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# Examination of the human remains from the medieval cemetery of Bátmonostor-Pusztafalu in Hungary

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**ABSTRACT** This paper summarizes the results of the physical anthropological examinations carried out on the remains of 3783 individuals from the medieval cemetery of Bátmonostor-Pusztafalu in Hungary. Distributions of sex and age at death are described along with the observations made concerning anatomical variations, developmental anomalies, pathological alterations and taxonomic features. This study is the shorter version of a more detailed paper to be published in *Opuscula Hungáriáé*.

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As a result of the excavations carried out in 1966 and 1977-1986 by archeologists Mihály Kőhegyi (1967) and Piroska Biczó (1978-1986), 2543 graves dating back to the second half of the 14<sup>th</sup> and the 15<sup>th</sup> centuries were excavated at the site of Bátmonostor-Pusztafalu (Southern Hungary, cca. 15 km south of the town of Baja). The findings comprise 80% of the individuals buried in the cemetery.

## Materials and Methods

In 67 graves no human remains were found, but 444 other graves contained skeletal elements of several individuals. The authors examined the remains of 3783 individuals in all. The state of preservation of the skeletons greatly varies. The remains are housed at the Department of Anthropology, University of Szeged.

In case of immature individuals, age at death was determined using the method of Stloukal-Hanáková (1978), while in case of adults, the method of Nemeskéri et al. (1960) was used. Sex was determined on the basis of 24 characteristics. Measurements were carried out on the skulls and long bones employing Martin's system. Height was calculated according to Sjøvold's practice (Sjøvold 1990).

Paleodemographic analysis was based on the Acsádi-Nemeskéri method (Acsádi and Nemeskéri 1962). Paleopathological anomalies were diagnosed on the basis of morphological observations; occasionally X-ray and CT scans were taken and histological examinations were also conducted to support diagnoses. Taxonomic analysis was carried out according to Lipták's classification using the method of Farkas (Farkas 1972). To compare metric data of our series to that of other medieval cemeteries, biological

distance was determined and analysed employing Penrose's method (Penrose 1954).

## Results

### Age at death and sex

The age at death and sex the distribution of the findings is summarized in Table 1. The high prevalence of 0-17 year-olds is rather uncommon (1510 skeletal remains, 39.92%). 39 of these remains were fetal skeletons. In case of the remains of adults a great difference was found between the numbers of the male and female findings (1342 male, 35.48%, and 720 female, 19.03%). On the other hand, in case of 354 findings (9.36%) neither age nor sex could be determined.

### Paleodemographic analysis

A summed up mortality table was drawn up using the method of Nemeskéri-Harsányi-Acsádi (Nemeskéri et al 1960), based on data of age at death and sex. The results show that in population of Bátmonostor life expectancy at birth of the was 30.81 years, which approximately corresponds with the demographic status of other medieval cemeteries excavated in the Carpathian Basin. Mortality manifests itself in the very low prevalence of infants, the excessive number of 5-14 year-olds and the child/adult ratio. The 2:1 ratio of men and women must be pointed out as a peculiar feature of this cemetery. A possible explanation of this phenomenon could be the fact that there was an inhrmary in Bátmonostor in the 14<sup>th</sup>-15<sup>th</sup> centuries.

### Description of the measurements and indices

As far as age groups are concerned, there is no notable difference between the sexes. The same goes for sex distribution. The mean values of measurements and indices fall within

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Table 1. Distribution of the findings according to age at death and sex.

Age at death Sex	Fetus	Neo- nate	Infantia 0-7yrs 8-17 yrs		?	Juv. 18-20 yrs	Ad. 21-40 yrs	Mat. 41-60 yrs	Sen. 61-x yrs	?	n	Total %
Male	-	-	-	-	-	38	310	595	234	165	1342	35,48
Female	-	-	-	-	-	66	199	262	127	66	720	19,03
?	39	13	584	833	41	49	8	26	5	123	1721	45,49
Total n	39	13	584	833	41	153	517	883	366	354	3783	100
	%	1,03	0,34	15,44	22,02	1,08	4,04	13,67	23,34	9,67	9,36	
				39,92								

the range of the medium category in most cases. No striking difference was found in any age groups of the two sexes. The available data seem to indicate that we are dealing with the remains of a rather closed community here.

We also noted that deviation of the pubic angle to one side and planoccipitalia are quite common.

### Anatomical variations

Anatomic variations were observed in 827 (21.86%) cases, which means that the remains of every fifth individual showed such alterations. There was no notable difference in prevalence among children and adults. Basically there is no difference between the sexes in absolute numbers either. As there are twice as many male skeletons as females, anatomic variations more often occur in women than in men.

Some rare variations were also discovered, namely: divided ala magna (Fig. 1), suture bone in sutura coronalis, conspicuously large os bregmaticum (Fig. 2), bilateral processus frontalis ossis temporalis (Fig. 3). The high prevalence of torus palatinus, also found on children's skulls, is quite uncommon.



Figure 1. Grave 134: Adultus, undetermined sex, ala magna bipartitum.

The high frequency of anatomic variations also supports the concept of a closed community that we had already presumed on the basis of measurements and indices.

### Developmental anomalies

Fenestration of the sternum (11), anomaly of the xyphoid process (4), syncondrosis of the sternum (7), sternum bimum (2) and other anomalies (2) were detected in several cases, mostly in adults. The 13 cases of pectus gallinaceum are of special interest, since this anomaly is very rarely found in excavated materials (Fig. 4).

Developmental anomalies of the spine are quite common; most of them are of no consequence. Solitary sacralization was discovered in 11 adults, together with spina bifida it occurred in 15 skeletons. Solitary lumbalization was seen in one case, combined with spina bifida in four cases. Spondylolysis was only detected on lumbar vertebrae, in 19 cases.

### Pathological alterations

Despite the state of preservation of the findings being very versatile, quite a large number of pathological alterations could be observed on the bones. We found morphological alterations (the signs of bone diseases) on 872 skeletons. Detailed information is provided below.

#### Traumatic lesions

Postcranial lesion (fracture) was observed in 105 cases on 75 skeletons (79 men, 13 women, 13 individuals of undetermined sex including four children). In case of 30 skeletons, multiple fractures could be detected. Lesions affected men six times more frequently than women. Cranial lesions were found on 16 skeletons. The prevalence of bone fractures in the whole population is 2.78%, that of the skull fractures is 0.43%.

Fractures most often affected tibiae (23), ribs (22) and ulnae (19). Double fractures were observed in two cases. As for the laterality, the fractures of right/left tibiae (11/12), radii (4:4) and ulnae (11:8) were more or less evenly distributed, while left humeri were more often affected (4:7). Left clavicular and ribs were also more often injured. Fracture of



Figure 2. Grave 894/a: Inf. II, os bregmaticum.

the pelvis was noted in four cases.

Among the 16 skull lesions, ten affected the os frontale and four the os parietale. Skull injuries seem to be well-healed and uncomplicated, only two cases of purulent osteomyelitis were observed.

As far as other bones are concerned, healing often entailed various complications.

The prevalence of skull injuries in 10<sup>th</sup>-12<sup>th</sup> century is 30.9%, while at the site of Bátmonostor it is only 16.8%. Cranial lesions affected mostly middle-aged or elderly males, the wounds were induced by some sharp tools or weapons and the persons in question lived for a maximum of 3-4 years after the trauma.

The prevalence of fractures among the Bátmonostor findings was compared to that of a Budapest dataset from 2001 (Józsa et al. 2004). Here the fractures of the femur make up almost one fourth (23.7%) of all fractures of the lower limbs, while in the Bátmonostor series the frequency is less than 1%. The difference is similar in case of the humerus (9.0% and 1.7%). The prevalence of the fractures on the bones of the lower arms combined is basically the same in the Bátmonostor data and the recent material (2.5% and 2.2%). The isolated fracture of the ulna in the medieval series is 8 times higher (16.0%) than nowadays (2.4%). The fracture of the leg was almost twice as common in the medieval sample (9.2%) as in the modern one.

Fractures usually healed without dislocation, which indicates the presence of skilled medicine men in the population.



Figure 3. Grave 1056: Juvenis female, bilateral processus frontalis ossis temporalis.

We observed five cases of ankylosis affecting either the kneejoint (Fig. 5) or the pelvis. In the case of 3 elderly males and an elderly female, the kneejoint became ossified, the left femur of a mature male was fixed at right angles in the acetabulum. In one case evidence shows that some kind of crutch was fastened to the knee to support locomotion. Such findings are unique in the medieval material.

#### *Non-specific infectious diseases*

Osteomyelitis primarily affecting males (19 cases) was detected in 26 cases. Periostitis was recorded in 43 cases, 28 of which were males. Among the 43 cases, 17 was chronic. Ostitis was observed on the remains of 24 individuals, also affecting more males (17 cases).

The traces of non-specific infectious diseases were detected in 93 cases altogether, which makes up approximately 10% of the total number of the pathological cases. Except the 3 cases of ostitis affecting the skull, all the diseases mentioned above occurred on the limbs.

#### *Specific infectious diseases*

Pott's curvature, a typical sign of tuberculosis, along with the wedge-shaped collapse of the vertebrae was observed in three cases.

#### *Haematological alterations*

In historical anthropological samples, porotic hyperostosis can primarily be observed on the flat bones of the skull. Along with different stages of cribra orbitalia in the upper region of the orbita they both suggest iron-deficiency anaemia. Such alterations were detected in 197 cases (14.10%) within the 1397 member immature population of Bátmonostor-Pusztafalu.



**Figure 4.** Grave 1414: Maturus female, pectus gallinaceum.

Among the 2272 adult skeletons, only 58 (2.55%) showed any signs of anaemia. In the latter group, the prevalence was higher in women (4.18%) than men (1.93%).

The occurrence of such alterations suggests iron-deficiency anaemia caused by malnutrition.

#### *Developmental anomalies and diseases of the spine*

Physiological curvature and poor body posture was only observed in ten cases, which may be explained by the fact that some of the skeletons are incomplete and fragmentary.

We have already mentioned some traces of developmental anomalies of the spine above. Different forms of sacralization could be detected in 26 cases, affecting primarily males. Five cases of lumbalization were found. Spina bihda is quite frequent (161 cases), affecting four times as many males as females. Considering all 872 pathological cases, the prevalence



**Figure 5.** Grave 993/a: Senium male, ankylosis of the right knee joint.

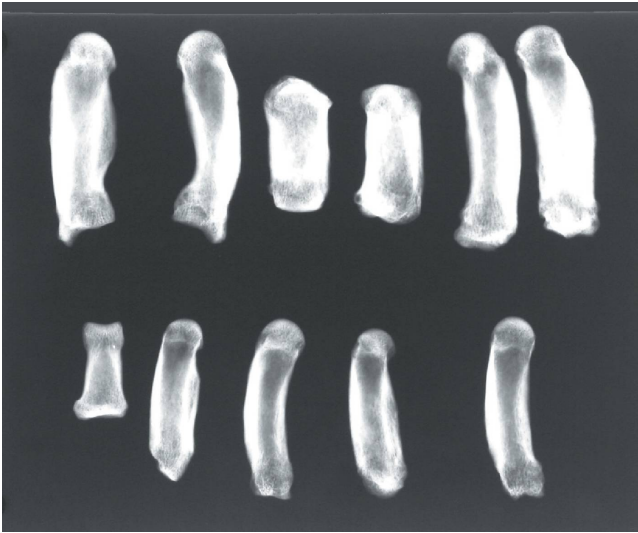
of spinal developmental anomalies is 26.61%. Spondylolysis is uncommonly frequent (24 cases), affecting males in more than 50% of the cases, and the majority of which (22) being of lumbar localisation.

Among the 160 diseased spines we found signs of inflammation in 17 (10.63%) cases. In comparison to the recent dataset, the prevalence of inflammation is much higher in Bâtmonostor.

82 (51.25%) cases of degenerative alterations were detected among the above mentioned 160 skeletons. Considering all 872 pathological findings, the total prevalence is 9.40%. The most common disorder is spondylarthrosis, which affected the cervical and thoracic vertebrae in 7-7 cases and the lumbar region in 47 cases, males and females in equal distribution. As there were twice as many male than female skeletons unearthed, spondylarthrosis seems to have been more frequent in women. Formation of osteophytes at the margin of the corpus vertebrae was also observed.

Also belonging to the degenerative group of disorders, Forestier-Rotes disease (the etiology of which being still unclear) was observed in 8 cases.

Block vertebrae were observed in the cervical region (5 cases), in the thoracic region (2 cases) and in the lumbar region (4 cases). In seven cases the fusion of two, in three cases the fusion of three vertebrae was observed. Triple fusions of vertebrae only occurred in the cervical region. In a special case lumbar and the lowest thoracic vertebrae were fused.



**Figure 6.** Grave 2528: Adultus male, Bamberger-Marie syndrome. X-ray picture of the metacarpals.

Herniated disk in the lumbar region was observed in three cases, Schmorl's hernia of the thoracic region in four, and of the lumbar region in nine cases.

Osteoporosis affected the vertebrae of an elderly woman. No tumours or traumatic lesions could be detected on any spines.

The findings in grave no. 2528 are especially worth mentioning. Large tumescences can be observed on the bones of the upper and lower arm, one phalanx and leg, which based on microscopic and X-ray scans show symptoms of Bamberger-Marie syndrome (hypertrophic osteoarthropathy) (Fig. 6). Such a case has never been described in excavated material in Hungary.

#### *Bone tumors*

We detected 24 primary and 1 metastatic bone tumor on the skeletal remains. Most of the tumors are benign, 19 cases of osteochondroma on 17 skeletons and a further three cases of osteoma were observed. There are two children, ten males, two females and three skeletons of undetermined sex among the 17 cases.

Osteosarcoma was diagnosed in two cases (Fig. 7). Metastatic bone tumour was observed on the ala ossis ilii, acetabulum and femora. The occurrence of benign bone tumors is quite rare in excavated materials, therefore, the cases mentioned above represent high prevalence.

We also found two cases of osteoma, one on the squamous part of the os temporale, the other at the tuber frontale. Both cases affected males. 15<sup>th</sup>-17<sup>th</sup> century sources refer to such bony growths as "human horns".



**Figure 7.** 16th section, stray find: osteosarcoma on a distal left femur.

#### *Prevalence of enthesopathia*

As the result of backbreaking labour of adults, we observed hyperplasia especially on the calcaneus, the patella, but also on all other limb bones. This hyperostosis can be considered as the natural adjustment of the human body.

According to our data, the total number of enthesopathic cases is 267, the calcaneus being affected in 238 cases, 213 of which were males. This prevalence - despite the fact that twice as many male skeletons were unearthed as female - clearly indicates that hyperostosis is characteristic to male skeletons.

This also supports the concept that the Bátmonostor population, and especially men, suffered from overburden of the muscles and joints, which is the indicative of hard physical work.

#### *Diseases of the teeth, maxilla and mandíbula*

Detailed examinations of the teeth or the oral cavity were not carried out. However, we noted some common anomalies during the examinations, namely: granulomas, massive plaque

formation, cysts, large-scale caries. In some cases, the traces of the arthritis of the caput mandibulae was observed. The prevalence of torus palatinus has already been referred to in the "Anatomical variations" section.

*The biological similarity of the Bátmonostor findings to other series according to Penrose's method*

The arithmetic average of ten measurements of the material from the Bátmonostor excavation was compared to 28 Hungarian series from the Arpadian- and Middle ages employing the Penrose-method. The material shows closest relation to the Ópusztaszer findings. Both series were unearthed from a graveyard around a monastery, but there is great chronological gap between the two. The findings at the Bátmonostor site and other sites show significant distance.

*Taxonomic distribution*

The prevalence of cromagnonids is 37.74% among males and 30.65% among females. Brachycephalous types occurred in 29.71% of the male and 33.86% of the female population. The relative prevalence of nordoids is quite low (19.81% of males, 18.55% of females). The rare presence of mediterranean races is surprising (12.74% of males, 16.94% of females).

Basically there is no difference between the taxonomic distribution of the sexes. The prevalence of alpine (12.26 of males, 12.90% of females) and pamirian types (13.21% of males, 16.13% of females) is remarkable.

As for the sexual distribution of the taxa, the population seems to be homogenous, while there prevalence of certain taxa greatly varies. In comparison to three sites from the Arpadian age (Szatymaz-Vasúfallomás, Orosháza-Rákóczi telep, Békés-Povárdzug) and Ópusztaszer, there are several similarities and differences as well.

*Humanecological perspectives*

Considering the analysis of human remains detailed above, we may well come to the conclusion that the findings derive from rather closed community of farmers. This concept is also supported by the taxonomic analysis, as the findings are fairly similar and we could only distinguish few different taxa. The population most probably lived under poor conditions, which is indicated by the high prevalence of severe diseases rarely found in historical anthropological samples. The large number of children refers to high infant mortality rate, which, however, is not surprising in the medieval ages. The most

probable cause of death that left traces on the bones too was anaemia caused by malnutrition.

## Discussion and Conclusion

The anthropological analysis of the findings of Bátmonostor raised several problems. As multiple burials were quite frequent, the excavation itself and the isolation of individuals became problematic. As a result of this, the exact number of persons buried cannot be determined. There were also quite a large number of incomplete skeletons, therefore the possibility of determining sex, age at death and taking measurements was rather limited. Nevertheless, we suppose that initially more individuals were buried here than the 3783 identified by us. This concept is also supported by the opinion of the site's archaeologist according to whom only approximately 80 % of the cemetery was opened up. However, the available skeletal material indicates that the graveyard belonged to a densely populated settlement, used for over 150 years. This cemetery could be considered as the largest medieval graveyard excavated in Hungary so far, so the series could serve as a very good comparative basis for studies on the anthropology of the medieval Hungarian populations.

Most certainly, there are further research possibilities considering this skeletal series; for instance, due to the enormous number of individuals our means were too limited to carry out investigations on dentition or growth rate of children. Therefore, all initiatives to perform new types of analyses and cooperation are welcome.

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