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INHABITANTS OF THE SOUTHERN SUBURB OF THE EARLY MEDIEVAL STRONGHOLD AT POHANSKO: UPDATED DEMOGRAPHIC STUDY

ABSTRACT: *The southern suburb counts among the largest locations excavated at Pohansko where about two hundred graves were explored. It is dated to the 9th century with a possible overlap to the beginning of the 10th century. Skeletal material (in present times 190 skeletons from 205 graves are preserved) was mainly excavated during archaeological rescue excavations in 1975–1979. The skeletal remains from the southern suburb are poorly preserved, the bones are fragmentary and in most cases unidentifiable. Using the traditional anthropological methods of sex estimation, 40 adult females and 27 adult males were identified. Later, modern genetic methods of sex determination were used. The analysis of aDNA of skeletal remains was especially significant when the sex of children was determined. Using these two approaches, 30 adult males, 55 adult females, 28 boys and 20 girls were identified. The sex of the remaining 57 skeletons (both children and adults) was impossible to define by any of the methods used. The results provide new information about the demography of this burial site and they have been compared with demographic data of other equally dated burial sites.*

KEY WORDS: *Pohansko – Southern Suburb – Early Medieval – Demography – Mortality – aDNA*

INTRODUCTION

The Pohansko archaeological site is situated in the south-eastern part of the Czech Republic near the town of Břeclav. Archaeological excavations at this site uncovered the relic of a fortified stronghold with two suburbs, two churches with graveyards and another

burial grounds (Dostál 1975, Dresler 2011, Kalousek 1971, Macháček 2010, Macháček 2011, Macháček *et al.* 2014, Přichystalová 2011, Vignatiová 1992). One of the important settlement units at Pohansko is the southern suburb. It is dated to approximately the 9th century and was explored during several archaeological campaigns. During the rescue excavations in the years 1960, 1962,

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1975–1979, and within the systematic scholarly research in 1991–1994, small scattered burial grounds, groups of graves and isolated graves were excavated amongst numerous settlement features (Drozdová, Beneš 1997, Přichystalová 2011, Vignatiová 1992, Vignatiová, Klanicová 2001). A total of 205 graves perhaps originally with 210 individuals were discovered (Přichystalová 2007). The majority of them contained skeletons of children and fragmentary skeletal remains of unknown sex. A part of the skeletons was processed by Lorencová in the 1970s (anthropological reports of Lorencová, which were discovered in dateless manuscript of Vignatiová) but most of them were anthropologically assessed by Drozdová, who analysed 189 skeletons (Drozdová 2005). Later, another two skeletons (JP/11 and JP/115) were rediscovered, but a child's skeleton (from Grave JP/7) was lost (Boberová 2012). At present there are 190 skeletons preserved. Molecular sex identification of children and undetermined skeletal remains (120 samples in total) was performed with the help of PCR amplification of amelogenin and SRY markers during a previous study (Boberová 2012). Anthropological and demographic studies of the Pohansko population were published (Boberová, Drozdová 2011, Drozdová 2005). The aim of this study is to compare several demographic indicators of the population from the southern suburb of Pohansko, which represents dispersed burial grounds in the settlements structure, with other populations from the equally dated regular burial grounds (Mikulčice, Josefov, Pohansko around the first church, Dolní Věstonice – Na Pískách) (Drozdová 2005, Fojtová, Jarošová 2012, Hanáková, Stloukal 1966, Stloukal, Vyhnánek 1976).

MATERIAL

The skeletons from the southern suburb are in very poor condition. Using morphometric and morphologic methods of sex estimation for the recognizable bones, 40 adult females and 27 adult males were identified (Drozdová 2005). The number of subadult (juvenile) skeletons was 87, and 36 skeletal remains were undetermined (Boberová 2012). After genetic analysis of individuals with undetermined sex, demographic data of the population from the southern suburb were completed. From among the 87 subadult skeletal remains, sex was determined in 48 samples: 28 boys and 20 girls (Boberová 2012). The sex determination in the remaining 39 juvenile individuals was not

successful, probably due to the poor state of preservation of the samples (degradation of authentic DNA). Among the 36 anthropologically unidentified skeletal remains, 3 males and 15 females were genetically identified. The sex identification in the remaining 18 individuals was not successful (*Table 1*).

TABLE 1. Sex structure of individuals from the southern suburb (after genetic sex determination).

		Number
Adults	Males	30
	Females	55
	Unidentified	18
Children (up to 14 years)	Boys	28
	Girls	20
	Unidentified	39
Total		190

METHODS

An updated version of demographic study was created based on demographic data published by Drozdová (2005). Age was determined by Drozdová (2005), who used a combination of the following methods: the Lovejoy's method according to the degree of dental wear (Iskan, Helmer 1991), the Vallois' method (modified by Rösing) according to the degree of cranial suture closure (Knussmann 1988) and the method of McKern and Steward based on age-related changes on the pubic symphyseal surface (Knussmann 1988). The combined method of Nemeskéri *et al.* (Knussmann 1988) was used in the case of well-preserved adult skeletons. When determining the age of children's skeletons, the Ubelaker's schema of dental development (Knussmann 1988) was used. The age of juvenile individuals was detected based on schema of fusion of epiphyses according to Brothwell (1972), Gray (1967), Hare *et al.* (1927), Rauber and Kopsch (1952) and Wolf-Heidegger (1954), mentioned in the manual of Anthropology (Knussmann 1988).

The original demographic data (Drozdová 2005) were complemented by the newly detected information regarding the sex of children, subadults and unidentified skeletal remains (incomplete or fragmentary skeletons) which were determined by

genetic methods (Boberová 2012). For the sex determination, two common sex markers (the amelogenin gene and the SRY gene) were used (Mannucci *et al.* 1994, Santos *et al.* 1998, Sullivan *et al.* 1993). Only the concordant results of both sex markers were considered valid.

The children's skeletal remains were divided into three subgroups: boys, girls and unidentified children's skeletons, and they were classified in age categories according to their individual age (age determination of all individuals was borrowed from Drozdová 2005): category of infans I (0–0.5 years), infans II (0.6–6 years) and infans III (7–13 years). The age categories of juvenile individuals and adults were also complemented by individuals with genetically determined sex.

Shortened mortality tables were developed, separately for males and separately for females with determined age at death (Boberová, Drozdová 2011). When computing mortality tables, the approaches published by Knussmann (1988) and Stloukal *et al.* (1999) were used.

Masculinity index was calculated according to the formulas used by Neustupný (1983) and Stloukal *et al.* (1999). The burial sites of Josefov, Mikulčice-Valy, Pohansko around the first church and Dolní Věstonice – Na Pískách were chosen for comparison of some demographic characteristics (Drozdová 2005, Fojtová, Jarošová 2012, Hanáková, Stloukal 1966, Stloukal, Vyhnánek 1976).

RESULTS AND DISCUSSION

The population from the southern suburb consisted by 30.5 % of males and by 39.5 % of females. The sex of the remaining 30 % of individuals was not determined, neither by anthropological methods nor through genetic analysis. The crucial study from Drozdová (2005) reported 14.3 % of males, 21.1 % of females and 64.6 % of children and non-identified adult individuals. The number of determined males increased from 27 to 30 and the number of determined females increased from 40 to 55. The number of children's skeletons with unknown sex decreased from 87 to 39 and the number of undetermined adult skeletons decreased from 36 to 18 (Boberová 2012).

Newly calculated masculinity index equates to 545, which means that females predominate over males. Compared with the original data of Drozdová (2005; masculinity index equates to 675) the number of men

was decreased because more women than men were determined by genetic methods. Similar low masculinity index was detected for example at the Josefov burial ground (value of 583; Hanáková, Stloukal 1966). On the other hand, high masculinity index was detected at the Pohansko regular burial ground around the first church (value of 1859), where higher social class is assumed to have been buried (Drozdová 2005). According to Hanáková and Stloukal (1966), the disproportion between male and female skeletons could be explained by the fact that a high number of men moved from Josefov to the nearby settlement in Mikulčice for military service (or another kind of utilitarian activities). The low number of adult men in the southern suburb of Pohansko is explained by the assumption that it was a residential place of families and farming background of the military units of second grade and the men could probably be buried outside their home territory (Vignatiová 1992).

From the age structure it results that most of the individuals from the southern suburb died during their childhood, from 6 months to 6 years (24.3 %), and from 7 to 13 years (17.8 %). In adult age, most of the individuals died in the age category of 30–39 years (18.4 %) (*Table 2*). These data complete and confirm previous findings (Drozdová 2001, Drozdová 2005). Findings from the other burial sites show identically that the age period from 6 months to 6 years is the most critical period in terms of child mortality (e.g. Hanáková, Stloukal 1966, Stloukal 1964, Stloukal 1969, Stloukal, Vyhnánek 1976, Stloukal 1981, Stloukal 1987b).

According to Drozdová (2001, 2005), the average age at death of children from the southern suburb was computed to be 6.1 years. After genetic sex determination it was detected that the average age at death in boys was 6.7 years (arithmetic mean) and the average age at death in girls was 5.4 years (arithmetic mean). Similarly, the average age at death of children in the Josefov burial site or in the Pohansko burial ground around the first church was found to be 5.4 years (Hanáková, Stloukal 1966) and 5 years, respectively (Drozdová 2005). The average age at death of children in individual burial sites of the Mikulčice area was slightly higher, its value was between 6 and 7 years (Stloukal 1962).

The low number of skeletons of newborns and children who died in the first months after birth is typical of the early medieval burial sites and it has usually been explained by the fact that the small

TABLE 2. Age structure of individuals from the southern suburb (after genetic determination). N – number of individuals.

Age category (years)	Boys (N), %	Girls (N), %	Unidentified children (N), %	Males (N), %	Females (N), %	Unidentified adults (N), %	Total (N), %
Inf I 0–0.5			(2), 6.6				(2), 1.3
Inf II 0.6–6	(9), 41	(11), 78.6	(17), 56.7				(37), 24.3
Inf III 7–13	(13), 59	(3), 21.4	(11), 36.7				(27), 17.8
Juv 14–19				(1), 3.8	(8), 16	(2), 20	(11), 7.2
Ad I 20–29				(1), 3.8	(11), 22	(3), 30	(15), 9.9
Ad II 30–39				(12), 46.2	(12), 24	(4), 40	(28), 18.4
Mat I 40–49				(1), 3.8	(7), 14		(8), 5.3
Mat II 50–59				(8), 30.8	(8), 16	(1), 10	(17), 11.2
Sen 60 +				(3), 11.5	(4), 8		(7), 4.6
Sum	(22), 100	(14), 100	(30), 100	(26), 100	(50), 100	(10), 100	(152), 100

children's skeletons were simply not preserved (Stloukal, Vyhnánek 1976, Stloukal 1987a). Only two skeletons of the smallest children (up to one year) were discovered in the southern suburb (*Table 2*). The mortality of the smallest children in the burial grounds at Pohansko around the first church (Drozdová 2005), Dolní Věstonice – Na Pískách (Fojtová, Jarošová 2012) or at Mikulčice-Valy is very similar (Stloukal, Vyhnánek 1976). Stloukal (Stloukal, Vyhnánek 1976) explains the low number of newborns and nurslings in the Mikulčice burial site through the ban on burials of unbaptised children in churchyards. But he does not exclude the infanticide of a part of newborns, either. However, the burial grounds in the southern suburb are not unified and were not placed in the consecrated area around the church. The most likely explanation of this phenomenon is that the fragile skeletons of children were not preserved between the settlement features due to shallow grave pits. Therefore there was a higher risk of mechanical grave disruption, for example due to penetrative removal of top soil (from 40 to 70 cm) in the course of archaeological rescue excavations (Drozdová 2001, Drozdová 2005). In the burial ground around the second church at Pohansko, where the latest advancements were used for excavation of skeletons (e.g.

careful sifting of the soil), one foetus, one newborn, 19 children aged 0–1 years and 53 children aged 1–6.9 years were unearthed (Sládek *et al.* 2017).

The children's mortality was high, but it does not mean that it always was the mortality rate of the youngest children. Despite the low number of children's skeletons with determined sex, this phenomenon can also be observed in the southern suburb.

In the southern suburb of Pohansko, most boys died at 7 years and then at the same rate at 2 and 8 years (*Table 3*). Girls mostly died at 2 years and at 3 years, then at 14 years (*Table 3*). Some authors explain the low number of newborns and nurslings in the burial grounds as a result of the fact that in the time of breastfeeding the children were "protected" by the breast milk and therefore fewer of them died. Conversely, children's mortality increases quickly after weaning (Stloukal 1987b). The time of weaning varies in different populations according to cultural traditions but usually it is between 2 and 5 years of age (Mielke *et al.* 2006). As already mentioned, children's graves were very shallow and many of them did not remain preserved until today. Moreover, children were often buried outside the burial grounds, for example in settlement pits. In these cases we usually take into account the

TABLE 3. Mortality of boys and girls by individual years of age.

Age (years)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Unidentified age	Total
Number of boys	0	0	3	2	1	1	2	4	3	2	1	1	2	0	0	6	28
Number of girls	0	0	7	3	0	0	1	1	0	0	0	1	1	0	2	4	20

possibility that these children have not yet been adopted as rightful members of community (Hanuliak 2004, Preissová Krejčí *et al.* 2014, Unger 2006).

The mortality table for the entire population of the southern suburb (Drozdová 2005) as well as the mortality table of males and the mortality table of females (Boberová, Drozdová 2011) were published previously. To provide complete data, the mortality tables of males and females are presented here again (Table 4, 5). The average age of males (including boys) from the southern suburb was 28 years (the expected age, related to 100 individuals). The average age of females (including girls) was 30 years (the expected age, related to 100 individuals). According to Drozdová (Drozdová, Beneš 1997, Drozdová 2001, Drozdová 2005) the average age was 42.9 years in adult males and 37.5 years in adult females. The expected age of this population was 24 years but children and juveniles could not be included in this calculation because their sex was not known (Drozdová 2005). The average age of the population from the southern suburb was decreased by the high children's mortality, especially within the range from birth up to 6 years. These data are in agreement

with demographic characteristics of early medieval Slavic population as it is, for example, stated by Stloukal (1987a). He relates that the value of life expectancy (e_0 of mortality tables) is within the range from 24 to 32 years. Similar value of the average age of the dead (regardless of sex) was calculated in the population from Pohansko around the first church – 25 years. The average age of adult males was calculated to be 38 years, identically to the average age of adult females (Drozdová 2005). This value of the average age of adult males is much lower than with other early medieval Slavic sites, which could probably be explained by their service in military troops at the residential place of the magnate (Drozdová 2005). The life expectancy of the population from Mikulčice was defined on the basis of mortality tables and its value is 27.6 years (Stloukal, Vyhnanek 1976). On the other hand, relatively low value of life expectancy (21.9 years) was detected at the Josefov burial ground (Hanáková, Stloukal 1966) or at Dolní Věstonice – Na Pískách, where the value of life expectancy is 19.98 (Fojtová, Jarošová 2012).

In contrast with the e_0 value which could be distorted by the fact that skeletons of small children

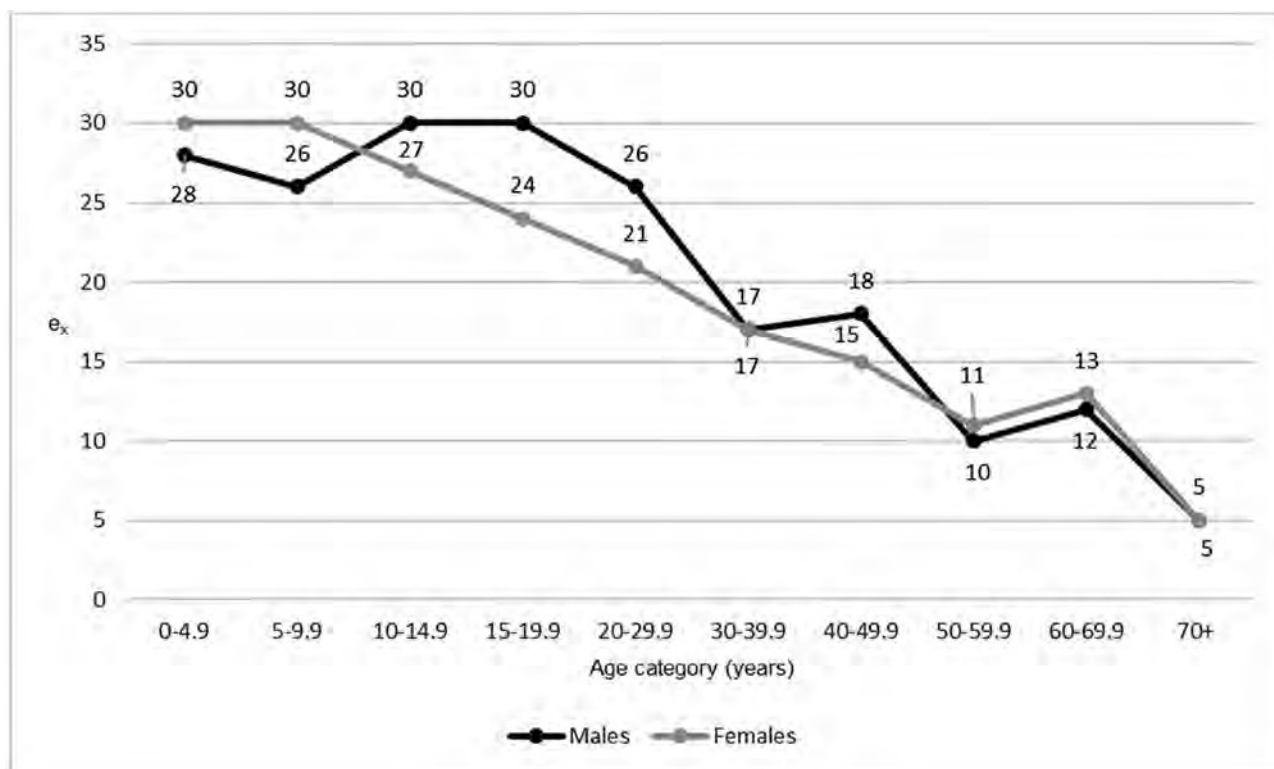


FIGURE 1: Life expectancy function of males and females from the southern suburb. e_x , the average number of years remaining to an individual who survived to the beginning of time interval x .

TABLE 4. Mortality table of males from the southern suburb. D_x , number of individuals in the age class; d_x , number of individuals included in the age class based on 100 individuals; l_x , number of individuals among 100 people, who lived to a certain age class; q_x , probability of death of individuals before reaching the following age class; p_x , probability of survival of individuals and their progress to the next age class; L_x , number of years lived in a certain age class; T_x , number of years that individuals can still live in the age class; e_x , average life expectancy.

Age category	D_x	d_x	l_x	q_x	p_x	L_x	T_x	e_x
0-4.9	6	12.5	100	0.125	0.875	469	2746	28
5-9.9	12	25	87.5	0.2857	0.7143	375	2277	26
10-14.9	4	8.34	62.5	0.1334	0.8666	292	1902	30
15-19.9	1	2.08	54.16	0.0384	0.9616	266	1610	30
20-29.9	1	2.08	52.08	0.0399	0.9601	510	1344	26
30-39.9	12	25	50	0.5	0.5	375	834	17
40-49.9	1	2.08	25	0.0832	0.9168	240	459	18
50-59.9	8	16.67	22.92	0.7273	0.2727	146	219	10
60-69.9	1	2.08	6.25	0.3328	0.6672	52	73	12
70 +	2	4.17	4.17	1	0	21	21	5
Total	48	100						

TABLE 5. Mortality table of females from the southern suburb. D_x , number of individuals in the age class; d_x , number of individuals included in the age class based on 100 individuals; l_x , number of individuals among 100 people, who lived to a certain age class; q_x , probability of death of individuals before reaching the following age class; p_x , probability of survival of individuals and their progress to the next age class; L_x , number of years lived in a certain age class; T_x , number of years that individuals can still live in the age class; e_x , average life expectancy.

Age category	D_x	d_x	l_x	q_x	p_x	L_x	T_x	e_x
0-4.9	10	15.63	100	0.1563	0.8437	461	3025	30
5-9.9	2	3.13	84.37	0.0371	0.9629	414	2564	30
10-14.9	4	6.25	81.24	0.0769	0.9231	391	2150	27
15-19.9	6	9.38	74.99	0.1251	0.8749	352	1759	24
20-29.9	11	17.19	65.61	0.262	0.738	570	1407	21
30-39.9	12	18.75	48.42	0.3872	0.6128	391	837	17
40-49.9	7	10.94	29.67	0.3687	0.6313	242	446	15
50-59.9	8	12.5	18.73	0.6674	0.3326	125	204	11
60-69.9	1	1.56	6.23	0.2504	0.7496	55	79	13
70 +	3	4.7	4.7	1	0	24	24	5
Total	64	100						

were not preserved for various reasons, the life expectancy of twenty-year-old individuals (e_{20}) is considered as a reliable indication. Stloukal (1987a) states that e_{20} of males tends to be higher (the values between 20–30 years), whereas e_{20} of females usually exhibits the value of 17–23 years. This fact is clearly explained with high female mortality in connection with pregnancy and childbirth. The population of the southern suburb has the e_{20} value of males equal to 26 years (Table 4), the e_{20} value of females is 21 years (Table 5). For example, the males from Pohansko around the first church exhibit the e_{20} value equal to 20

years, whereas the value in females is 19 years (Drozdová 2005).

The lowest numbers of deceased individuals are usually recorded at the age of 15–20 years, then the mortality increases with an earlier peak for females and with a later peak for males (Stloukal 1987a). The highest number of deceased adult males from the southern suburb was registered in the age category of 30–39.9 years (Table 2). The highest number of deceased adult females was in the age categories of 20–29.9 and 30–39.9 years (Table 2), which is related to pregnancy, childbirth and puerperium (Drozdová 2001, Drozdová

2005). After completing the numbers of males and females with genetically determined males and females, these data have not changed. Usually only a small percentage of people lived to over the age of 60 years, more females than males (Stloukal 1987a). If females survived the critical period of reproductive age, they had a chance to live longer than males (as it also is today) (Stloukal *et al.* 1999). In the southern suburb of Pohansko three males and four females lived to over the age of 60, which corresponds with data from other sites (Table 4, 5).

The life expectancy function (e_x) of males and females from the southern suburb is pictured in Figure 1. The most critical life period of males was the interval between 0–4.9 years, when the life expectancy was only 28 years. Then the value of e_x rose, in 20 years the life expectancy was 46 years already. After this age category, the e_x curve declined. In the highest age cohort (70+) males could still live for 5 years. The most critical life period of females was the interval between 0–4.9 years, when the life expectancy was only 30 years. In 20 years the life expectancy was 41 years already. Then the e_x curve declined. In the highest age cohort (70+) females could still live for 5 years (identical to males). The life expectancy function (e_x) of the population from Pohansko around the first church also has similar characteristics (Drozdová 2005).

CONCLUSION

The purpose of this study was to compare several demographic indicators of the population from the southern suburb of Pohansko, which represents scattered burial grounds, with other populations from the equally dated regular burial grounds. The data for demographic analysis of the southern suburb population were obtained using standard anthropological methods for sex estimation as well as modern molecular-genetic approach for sex determination of children and fragmentary skeletal remains. Comparing some selected demographic indicators, no significant differences between the compared populations were found. It is therefore possible to expect their similar social stratification and similar living conditions (e.g. diet, diseases, culture). Of course, this result could be affected by a large number of individuals with undetermined sex and also by the number of preserved skeletons. However, the use of the aDNA analysis for sex determination helped to obtain more accurate information about the age structure of population from the southern suburb

and also more accurate demographic data. It is therefore certainly suitable to use this approach also with other archaeological sites.

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