are orthognathic, one is mesognathic, and one of the skulls is characterized by prognathism.

Despite the revealed variability of craniological signs, most of the standard deviations of the sample of male skulls are within the standard values (Алексеев, Дебец 1964, p. 123, 124), except for the face base length, the upper facial height and orbit height, the nose breadth and height.

Females. The state of skeletal material preservation allowed the measurements of only 7 female skulls (table 1). In almost all indicators of the cerebral and facial parts of the skull, as well as in the angles of horizontal profiling, the female sample is similar to the male one. Like the men's, the women's series is characterized by mesocrania with large sizes of the longitudinal and altitudinal diameters of the skull, and medium — transverse, orthognathic, face average on the upper facial index. As in men, the face is slightly flattened at the level of the orbits, and is strongly profiled at the level of the cheekbones; the nose protrudes well, as evidenced by the high values of the dacrial and symotic indices.

Some differences between the female and male samples relate only to certain size categories. If in the male sample all sizes of the facial skeleton are classified as medium, then in the female sample, most of the absolute sizes (malar diameter, upper facial breadth, and upper facial height) belong to the category of large values.

Individual variations of the female sample are presented as follows: of 7 skulls, two are characterized by dolichocrania, three skulls have a mesocrane shape, and two have a brachycranial shape. According to the upper facial index, one skull belongs to the category of narrow-faced, the remaining three to the category of medium-faced. According to the index of the face protrusion, most skulls are orthognathic, mesognathism is marked on one skull.

The similarity of the signs of the neurocranium and viscerocranium of the skull, as well as signs characterizing the profile of the face and the degree of protrusion of the nasal bones, allows us to state the anthropological proximity between the female and male samples.

Comparison of a series of male skulls of the 13th—14th centuries from Polotsk with a chronologically close series of rural burial mounds of the 11th—13th centuries from the territory of Polotsk Land showed significant similarities in most absolute sizes (Емельяничук, Шипило 2018, p. 20—22). The Polotsk series of the 13th—14th centuries naturally differs from the rural series of the 11th—13th centuries in higher skull index, which reflects the beginning of the epochal process of brachycephalization in the later Polotsk populations. In addition, Polotsk series of male skulls is

Table 1. Average sizes and indices of male and female skulls from the 13—14th centuries burial in Polotsk

No, according to Martin	Trait	Males, 18			Females, 7		
		N	M	S	N	M	S
<i>Neurocranium</i>							
1	Longitudinal diameter	18	186.4	6.3	7	179.1	3.7
8	Transverse diameter	17	140	4.6	7	138.6	6.4
5	Skull base length	17	104	4.8	5	102.0	3.7
9	Breadth frontal minimum	18	98.3	4.4	7	97.4	2.2
10	Breadth frontal maximum	18	119.3	3.9	7	120.6	5.4
12	Occipital breadth	17	109.2	4.6	7	106.3	3.0
17	Height diameter	17	137.8	4.3	6	138.2	4.4
<i>Viscerocranium</i>							
45	By-zygomatic diameter	14	132.6	4.5	6	127.5	4.1
43	Upper facial breadth	18	105.7	4.2	7	104.0	3.1
46	Medium facial breadth	17	95.5	4.5	4	90.8	4.2
40	Face base length	16	100.1	6.7	5	96.4	4.9
48	Upper facial height	17	71.7	4.7	5	68.8	4.3
51	Orbit breadth	17	42.5	1.4	5	41.2	2.1
52	Orbit height	17	31.7	2.4	5	33.6	2.9
54	Nose breadth	16	25.7	2.1	5	24.0	1.6
55	Nose height	17	51.4	3.6	5	50.2	3.3
DC	Dacrial breadth	15	22.0	2.2	5	21.4	0.6
DS	Dacrial height	15	12.1	1.5	5	11.3	1.2
SC	Symotic breadth	16	9.5	1.9	5	9.7	0.8
SS	Symotic height	16	4.6	1.1	5	4.7	1.4
<i>Indices</i>							
8 : 1	Skull index	17	75.3	3.5	7	77.4	4.5
40 : 5	Face profile index	16	96.0	3.0	5	94.6	4.7
48 : 45	Upper facial index	14	54.0	3.7	4	53.6	3.2
52 : 51	Orbit index from mf.	17	74.6	5.3	5	81.6	6.9
54 : 55	Nose index	16	50.4	4.5	5	47.9	3.4
DS : DC	Dacrial index	15	55.5	7.5	5	52.9	6.4
SS : SC	Symotic index	16	48.2	9.5	5	48.1	12.8
<i>Horizontal profiling angles</i>							
77	Nasomalar angle	17	140.0	3.4	5	140.6	4.2
zm	Zygomaxillar angle	15	122.8	3.9	4	122.9	2.1

statistically significantly different from the rural series in a higher face, a larger face profile index, as well as a lower nose bridge.

The female series of skulls from Polotsk differs from the mound female series in larger absolute sizes of the brain and facial sections. The comparison of Polotsk female series and the mound series with the use of the Student's t-criterion revealed nonrandom intergroup differences in longitudinal diameter and height diameter of the skull, skull base length and face base length, as well as upper facial breadth. Like the men's, Polotsk women's series is characterized by a larger skull index compared to the earlier rural series.

The fact that the urban series of male skulls of the 13th—14th centuries from Polotsk differs from the mound rural series of the 11th—13th centuries from the territory of Polotsk land in a complex

of features that are not associated with secular trend and characterizing the structural features of the facial skeleton (a higher face with a smaller protrusion of the nose, a larger face profile index) may indicate genetic differences and participation in the formation of alien component in the anthropological composition of the later medieval Polotsk population.

The body length of adult men from Polotsk, reconstructed on the basis of measuring the long tubular bones of the limbs, varies within 162—175 cm and averages 169.5 cm. The body length of adult women varies within 147—159 cm and averages 156 cm. Compared with the later population of Polotsk 17th—18th centuries the medieval urban population was taller. So, the height of medieval men was 2.5 cm more than the height of the townspeople of the 17th—18th centuries, the

medieval Polotsk women were on average 2 cm higher than the women of the 17th—18th centuries.

Paleodemographic analysis. For the studied osteological series, a life table was calculated (table 2). Due to the fact that the average life expectancy at birth is significantly distorted depending on the representativeness of the child part of the sample, the mortality rate of adults was analyzed. The average life expectancy without taking into account child mortality (E_{20}) in the group of the Polotsk medieval population was 16.2 years. This means that individuals who have reached the age of 20, on average, could expect to live another 16.2 years. The average age of adult death in the studied group was 35.1 years. The life expectancy of Polotsk women of the 13th—14th centuries was 3 years less than that of men.

The average life expectancy and the average age of death of Polotsk 13th—14th centuries urban population were 6 years lower than that of the medieval rural population represented by the materials of burial mounds of the 11th—13th centuries (Емельянчик 2015а, p. 322).

Cribra orbitalia (porosity and hyperostosis of the superior wall of the orbits) is currently considered to be an indicator of stress due to malnutrition and increased pathogenic load. Like demographic indicators, *cribra orbitalia* is a kind of generalizing criterion of the ancient population health status. Analysis of the incidence of *cribra orbitalia* in different populations allows a comparative assessment of the population general health status without taking into account the specific paleoepidemiological situation.

The group of Polotsk medieval population is characterized by increased frequencies of *cribra orbitalia*. Among adults, the indicator is present in 32.2 % of cases, among children — in 55.5 % of cases. These indicators are higher than those of the medieval rural population (14.7 % among adults and 50 % among children). The differences in the frequencies of *cribra orbitalia* between medieval groups of rural and urban populations achieve statistical significance ($\chi^2 = 4.6$, $p < 0.05$).

Discussion. In general, higher incidence of *cribra orbitalia* were characteristic for the popu-

lation of Polotsk 13th—14th centuries, as well as increased mortality compared to the medieval rural population. This indicates the deterioration in living conditions and the general state of health of the studied group of urban population in comparison with the earlier rural population.

As a hypothesis explaining the deterioration of the general health status of Polotsk residents compared with the rural population, we can consider the factor of urbanization. The negative impact of the urban environment was noted by A.P. Buzhilova in her study of a number of ancient Rus' cities. In particular, in urban groups there is an increase in the incidence of *cribra orbitalia* and tooth enamel hypoplasia, as well as a wider spread of bacterial infections, such as tuberculosis and syphilis (Бужилова 2005, p. 241, 242). These facts A.P. Buzhilova explains as the result in the increase of urban population density, in some cases — insufficient or poor-quality nutrition (Бужилова 2005, p. 241).

In addition to the noted factor of urbanization, one of the possible reasons for the deterioration of the general health of the Polotsk population in the 13th—14th centuries there could be climate changes that began in Europe in the fourteenth century. On the eve, in the 10th—13th centuries, the so-called «medieval climatic optimum» was observed, the era of a relatively warm climate. However, from the beginning of the 14th century the period of relative cooling began, which lasted until the 19th century (Борисенков 1988, p. 175). The direct consequence of the first phase of this so-called «small ice age» was the mass famine of the first half of the 14th century in Europe. Only in the 14th century in the annals there are more than 100 extreme natural phenomena, which resulted in 30 hungry years (Борисенков 1988, p. 179). A confirmation of the hypothesis of the influence of the climatic factor is the recorded earlier fact of an increase in the frequency of *cribra orbitalia* among Polotsk rural population land in the 13th—16th centuries in comparison with the «mound population» of the 11th — beginning of the 13th centuries (Емельянчик 2015b, с. 304).

Conclusions. As a result of the study, the following conclusions can be drawn.

Table 2. Life table

Age category	D_x	d_x	l_x	q_x	L_x	T_x	E_x
0—7	5	8.2	100.0	0.082	575.4	2903.3	29.0
7—15	7	11.5	91.8	0.125	688.5	2327.9	25.4
15—20	2	3.3	80.3	0.041	393.4	1639.3	20.4
20—30	18.5	30.3	77.0	0.394	618.9	1245.9	16.2
30—40	11.5	18.9	46.7	0.404	373.0	627.0	13.4
40—50	10	16.4	27.9	0.588	196.7	254.1	9.1
50+	7	11.5	11.5	1.000	57.4	57.4	5.0
	61	100	—	—	—	—	—

The total male sample of skulls from medieval Polotsk is characterized by meso-dolichocrania, large sizes of the brain. The face is of medium size, orthognathic, well profiled at the level of the cheekbones and slightly flattened at the level of the orbits, with a strongly protruding nose. The female sample of skulls is similar to the male in most indicators, as well as in terms of characterizing the profile of the face and the degree of protrusion of the nasal bones. According to most craniological characteristics, a series of male skulls from Polotsk of the 13th—14th centuries is similar to a sample of the medieval rural population of Polotsk land from burial mounds of the 11th—13th centuries. The differences relate to an increase in the cranial index in the later Polotsk series, which reflects the onset of the epochal process of brachycephalization. In addition, Polotsk urban population differs from the rural population in a number of features of the facial skeleton (a higher face, a larger index of facial protrusion, a smaller protrusion of the nose). These differences can be genetically determined and indicate the participation of the alien component in the formation of Polotsk medieval population.

The body length of adult men from Polotsk varies within 162—175 cm and averages 169.5 cm. The body length of adult women varies within 147—159 cm and averages 156 cm. Compared to the later Polotsk population of the 17th—18th centuries, the medieval urban population was taller (2.5 cm in men and 2 cm in women).

The average age of adult death in the studied group was 35.1 years. The average age of death for Polotsk women was 3 years less than for men. The group of Polotsk medieval population is characterized by relatively high frequencies of *cribra orbitalia*. Among adults, the indicator is present in 32.2 % of cases, among children — in 55.5 % of cases.

Compared with the rural population of the 11th—13th centuries urban population of Polotsk of the 13th—14th centuries had higher mortality rates and increased incidence of *cribra orbitalia*, which indicates deterioration in general health in Polotsk urban population. The most probable causes of this phenomenon were, on the one hand, negative factors of urbanization, and on the other hand, the cooling of the climate, which began in Europe in the 14th century and led to deterioration in the living conditions of a significant part of the region's population.

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According to most craniological characteristics, a series of male skulls from Polotsk of the 13th—14th centuries is similar to a sample of the medieval rural population of Polotsk land from burial mounds of the 11th—13th centuries. The differences relate to an increase in the cranial index in the later Polotsk series, which reflects the onset of epoch-making brachycephalization. In addition, Polotsk urban population differs from the rural population in a number of features characterizing the structural features of the facial skeleton (a higher face, a larger index of facial protrusion, a smaller protrusion of the nose). These differences can be genetically determined and indicate the participation of the alien component in the formation of Polotsk medieval population.

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The group of Polotsk medieval population is characterized by relatively high frequencies of *cribra orbitalia*. Among adults, the indicator is present in 32.2 % of cases, among children — in 55.5 % of cases.

Compared with the rural population of the 11th—13th centuries urban population of Polotsk of the 13th—14th centuries had higher mortality rates and increased incidence of *cribra orbitalia*, which indicates deterioration in general health in Polotsk urban population. The most probable causes of this phenomenon were, on the one hand, negative factors of urbanization, and on the other hand, the cooling of the climate, which began in Europe in the 14th century and led to deterioration in the living conditions of a significant part of the region's population.

Keywords: Polotsk, 13th—14th centuries, craniology, paleodemography, *cribra orbitalia*.

V. A. Смельянчик

СЕРЕДНЬОВІЧНЕ НАСЕЛЕННЯ ПОЛОЦЬКА ЗА АНТРОПОЛОГІЧНИМИ ДАНИМИ

Метою цього дослідження є аналіз людських скелетних решток поховань XIII—XIV ст., виявлених на території Нижнього замку в Полоцьку, Білорусь. У статті розглянуто морфологічні характеристики середньовічного міського населення і показники скелетного стресу, такі як смертність та *cribra orbitalia*.

За більшістю краніологічних характеристик серія чоловічих черепів з Полоцька XIII—XIV ст. схожа на зразок середньовічного сільського населення Полоцької землі з курганів XI—XIII ст. Відмінності стосуються збільшення черепного індексу в пізніших Полоцьких рядах, що відображає початок епохи брахіцефалізації. Крім того, міське населення Полоцька відрізняється від сільського за низкою ознак, що характеризують особливості будови лицьового скелета (більш високе обличчя, більший показник випинання обличчя, менший виступ носа). Ці відмінності можуть бути генетично детермінованими та свідчити про участь чужорідного компоненту у формуванні полоцького середньовічного населення.

Довжина тіла дорослих чоловіків з Полоцька коливається в межах 162—175 см, в середньому становить 169,5 см. Довжина тіла дорослих жінок коливається в межах 147—159 см, в середньому становить 156 см. Порівняно з пізнішим населенням Полоцька XVII—XVIII ст., середньовічне міське населення було вищим на 2,5 см у чоловіків і 2 см у жінок.

Середній вік смерті дорослих у досліджуваній групі становив 35,1 року. Середній вік смерті для полоцьких жінок був на 3 роки менший, ніж для чоловіків.

Група середньовічного населення Полоцька характеризується відносно високими частотами *cribra orbitalia*. Серед дорослих показник присутній у 32,2 % випадків, серед дітей — у 55,5 % випадків.

У порівнянні із сільським населенням XI—XIII ст. міське населення Полоцька XIII—XIV ст. мало вищі показники смертності та збільшення захворюваності на *cribra orbitalia*, що свідчить про погіршення загального стану здоров'я міського населення Полоцька. Найвірогіднішими причинами цього явища були, з одного боку, негативні фактори урбанізації, а з іншого — охолодження клімату, що розпочалося в Європі в XIV ст. і призвело до погіршення умов життя значної частини населення регіону.

Ключові слова: Полоцьк, XIII—XIV ст., краніологія, палеодемографія, *cribra orbitalia*.

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