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MORBIDITY AND MORTALITY IN THE NEOLITHIC OF NORTHEASTERN HUNGARY

ABSTRACT: Analysis of 71 human skeletons from archaeological contexts representing the Neolithic of northeastern Hungary suggests slightly higher indicators of morbidity and interpersonal violence than suggested by more recent samples from that same region. This study contributes to a larger effort to examine long-term temporal changes in skeletal samples from that region.

KEYWORDS: Northeastern Hungary – Neolithic – Skeletal – Morbidity

INTRODUCTION

In 1993, the first two authors initiated a program to examine long-term temporal trends in morbidity and mortality in northeast Hungary. The goal of the project was to study samples of human remains in the collections of the Hungarian Natural History Museum which had been carefully excavated, could be dated with reasonable accuracy and which originated from the northeastern area of Hungary. This area of Hungary was selected because an initial survey of the collection records indicated that large samples were available, meeting the criteria of this project and representing key time periods. Data were collected on a selected number of skeletal attributes which offered information on both morbidity and mortality, facilitating broad comparisons with other groups.

This project complements previous research, especially in the Americas, suggesting with some variation, long term temporal trends (among pre-1492 populations) of increasing morbidity and mortality (Armelagos *et al.* 1991, Cohen, Armelagos 1984, Larsen, Milner 1994, Steckel, Rose 2002, Ubelaker 1994, Verano, Ubelaker 1992). Extensive work with diverse samples in the Americas has suggested that increasing population density and sedentism, perhaps coupled with dietary changes, may have been factors in this trend.

The research described above seeks to examine if similar types of temporal change occurred in populations of eastern Europe who underwent long term population changes comparable to those experienced by people in the New World. The project with northeastern Hungary samples began with examination of a large Bronze Age sample from the site of Tiszafüred (Ubelaker, Pap 1996). The remains of 593 individuals were examined to provide the comparative baseline for additional studies. Following a detailed skeletal and dental inventory (Buikstra, Ubelaker 1994), data were collected on a select list of attributes including information on sex, age at death, measurements needed to estimate living stature, trauma, evidence suggestive of anemia and infection, dental disease and other gross pathology.

Subsequently, data collection shifted to samples from northeastern Hungary which could be reliably dated to the Iron Age (Ubelaker, Pap 1998). This sample consisted of 171 individuals originating from two Hungarian archaeological sites, Mezőcsát and Tápiószele. Analysis suggested generally a slight temporal increase in most indicators of morbidity, in comparison with the earlier Bronze Age sample.

This study reports on analysis of earlier samples from northeastern Hungary dated to the Neolithic.

THE NEOLITHIC

The Neolithic represents a period when human populations developed agriculture and animal domestication with the associated greater accumulation of material culture and more permanent settlement. The increased diversity of material culture included the introduction of pottery.

According to classic archaeological chronology, the Neolithic way of life in Hungary lasted from about 4000 to 2500 BC (Makkay 1982). However, a limited number of Neolithic occurrences have been dated by the ^{14}C method. Based on these uncalibrated data, the period lasted between about 5000 and 3500 BC (Kalicz 1980). Hertelendi and his co-workers (1995) reevaluated the Neolithic in eastern Hungary based on calibrated radiocarbon dates. The tell settlements on the Great Hungarian Plain are characterized by consecutive layers of habitation built on top of each other forming vertical stratigraphies. Although the stratified layers or "cultures" defined on a purely typochronological basis (ceramics) had been regarded as sequential, radiocarbon dating reveals some chronological overlap. Based on more than 300 samples from the Neolithic cultures of eastern Hungary, Hertelendi and his team (1998) stated that the most probable time scales for the Early Neolithic range between 5860 and 5310 BC. The Middle Neolithic has been dated between 5330 and 4940 BC, and the Late Neolithic between 4970 and 4380 BC. The estimated 250–300 year duration of the Late Neolithic tell settlements obtained by typological comparisons is also confirmed by radiocarbon data. The newly established ^{14}C date representing the end of the Late Neolithic agrees with the previously established date from the Early Copper Age (Bognár-Kutzián 1985, Bognár-Kutzián, Csongor 1987).

In Hungary the earliest known Neolithic culture was the Körös-Starčevo culture. Plant cultivation and animal domestication were decisive factors in this culture. Their art and cultic life were documented by godess idols, small human-shaped pottery and reliefs with animal images (Kalicz 1980). Their dead were buried within the settlements, in contracted position. During the Middle Neolithic Age in the eastern part of Hungary the Alföld (Great Plain) Linear Pottery Culture (AVK) took shape. Their settlements and dwellings were small and the pottery could be characterized by vessels with faces (Kalicz 1980, Makkay 1982). They also buried their dead within the settlements. Somewhat later the Transdanubian Linear pottery Culture (DVK) was formed in the southern part of Hungary. During the time when the Linear Pottery Cultures were at the peak of their development, a new wave of southern populations arrived to the Carpathian Basin. Under their influence, new cultures took shape. One of these late Neolithic cultures was the Tisza-Herpály-Csőszhalom culture.

The first flowering of the tell tradition in Hungary dates to the Late Neolithic. There is one burial method in the Late Neolithic: intra-mural inhumation on tells, within flat settlements and possibly in separate cemeteries (though none is yet published) (Chapman 2000). In their cult a male god took over the role of the earlier feritility godesses (Makkay 1982).

Sheep and goats were brought to the Carpathian basin in a domesticated form with the earliest Neolithic people (Körös culture). Although Caprovinae were preferred, cattle were also evident. In the Middle Neolithic, a rapid increase of domestic livestock (cattle and pigs) was achieved with species which had wild but domesticable ancestors. In this way the role of hunting increased. The Late Neolithic may be characterized by a very evident breakthrough of hunting aurochs (bison) and wild boar, which can be explained by the "domestic fever" (Bökönyi 1988). Secondary utilization of domestic animals (e.g. for milk, propulsion power, eggs, wool) can also be traced back to this period (Pap 1989).

SITE SAMPLES EXAMINED

Human remains from northeastern Hungary which can securely be dated to the Neolithic period originate from the sites of Tiszavasvári–Deákhalmi dűlő, Kisköre–Gát (Kisköre-Damm) Kisköre–Gáton kívül (Kisköre-Outside Damm), Kisköre–Gátőrház, Tiszavasvári–Paptelekhát, Tiszavasvári–Keresztfal, Aggtelek and Berettyóújfalu–Herpály. These samples are all housed in the storage areas of the Department of Anthropology, Hungarian Natural History Museum in Budapest.

During the excavation of the Tiszavasvári–Deákhalmi dűlő site, six graves were uncovered. The graves belong to the AVK culture (Istvánovics, Kurucz 1993, Istvánovics 1994). Detailed anthropological studies of the series had not been conducted previously, although a pathological investigation was completed in 1994 (Kustár, Pap 1994).

The graves from site Berettyóújfalu–Herpály were excavated by Kalicz *et al.* (1978), and Kalicz (1979, 1980, 1981, 1982, 1983). The site belongs to the Late Neolithic of Hungary, specifically to the Tisza-Herpály-Csőszhalom Culture, and has been radiocarbon dated (the confidence interval 1σ) to 4860–4490 cal BC (Kalicz 1985, Kalicz, Raczky 1987a, b, Raczky 1989). Detailed anthropological studies of the series had not been conducted previously, but stature and body weight had been estimated by Tóth (1986, 1987).

During the excavation of the Tiszavasvári–Deákhalmi dűlő site, six graves were uncovered. The graves belong to the Middle Neolithic Age of Hungary, to the Alföld Linear Pottery culture (Istvánovics, Kurucz 1993, Istvánovics 1994). Detailed anthropological studies of the series had not been conducted previously although a pathological investigation was completed in 1994 (Kustár, Pap 1994).

The graves from the Kisköre–Gát (Kisköre–Dam) site were excavated by Korek. During 1964–1966, 36 graves and 12 dwellings of different types were discovered (Korek 1966, 1967, 1973). The site belongs to the Tisza culture of the Late Neolithic. During the excavation at the sites of Kisköre–Gáton kívül (Kisköre–Outside the Dam) and Kisköre–Gátőrház additional graves were discovered (Korek 1973). The best published example of intra-mural burial on a Late Neolithic settlement is Kisköre-Dam.

Area excavation preceding the dam construction yielded a part of a Middle Neolithic (Alföld Linear Pottery, AVK) settlement, a Tisza settlement with intra-mural graves and an early Copper Age occupation. Four, possibly five, AVK graves were documented. Six Tisza dwellings can be identified at Kisköre, around four of which were groups of graves – two lines and three clusters. Each group contains a different set of age/sex categories. As in the case of Late Neolithic on-tell burials, a clear rule for grave orientation was established. Skull orientation was not only varied but also showed no correlation with sex (Chapman 2000).

The graves from the Tiszavasvári–Paptelekhát site were excavated by Kalicz and Makkay (Kalicz 1958), Csallány (1959), and later by Csallány, Makkay and Gombás (1963). The Tiszavasvári–Paptelekhát sample consisted of 14 individuals. Five male, seven female, and two subadults were examined. The mean age of these individuals is 30.5 years.

The site of Tiszavasvári–Keresztfal was excavated by Csallány *et al*. (1963) and Kalicz (1964). Five individuals were examined from the site of Tiszavasvári–Keresztfal. Four subadults and one male were present in the sample. The mean age of these individuals is 15.1 years.

The Tiszavasvári–Deákhalmi dűlő sample consisted of six individuals: three males, two females, and one immature individual (<15 years of age). The mean age of these individuals is 34.2 years.

Seven individuals from the Berettyóújfalu-Herpály site were examined. Of these, four were male, two female, and one immature individual. The mean age of individuals from this site is 33.5 years.

A total of 34 individuals from the Kisköre–Gát site were examined. This sample included 15 males, nine females, and ten subadults. The mean age of individuals from this site is 25.1. The sites of Kisköre–Gáton kívül and Kisköre–Gátőrház both consisted of one individual each. The sex and age of the individuals are: male, age 15–19; and adult (sex unknown), age 25–29, respectively.

The final site included in this report is Aggtelek. The excavation of the Aggtelek site was led by Korek in 1969 (Korek 1970). This sample consisted of two individuals, a female and an adult of unknown sex, with a mean age of 44.5 years.

Once the samples had been selected for study, each feature was removed from storage, unpacked and arranged on an examining table. A detailed skeletal and dental inventory was conducted following the procedures recommended by Buikstra and Ubelaker (1994) and employed in previous studies of Hungarian samples (Ubelaker, Pap 1996, 1998). Note that the inventory procedure recorded four different levels of completeness of bones and various components of bones. See the publications of Buikstra and Ubelaker (1994), and Ubelaker and Pap (1996) for detail on the scoring procedures employed.

The dental inventory documented each permanent and deciduous tooth using the following classification system:

TABLE 1. Life table for the Neolithic sample, derived from estimates of age at death from the skeletons.

x	D_x	d_x	l_x	q_x	L_x	T_x	e_x
0–0.9	2	2.82	100.00	0.0282	98.590	2863.145	28.63
1–4.9	8	11.27	97.18	0.1160	366.180	2764.555	28.45
5–9.9	7	9.86	85.91	0.1148	404.900	2398.375	27.92
10–14.9	0	0.00	76.05	0.0000	380.250	1993.475	26.21
15–19.9	4	5.63	76.05	0.0740	366.175	1613.225	21.21
20–24.9	4	5.63	70.42	0.0799	388.025	1247.050	17.71
25–29.9	14	19.72	64.79	0.3044	274.650	859.025	13.26
30–34.9	2	2.82	45.07	0.0626	218.300	584.375	12.97
35–39.9	8	11.27	42.25	0.2667	183.075	366.075	8.66
40–44.9	12	16.90	30.98	0.5455	112.650	183.000	5.91
45–49.9	7	9.86	14.08	0.7003	45.750	70.350	5.00
50–54.9	1	1.41	4.22	0.3341	17.575	24.600	5.83
55–59.9	2	2.82	2.81	1.004	7.025	7.025	2.50
60–64.9	0	0.00	0.00	0.0000	0.000	0.000	0.00

(1) present, but not in occlusion, (2) present, fully developed in occlusion, (3) missing, with no associated alveolar bone, (4) missing, with alveolus resorbed indicating ante-mortem loss, (5) missing, with no alveolar resorption indicating post-mortem loss, and (6) incompletely formed teeth, classified using the system of Moorrees, Fanning and Hunt (1963a, b).

Observations of pathological and stress-related conditions included enamel defects, dental caries, alveolar abscesses, ante-mortem loss of permanent teeth, *cribra orbitalia*, porotic hyperostosis, vertebral osteophytosis, trauma, and abnormal periosteal bone formation likely related to infection.

Estimates of sex and age at death were generated using standard non-invasive techniques (Ubelaker 1999). Sex was estimated largely from morphology of the pelvic bones, when they were present. In the absence of pelvic indicators, general bone size was considered, especially cranial morphology.

Ages at death of immature individuals were estimated from the extent of dental formation whenever possible. In other cases, bone size and morphology were considered.

For estimation of age at death in adults, all available criteria were consulted, including morphology of the symphysis pubis and auricular area of the pelvis, dental attrition, ante-mortem dental loss, vertebral osteophytosis, and other general age indicators.

RESULTS

A total of 71 individuals were available from the Neolithic sites. Of these, two were less than one year of age, 17 were less than age 15 and 54 were adults (15 years or older). Of the 54 mature individuals, 22 were females, 29 were males and only three were adults of undetermined sex. The 29 males range in age from 15 to 59, with a mean of 37.6 years. The 22 females range in age from 15 to 54, with a mean of 32.5 years.

Demographic characteristics

Table 1 presents a life table for the combined Neolithic sample. This table has been calculated directly from the age at death information summarized above and assumes a stationary population model. Note that population growth or decline, as well as variations of fertility can impact life table interpretation. Since the magnitude of these factors has not been established for the populations in question, the life table has not been adjusted accordingly.

As reconstructed, the life table suggests a life expectancy at birth of about 29 years, a life expectancy at age 15 of about 21 years and a maximum longevity of about 60 years. The relatively low number of deaths in the first one year age interval is suspicious and may represent preservation or sampling problems rather than low mortality for this age group. The remainder of the age distribution appears reasonable and not suffering from severe sampling problems.

Dental hypoplasia

Within the composite Neolithic sample, 626 permanent teeth were examined for the presence of enamel hypoplasia (*Table 2*). These were relatively evenly distributed between the maxilla (309) and mandible (317). Of these, only nine teeth (1.4%) displayed evidence of enamel hypoplasia. Hypoplastic defects were slightly more common in maxillary teeth (1.9%) than in mandibular teeth (0.9%). Within maxillary teeth, defects were most commonly found among left second premolars (8.7%) and right canines (8.7%), followed by left canines (5.9%) and right first premolars (4.5%). Within mandibular teeth, defects were most frequent in the right first premolars (9.1%) followed by the left canines (5.6%). Lesions were more common in males (2.2%) than females (0.7%).

The nine examples of hypoplasia were found in five individuals. One of these individuals had five lesions, the other four individuals each had one lesion. Within the dentition of the individual with five lesions, a maxillary left second premolar and a mandibular right first premolar each had two lesions. All of the defects were of the linear type.

Dental caries

Observations for carious teeth were recorded for 735 permanent teeth, 347 from the maxilla and 388 from the mandible (*Table 3*). Of these teeth, 46 (6.3%) were carious. Distribution of carious teeth was relatively evenly divided between maxillary (6.1%) and mandibular (6.4%) teeth. Carious lesions were slightly more common in the teeth of females (6.7%) than of males (5.6%). Within the maxillary teeth, caries frequencies among males were 5.9% and 5.1% among females. Within mandibular teeth, carious teeth occurred among males at a frequency of 5.4% and among females at a frequency of 8.0%.

Within the maxilla, the tooth with the highest frequency of dental caries was the right second molar (26.1%), followed by the left first molar (12.0%), left second premolar (11. 1%), and the right first molar (10.0%).

Within mandibular teeth, the highest caries frequency was found in the right first molar (20.0%), followed by the right second molar (16.0%), and right third molar (13.6%).

Of the 46 carious lesions, 22 represented root carious lesions, 19 cervical carious lesions, three large carious lesions and two smooth surface carious lesions.

Alveolar abscesses

Although alveolar abscesses represent lesions in the bony alveolus, they were recorded in regard to their association with particular teeth (*Table 4*). Of 973 observations for alveolar abscesses associated with permanent teeth, 25 abscesses (2.6%) were present. Abscesses were slightly more common in males (2.8%) than females (2.0%). Within the maxilla, lesions were slightly more common (5.3%) among males than females (3.2%). The reverse occurred in the mandible (males, 0.7%; females, 1.0%).Within the maxilla, abscesses were most common in association with

TABLE 2. Frequencies of dental hypoplasia. Values for each tooth type represent the number of teeth with hypoplasia compared to the number of teeth examined.

Maxilla

	Right								Left									
	M^3	M^2	M^1	Pm^2	Pm^1	C	I^2	I^1	I^1	I^2	C	Pm^1	Pm^2	M^1	M^2	M^3	Totals	%
Males	0/8	0/11	0/13	0/13	1/12	2/12	0/11	0/5	0/7	0/10	0/9	0/12	2/13	0/10	0/7	0/8	5/161	3.1
Females	0/8	0/10	0/11	0/9	0/10	0/9	0/6	0/5	0/2	0/8	1/7	0/9	0/9	0/9	0/10	0/8	1/130	0.8
?	0/1	0/2	0/4	0/0	0/0	0/2	0/1	0/2	0/0	0/0	0/1	0/0	0/1	0/3	0/1	0/0	0/18	0.0
Total	0/17	0/23	0/28	0/22	1/22	2/23	0/18	0/12	0/9	0/18	1/17	0/21	2/23	0/22	0/18	0/16	6/309	1.9
%	0.0	0.0	0.0	0.0	4.5	8.7	0.0	0.0	0.0	0.0	5.9	0.0	8.7	0.0	0.0	0.0		

Mandible

	Right								Left									
	M_3	M_2	M_1	Pm_2	Pm_1	C	I_2	I_1	I_1	I_2	C	Pm_1	Pm_2	M_1	M_2	M_3	Totals	%
Males	0/10	0/11	0/15	0/12	2/12	0/12	0/10	0/6	0/6	0/7	0/10	0/11	0/10	0/11	0/10	0/6	2/159	1.3
Females	0/9	0/11	0/12	0/12	0/10	0/7	0/8	0/3	0/5	0/8	1/7	0/10	0/10	0/10	0/9	0/9	1/140	0.7
?	0/1	0/2	0/4	0/1	0/0	0/0	0/1	0/1	0/0	0/1	0/1	0/0	0/1	0/3	0/2	0/0	0/18	0.0
Total	0/20	0/24	0/31	0/25	2/22	0/19	0/19	0/10	0/11	0/16	1/18	0/21	0/21	0/24	0/21	0/15	3/317	0.9
%	0.0	0.0	0.0	0.0	9.1	0.0	0.0	0.0	0.0	0.0	5.6	0.0	0.0	0.0	0.0	0.0		

TABLE 3. Frequencies of carious teeth. Values for each tooth group represent the number of carious teeth compared to the number of teeth examined.

Maxilla

	Right								Left									
	M^3	M^2	M^1	Pm^2	Pm^1	C	I^2	I^1	I^1	I^2	C	Pm^1	Pm^2	M^1	M^2	M^3	Totals	%
Males	1/10	4/12	2/15	0/14	0/14	0/13	0/14	0/7	0/8	0/11	0/11	0/13	1/14	3/14	0/8	0/10	11/188	5.9
Females	0/7	1/10	0/11	1/11	0/11	0/10	0/6	0/5	0/3	1/8	1/8	1/11	1/11	0/8	1/9	0/8	7/137	5.1
?	0/0	1/1	1/4	0/0	0/0	0/2	0/1	0/2	0/1	0/2	0/2	0/1	1/2	0/3	0/1	0/0	3/22	13.6
Total	1/17	6/23	3/30	1/25	0/25	0/25	0/21	0/14	0/12	1/21	1/21	1/25	3/27	3/25	1/18	0/18	21/347	6.1
%	5.9	26.1	10.0	4.0	0.0	0.0	0.0	0.0	0.0	4.8	4.8	4.0	11.1	12.0	5.6	0.0		

Mandible

	Right								Left									
	M_3	M_2	M_1	Pm_2	Pm_1	C	I_2	I_1	I_1	I_2	C	Pm_1	Pm_2	M_1	M_2	M_3	Totals	%
Males	1/11	1/13	3/18	0/15	0/14	0/14	0/13	1/9	0/9	0/11	0/13	1/14	0/13	1/14	2/12	1/9	11/202	5.4
Females	2/11	3/12	3/13	0/14	0/13	0/10	1/10	0/5	0/5	0/8	0/9	1/12	0/11	1/11	1/10	1/9	13/163	8.0
?	0/0	0/0	1/4	0/0	0/1	0/1	0/3	0/2	0/0	0/1	0/1	0/1	0/2	0/4	0/3	0/0	1/23	4.3
Total	3/22	4/25	7/35	0/29	0/28	0/25	1/26	1/16	0/14	0/20	0/23	2/27	0/26	2/29	3/25	2/18	25/388	6.4
%	13.6	16.0	20.0	0.0	0.0	0.0	3.8	6.3	0.0	0.0	0.0	7.4	0.0	6.9	12.0	11.1		

TABLE 4. Frequencies of alveolar abscesses. Values for each tooth group represent the number of abscesses observed compared to the number of observations for abscesses.

Maxilla

	Right								Left									
	M^3	M^2	M^1	Pm^2	Pm^1	C	I^2	I^1	I^1	I^2	C	Pm^1	Pm^2	M^1	M^2	M^3	Totals	%
Males	0/11	0/11	0/13	0/14	4/15	0/15	1/15	2/15	0/15	0/16	0/15	3/15	0/15	2/15	0/13	0/12	12/225	5.3
Females	1/12	2/12	1/13	0/13	0/13	0/13	0/12	1/12	0/10	0/11	0/11	0/11	1/11	0/11	0/11	0/11	6/187	3.2
?	0/1	0/1	0/1	0/1	0/0	0/0	0/0	0/1	1/2	0/2	0/2	0/2	1/3	1/3	0/3	0/3	3/25	12.0
Total	1/24	2/24	1/27	0/28	4/28	0/28	1/27	3/28	1/27	0/29	0/28	3/28	2/29	3/29	0/27	0/26	21/437	4.8
%	4.2	8.3	3.7	0.0	14.3	0.0	3.7	10.7	3.7	0.0	0.0	10.7	6.9	10.3	0.0	0.0		

Mandible

	Right								Left									
	M_3	M_2	M_1	Pm_2	Pm_1	C	I_2	I_1	I_1	I_2	C	Pm_1	Pm_2	M_1	M_2	M_3	Totals	%
Males	0/17	0/18	1/19	1/19	0/18	0/18	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	0/17	2/279	0.7
Females	1/13	0/13	0/14	0/14	0/14	0/14	0/14	0/12	0/12	0/13	0/12	0/13	0/13	1/12	0/12	0/12	2/207	1.0
?	0/1	0/1	0/3	0/2	0/2	0/2	0/3	0/4	0/3	0/3	0/3	0/4	0/5	0/5	0/5	0/4	0/50	0.0
Total	1/31	0/32	1/36	1/35	0/34	0/34	0/34	0/33	0/32	0/33	0/32	0/34	0/35	1/34	0/34	0/33	4/536	0.7
%	3.2	0.0	2.8	2.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0		

TABLE 5. Frequencies of antemortem tooth loss. Values for each tooth group represent the number of teeth lost antemortem compared to the number of observations for possible tooth loss.

Maxilla

	Right								Left									
	M^3	**M^2**	**M^1**	**Pm^2**	**Pm^1**	**C**	**I^2**	**I^1**	**I^1**	**I^2**	**C**	**Pm^1**	**Pm^2**	**M^1**	**M^2**	**M^3**	**Totals**	**%**
Males	2/11	3/14	2/17	1/17	1/17	0/15	0/16	0/12	0/12	0/13	0/14	0/16	0/15	2/16	4/11	3/13	18/229	7.9
Females	3/11	2/13	1/13	0/13	0/12	1/13	1/11	0/10	0/8	0/10	0/12	0/12	0/12	2/11	2/11	3/12	15/184	8.2
?	0/0	0/1	0/4	0/0	0/0	0/2	0/1	0/2	0/2	0/2	0/2	1/2	0/3	0/3	0/2	0/0	1/26	3.8
Total	5/22	5/28	3/34	1/30	1/29	1/30	1/28	0/24	0/22	0/25	0/28	1/30	0/30	4/30	6/24	6/25	34/439	7.7
%	22.7	17.9	8.8	3.3	3.4	3.3	3.6	0.0	0.0	0.0	0.0	3.3	0.0	13.3	25.0	24.0		

Mandible

	Right								Left									
	M_3	**M_2**	**M_1**	**Pm_2**	**Pm_1**	**C**	**I_2**	**I_1**	**I_1**	**I_2**	**C**	**Pm_1**	**Pm_2**	**M_1**	**M_2**	**M_3**	**Totals**	**%**
Males	1/14	2/17	1/19	1/17	0/16	0/17	0/15	1/12	1/12	0/14	0/16	1/17	0/16	1/17	2/16	2/13	13/248	5.2
Females	0/14	2/16	1/15	0/16	0/16	0/13	0/13	0/10	0/9	0/11	0/12	0/13	1/14	1/14	2/14	2/13	9/213	4.2
?	0/0	0/2	0/4	0/2	0/1	0/1	0/3	0/2	0/2	0/2	0/3	0/2	0/2	0/5	0/4	0/1	0/36	0.0
Total	1/28	4/35	2/38	1/35	0/33	0/31	0/31	1/24	1/23	0/27	0/31	1/32	1/32	2/36	4/34	4/27	22/497	4.4
%	3.6	11.4	5.3	2.9	0.0	0.0	0.0	4.2	4.3	0.0	0.0	3.1	3.1	5.6	11.8	14.8		

the right first premolar (14.3%), followed by the right central incisor and the left first premolar (10.7%). Within the mandible, abscesses most frequently occurred in association with the right third molar (3.2%), followed by the right second premolar (2.9%) and the left first molar (2.9%).

Alveolar abscesses usually result when the pulp cavity of the associated tooth has been exposed because of carious lesions and/or extreme dental attrition.

Ante-mortem tooth loss

Ante-mortem tooth loss was recorded when a tooth was not present and the associated alveolus presented evidence of remodelling (*Table 5*). Of 936 observations for ante-mortem loss of permanent teeth, 56 (6.0%) involved ante-mortem loss. Frequencies for males and females were about the same. Permanent teeth were lost ante-mortem with a slightly higher frequency in the maxilla (7.7%) than in the mandible (4.4%).

Within the maxilla, the highest frequency of ante-mortem tooth loss was with the left second molar (25.0%), followed by the left third molar (24.0%) and the right third molar (22.7%).

Within the mandible, the highest frequency of ante-mortem loss of permanent teeth was with the left third molar (14.8%), followed by the left second molar (11.8%) and the right second molar (11.4%).

Deciduous teeth

Seventy-one deciduous teeth were examined for the same problems described above for adult teeth. Of 43 observations for carious lesions, none were present. Of 63 observations for associated alveolar abscesses, none were present. Of 66 observations for dental hypoplasia, none were present. Of 71 observations for ante-mortem tooth loss, none were present.

Cribra orbitalia

Cribra orbitalia represents abnormal bone formation of the superior area within the orbits. Examples of this condition were classified into one of three categories: bony deposits, fine porosity, or extensive porosity.

In the adult orbits, *cribra orbitalia* was present in three of 30 left orbits (10.0%) and five of 31 right orbits (16.1%). In adult males, only one of 15 left orbits (6.7%) and one of 12 right orbits (8.3%) displayed a form of this condition. Within female orbits, the trait was present in two of 15 left orbits (13.3%) and four of 19 right orbits (21.1%). All expressions of *cribra orbitalia* in adults were of fine porosity, except for one example of extensive porosity in one right orbit.

Within subadults, the condition was detected in one of four left orbits (25.0%) and one of four right orbits (25.0%). All of the subadult examples consisted of fine porosity.

Porotic hyperostosis

This condition refers to abnormal bone deposits and/or porosity on the cranial vault. When found in other samples, this condition usually is concentrated on the parietal bones. No examples of this condition were found in the Neolithic sample reported here.

Vertebral osteophytosis

For each individual, the maximum expression of osteophyte formation was recorded for each vertebral group (cervicals, thoracics, and lumbars). *Table 6* presents these data, showing that osteophytosis occurred in all vertebral groups of both males and females. The extent of osteophytosis was assessed in 81 vertebral groups. Of these 81 groups, no osteophytosis was recorded in 31. Of the other 50 groups with osteophytosis, the maximum expression was at stage

TABLE 6. Observations of the stage of vertebral osteophytosis in adult centra.

		Vertebral stage			
Bone	**Sex**	**0**	**1**	**2**	**3**
Cervical	male	9	2	2	0
Thoracic	male	3	10	3	0
Lumbar	male	2	10	5	1
Cervical	female	9	0	0	0
Thoracic	female	6	7	1	0
Lumbar	female	2	7	1	1
Cervical	unknown	0	0	0	0
Thoracic	unknown	0	0	0	0
Lumbar	unknown	0	0	0	0
Total		31	36	12	2

FIGURE 1. Pathological alterations of right distal radius and ulna of an adult male from Kisköre-Gát (68.29.27).

FIGURE 2. Healed trauma involving the frontal of an adult male from Tiszavasvári-Paptelekhát (68.39.1).

one in 36 groups, stage two in 12 groups and stage three in two groups.

In both sexes, evidence of osteophytosis was found most commonly in the lumbar vertebrae (76.0% of all adults), followed by the thoracic vertebrae (70.0%) and the cervical vertebrae (18.0%). When osteophytosis was present, its maximum expression was confined to stage one in 36 examples, stage two in 12 examples and stage three in only two examples (note example in this context refers to maximum expression in each vertebral group not in each individual).

Trauma

Evidence of skeletal trauma was detected on 12 bones from four individuals in this sample.

The 40 to 44 year old male from Tiszavasvári–Deákhalmi dűlő 12 presents a depressed fracture on the right parietal. The alteration is oval shaped, measures approximately 19 mm by 27 mm and shows evidence of healing.

The 35 to 39 year old male from Kisköre–Gát 68.29.27 displays an unusual deposit of bone on the right distal radius (*Figure 1*). Morphology of the alterations suggests generalized trauma to the wrist area. This individual also displays slight skeletal exostoses on the distal right tibia and fibula which likely are trauma related.

The 40 to 44 year old male from Tiszavasvári–Paptelekhát 68.39.1 shows old healed trauma to the frontal. The alteration is oriented vertically in the midline (slightly to the right side) and measures 25 mm by 53 mm (*Figure 2*).

The 45 to 49 year old male from Tiszavasvári–Paptelekhát 68.40.1 displays five depressed fractures on the cranium. The locations and approximate measurements of these five depressed fractures are as follows: frontal, 8 mm by 10 mm; both parietals (midline), 13 mm by 15 mm; both parietals (midline), 16 mm by 20 mm; left parietal, 21 mm by 25 mm; right parietal, 11 mm by 24 mm.

The ratio of the number of bones with trauma (12) to the number of adults (54) in the sample is 0.22. The ratio of the number of bones with trauma (12) to the number of individuals in the sample (71) is 0.17. The ratio of the number of adults with trauma (four) to the number of adults in the sample (54) is 0.07. The ratio of the number of adults with trauma (four) to the number of individuals in the sample (71) is 0.06. No evidence of trauma was found on immature remains.

Completion of the detailed inventory allows assessment of the frequency of trauma for each type of bone, or part of bone. This assessment is important in this study because of the fragmentary and incomplete nature of the remains. *Table 7* presents the number of each bone with evidence of trauma compared to the total number of those bones in the sample. The resulting fractions suggest that the right parietal was the bone most commonly involved in trauma (four alterations on two individuals), followed by the left parietal, frontal, right distal radius, right distal tibia and right distal fibula.

Abnormal periosteal lesions

Abnormal periosteal lesions represent deposits of periosteal bone on the normal outer bone surface. Although such deposits frequently are attributed to infection, other causes, especially local trauma, cannot be ruled out.

Abnormal periosteal lesions were located on five bones of two male individuals in the Neolithic sample. The 30 to 34 year old individual of Kisköre–Gát 68.29.30 presented well-remodelled deposits on the distal tibiae and fibulae (four bones).

The additional example originates from the 15 to 19 year old probable male from Kisköre–Gáton kívül 68.29.36. This individual showed well-remodelled deposits on the left tibia anterior midshaft.

The ratio of the number of bones with lesions (five) to the number of individuals in the sample (71) is 0.07. The ratio of the number of bones with lesions (five) to the number of adults in the sample (54) is 0.09. The ratio of the number of

TABLE 7. Comparison of the number of bones with trauma to the total number of bones in the sample.

Affected bone	Number with lesions	Total number	Fraction
R parietal	4	47	0.0851
L parietal	3	48	0.0625
Frontal	2	46	0.0435
R radius distal	1	41	0.0244
R tibia distal	1	45	0.0222
R fibula distal	1	36	0.0278

TABLE 8. Comparison of the number of bones with periosteal lesions to the total number of bones in the sample.

Affected bone	Number with lesions	Total number	Fraction
R tibia distal	1	45	0.0222
L tibia distal	1	52	0.0192
L tibia middle	1	51	0.0196
R fibula distal	1	36	0.0278
L fibula distal	1	35	0.0286

individuals with lesions (two) to the number of individuals in the sample (71) is 0.03.

The detailed inventory allows examination of the frequency of abnormal periosteal lesions by area of bone involved in consideration of the total number of those bone segments in the sample. The five examples of abnormal periosteal lesions were present on five distinct bone segments (*Table 8*). Although single examples of lesions at each of these locations were detected, the frequency of the corresponding bone segments in the total sample varied from 35 (distal left fibula) to 52 (distal left tibia). Accordingly, the frequency of the lesions in the number of bone segments present (*Table 8*) varies from 0.0192 (left distal tibia) to 0.0286 (left distal fibula).

Skeletal robusticity

To provide some measure of skeletal robusticity, measurements of the mid-diaphyseal circumference were recorded for adult femora and tibiae. All measurements were recorded in millimetres using a flexible tape measure. Left bones were measured when available. Bones from the right side were measured when left bones were not available.

For males, measurements were recorded for 23 femora and 20 tibiae. The femoral measurements ranged from 81 mm to 104 mm with a mean of 89.8 mm and a standard deviation of 4.8. For the tibia, measurements ranged from 77 mm to 97 mm with a mean of 85.1 mm and a standard deviation of 5.2.

For females, measurements were recorded for 15 femora and 15 tibiae. The femoral values ranged from 70 mm to 90 mm with a mean of 80.5 mm and a standard deviation of 5.6. The tibia values ranged from 64 mm to 86 mm with a mean of 75 mm and a standard deviation of 6.4.

Estimated living stature

Living stature was estimated from long bone lengths using the formulae of Trotter (1970) for White males and females. Stature was estimated from the maximum length of the left femur whenever possible. In the absence of the left femur, the right femur was substituted, or in one case in a female skeleton, the right fibula.

For adult males, living stature was estimated for 15 individuals. These estimates ranged from 159.0 cm to 180.4 cm with a mean of 168.1 cm and a standard deviation of 6.6.

Statures of adult females were estimated for 12 individuals. These estimates ranged from 147.7 cm to 164.5 cm with a mean of 155.0 cm and a standard deviation of 6. 1.

Other published studies

Though the increasing number of archaeological excavations resulted in a growing number of anthropological material representing the prehistoric population of the Carpathian Basin, research summaries have been restricted to smaller geographical units of the Basin, and to shorter periods of the prehistory (Zoffmann 2000a). Two previous studies have involved systematic pathological evaluation for the Neolithic period in Hungary. One of these was the examination of the population from the southeastern part of Hungary, mainly from the Körös-Starčevo and Tisza cultures (Farkas, Marcsik 1975). The other concentrated on the Late Neolithic of western Hungary (Regöly-Mérei 1962). The pathological study of the Zengővárkony series (Transdanubia) was made by Regöly-Mérei (1960, 1962). He found severe spondylothic changes of the vertebrae, arthritic alteration on the pelvis and on the sacrum and arthrosis of the mandibular joint. The same author (Regöly-Mérei 1960) and later Bartucz (1966) described multiple injuries of a male skull from the same cemetery caused by blow (possibly a stone-axe). Zoffmann (1974) also described some additional pathological alterations found in the material. Zoffmann (1985) mentioned spondylosis and spondylarthropathia in the middle Neolithic samples.

Farkas (1974) mentioned one example of sharp force trauma of a female and vertebral osteophytes of one male in the Early Neolithic material of Szegvár-Tűzköves. He described cases of *spondylosis deformans*, arthrosis, spondylarthrosis, healed fractures and sharp force trauma, severe periostitis, as well as *cribra orbitalia* and *cribra cranii* (Farkas 1994). Data have been published on *cribra orbitalia*, and porotic hyperostosis (Farkas, Marcsik 1975, 1988). Some of these lesions were found in the anthropological material of the Early and Late Neolithic periods. The vast majority of the specimens affected were children and young women (Zoffmann 1986).

Previous studies have suggested that caries was relatively rare during the Neolithic (Schranz, Huszár 1962). Pit and fissure caries, and proximal caries of incisors and canines were uncommon. Cervical caries was the most frequent type.

In a comparative caries study Schranz and Huszár (1952) examined 48 adult skulls of the ancient period from the western part of Hungary (Transdanubia). They found 2.17% caries intensity and 0.53% ante-mortem lost teeth intensity with “intensity” representing the percentage of teeth with lesions.

Two years later Schranz and Huszár (1954) extended their examination to the skulls excavated from the whole territory of Hungary (36 subadults and 240 adults: 4 Neolithic Age, 141 Eneolithic Age, 85 Copper Age). They found 1.62% caries intensity and 2.44% ante-mortem lost teeth intensity (Schranz, Huszár 1954).

Schranz and Huszár (1962) examined tooth caries among individuals from the Neolithic (N=22 skulls), the Eneolithic (N=120) (Eneolithic=the end of Neolithic), the Copper Age (N=137), and the Iron Age (N=118). They found caries frequency to be 13.6% from the Neolithic, 19.9% from the Eneolithic, 15.6%, from the Copper Age, and 16.0% from the Iron Age. They calculated a 16.5% mean caries frequency for the whole ancient period in adults, and 5.1% in infants. They noted that among the prehistoric material, carious teeth and lost teeth were relatively uncommon, showing little temporal variation. They also noted that carious lesions on the buccal sides of the teeth were most common. During the Neolithic, Eneolithic and Copper Age, both proximal and buccal carious lesions were concentrated at the cemento-enamel junction.

In the Neolithic period almost all types of caries began at the cemento-enamel junction (Molnar, Molnar 1985). Farkas (1974) mentioned several cysts of two individuals from the 14 Neolithic (Tisza Culture) specimens. Farkas and Szalai (1992) described cervical caries, *cribra orbitalia* and porotic hyperostosis of a young (6–8-year-old) individual.

Zoffmann (1968, 1985, 1996a,b, 2000b, 2001, 2005) mentions very few examples of pathological alterations and carious lesions in the Neolithic. One of the few severe cases was a 40–44-year-old woman from the late period of the Körös Culture who had enamel hypoplasia (upper incisors), ante-mortem lost teeth, and suffered from a healed fracture with shortening of her clavicle (Zoffmann 1997). In addition, a very unique alteration, deep grooves in a transverse orientation on the occlusal surface, was found on the upper incisors of a 48–57-year-old woman (Zoffmann 2001). Similiar grooves have been described in a sample from the early Neolithic site of Ecsegfalva 23 (Schulting, in press).

Tóth (1985, 1986, 1987) suggested that paleosomatological reconstruction based on the postcranial data showed a clearly expressed sexual dimorphism, both in stature and body weight. The marked difference found in stature and weight of the people from the eastern and southern part of Hungary was explained by different ecological factors and diets (Tóth 1985, 1986, 1987). In general, stature values reported in the literature are difficult to compare due to variability in estimation methodology.

Farkas and Marcsik (1988) did not find severe pathological alterations on the 17 individuals from two Late Neolithic sites from southern Hungary. They found Schmorl's nodes on an adult female's thoracic vertebra, spondylosis of a thoracic vertebra of a senile female, and traces of severe periostitis on the long bones of two adults (female?, and a mature male).

Farkas, Marcsik and Oláh (1993) described pathological alterations of 63 specimens from a Neolithic cemetery of south-eastern Hungary including *spondylosis deformans*, spondylarthrosis, periostitis, healed fractures, sharp force trauma, *cribra orbitalia* and osteoporosis. They also called attention to the small sample size but suggested that health status of the people examined was quite good, based on the evidence of the low number of pathological alterations.

Kustár and Pap (1994) examined six specimens from the Neolithic site of Tiszavasvári–Deákhalmi dűlő (northeastern Hungary). The adults' bones bore the marks of considerable pathological alterations. The most conspicuous deformations were the unusually overdeveloped muscle adhesion grooves, due to hypertrophied musculature formed by overwork. A mature age woman had overdeveloped muscle adhesion surfaces on her forearms. The skeleton of a senile age male bore the marks of physical overstress. The degree of development of the muscular adhesion surfaces on his arms and on his abdominal and dorsal musculature indicated some physical labour (regular lifting of heavy objects). Alterations on his spine and lower extremities pointed towards extensive overuse. This person showed deforming arthritis in his sternoclavicular joint and a healed depressed fracture on his skull (*tuber parietale*). An adult female had badly deformed articular joints of both ulnae. Well developed enthesopathies occurred on the calcaneus of two males.

Bernert, Csapó and Eszterhás (2002) found slight osteoporosis, and no traces of any kind of pathological lesions of a 15 to 20-year-old specimen from the Neolithic of Transdanubia.

DISCUSSION

The analysis of the Neolithic sample from northeastern Hungary summarized above presents important comparative data about the mortality and morbidity of those populations. Comparisons with later populations from this region are possible because of previous studies of samples from the Copper Age (Ubelaker, Pap unpublished manuscript), Bronze Age (Ubelaker, Pap 1996) and Iron Age (Ubelaker, Pap 1998). Because data from these four periods were collected using identical procedures by the same investigators, they are directly comparable. The comparison allows assessment of temporal trends in this region beginning with the Neolithic, as early as about 4000 BC and extending to the Iron Age, with a terminal date of about the beginning of the Christian Era. Of course, neither all populations nor all time periods within this 4000 year period are represented. Hopefully the 1018 individuals who make up this composite sample provide a representative look at the temporal trends involved.

High values for the Neolithic

Somewhat unexpectedly, the majority of the indicators in this four period comparison suggest greater morbidity in the Neolithic than in later periods. For example, the percentage of permanent teeth with carious lesions decreases significantly from 6.3% in the Neolithic to 2.3% in the Copper Age, 3.2% in the Bronze Age and 3.7% in the Iron Age.

Untreated carious lesions can produce alveolar abscesses, thus it is expected that the latter should follow similar trends as the former. The frequency of alveolar abscess was highest of all samples in the Neolithic (2.6%). This frequency decreased in later samples to 0.8 in the Copper Age, 0.4 in the Bronze Age, and 1.5 in the Iron Age. The trends were very similar for both males and females.

The similarly related condition of ante-mortem loss of teeth decreases from 6.0% in the Neolithic to 5.2% in the Copper Age, 4.7% in the Bronze Age and 5.0% in the Iron Age.

The percentage of dental hypoplasia in the permanent teeth of males decreased through time. In the Neolithic sample, 2.2% of all teeth examined from adult males presented evidence of hypoplasia. This value was reduced to only 0.3% in the Copper Age, 0.5% in the Bronze Age and then it increased slightly to 1.8% in the Iron Age. Values for *cribra orbitalia* in adults generally decrease through time. In left orbits, the alterations were found with a frequency of 10.0% in the Neolithic, 2.5% in the Copper Age, 5.3% in the Bronze Age and then 11.4% in the Iron Age. In right orbits, the lesions were present at a frequency of 16.1% in the Neolithic, no examples were found in the Copper Age samples, and frequencies of 7.4% in Bronze Age samples, and 8.5% in Iron Age samples.

All calculations of adult trauma decreased with time with highest frequencies in the Neolithic. For example, the ratio of adult bones with trauma to the number of adults in the sample decreased from 0.22 in the Neolithic to 0.03 in the Copper Age, 0.04 in the Bronze Age and 0.03 in the Iron Age. Similar trends are revealed in comparisons of other calculations of adult trauma (e.g. ratio of number of bones with trauma to the number of individuals in the sample, ratio of the number of adults with trauma to the number of adults in the sample, ratio of the number of individuals with trauma to the number of individuals in the sample). In addition, whereas the right parietal was the most common bone with evidence of trauma in the Neolithic, trauma was most commonly found on long bones in later periods (left radius in the Copper Age, left clavicle in the Bronze Age and right fibula in the Iron Age). Although sample sizes are small, at face value these data would suggest a temporal shift from interpersonal violence in the Neolithic to accidents in later periods producing the detected trauma.

Additional perspective is gained by assessing the number of examples of trauma which likely reflect interpersonal violence, as opposed to accidents, falls or other types of injuries. In the Neolithic sample, seven lesions on three individuals likely reflect interpersonal violence. The values for the Copper Age are one example on one individual, five examples on four individuals in the Bronze Age and only one example on one individual in the Iron Age.

The ratio of the number of examples of likely interpersonal trauma to the number of adults in the sample for the Neolithic is 0.13. This value is only 0.01 for the Copper Age, Bronze Age and Iron Age.

The related calculation of the ratio of the number of individuals (all adults) with evidence of interpersonal violence to the number of adults in the sample is 0.06 for the Neolithic sample. This ratio is only 0.01 for the samples from the more recent periods.

The frequencies of abnormal periosteal lesions, likely reflecting infection, suggest relatively high levels during the Neolithic, a decrease during the Copper Age and then an increase again in the later Bronze Age and Iron Age. For example, the ratio of total bones with evidence of abnormal periosteal bone to the total number of adults was 0.09 for the Neolithic sample, 0.01 for the Copper Age and 0.08 for both the Bronze Age and Iron Age. Other expressions of this condition revealed similar patterns.

The final condition of morbidity which shows the highest expression in the Neolithic is osteophytosis. As noted above, this condition was recorded as the greatest expression within each vertebral group. The classification system consisted of 0 (no osteophytosis), 1 (sharpened margins), 2 (defined osteophytosis) and 3 (extreme osteophytosis). Sixty-two percent of the values for the vertebral groups in the Neolithic indicated the presence of osteophytosis (stage one or higher). This value was 51% in the Copper Age, 45% in the Bronze Age and 45% in the Iron Age. While osteoarthritis of the spine can be produced by disease and activity-related stress, it also generally increases with age of the individual.

Living adult stature and long bone lengths represent the culmination of the growth process. As such, they reflect the complex factors contributing to bone growth. Although genetics can play a significant role in this process, nutrition and morbidity are key factors. The Neolithic male mean stature of 168.1 cm is slightly shorter than the successive periods of 168.2 for Copper Age, 168.3 for Bronze Age and 168.9 for Iron Age.

Low values for the Neolithic

Only four indicators of morbidity/mortality increased through time in this comparison, with low values for the Neolithic.

Both life expectancy at birth and at age one decrease slightly from the Neolithic. Life expectancy at birth calculated from the Neolithic sample was 29 years, compared with 28 for the Copper Age, 24 for the Bronze Age and 27 for the Iron Age. Although these differences indicate a temporal change of decreased life expectancy at birth, they are minimal and difficult to interpret because of the possibility of sampling bias within the samples.

Similarly, the calculation of life expectancy at age one was 28 years based on the Neolithic sample. The value was also about 28 years in the Copper Age and then decreased in subsequent periods to 24 years in the Bronze Age and 27 years in the Iron Age. As with the life expectancy at birth values, these differences are relatively minimal and difficult to interpret for the reasons discussed above.

Porotic hyperostosis for both adults and subadults was detected in neither the Neolithic nor Copper Age samples. In adults, the condition also was not found in the Bronze Age sample but frequencies of 1.2% were reported on both the left and right sides in the Iron Age sample. In subadult skeletons, evidence of porotic hyperostosis was found only in the Bronze Age sample with frequencies of 3.5% of left parietals and 4.3% of right parietals.

No examples of trauma were detected in immature skeletons from the Neolithic. The Copper Age and Iron Age samples also yielded no evidence of skeletal trauma in immature remains. However, minimal evidence of trauma in immature remains was detected in the Bronze Age sample. In the Bronze Age sample, the ratio of the number of immature bones with trauma to the number of immature individuals in the sample was a very low 0.01.

Attributes with temporal variability

Several of the biological attributes revealed no clear trend in the temporal comparisons or revealed values that varied in no apparent pattern. For example, whereas the frequency of dental hypoplasia in males in the Neolithic sample was higher than any succeeding period, the value for females (0.7%) was the lowest, but subsequent female values varied from 1.7% in the Copper Age, 0.07% in the Bronze Age and 5.7% in the Iron Age. The overall dental hypoplasia percentage for permanent teeth was 1.4% for the Neolithic, 0.7% for the Copper Age, 0.5% for the Bronze Age and 4.9% for the Iron Age.

The percentage of the Neolithic individuals with an age at death greater than 15 years was 76. This value in the Copper Age increased to 85%, followed by 70% in the Bronze Age, and then up again to 84% in the Iron Age. As with the other demographic variables discussed above, these values could be influenced by sampling problems, especially the loss of infant remains due to preservation problems or other factors.

The percentage of subadult orbits with *cribra orbitalia* also varied in no clear pattern. The percentages for left orbits were 25.0% in the Neolithic, 18.2% in the Copper Age, 25.0% in the Bronze Age and 26.7% in the Iron Age. The values for right orbits were 25.0% for the Neolithic, 33.3% for the Copper Age, 31.0% for the Bronze Age and 23.1% for the Iron Age.

Although Neolithic male statures were estimated to be the shortest in the chronological sequence, female statures revealed a slightly different pattern. The female Neolithic mean stature was 155.0 cm, followed by values of 156.7 cm for the Copper Age, 157.2 cm for the Bronze Age and 154.3 cm for the Iron Age.

Measurements of long bone circumference showed varied results in temporal comparisons. For the femur, the Neolithic male mean was 89.8 mm, followed by 89.4 mm for the Copper Age, 91.4 mm for the Bronze Age and 90.0 mm for the Iron Age. The male tibia value was 85.1 mm for the Neolithic, 85.9 mm for the Copper Age, 86.0 mm for the Bronze Age and 84.0 mm for the Iron Age.

For females, the mean circumference of the midshaft femur was 80.5 mm in the Neolithic, 81.6 mm in the Copper Age, 81.0 mm in the Bronze Age and 79.8 mm in the Iron Age. The female tibia values were 75.0 mm in the Neolithic, 75.4 mm for the Copper Age, 75.6 mm for the Bronze Age and 73.2 mm for the Iron Age.

Although the data discussed above show some variability, they argue that significant morbidity occurred during the Neolithic in northeastern Hungary, in comparison with the later time periods included in the study. This evidence contrasts somewhat with various studies in the Americas which suggest a gradual temporal increase in morbidity with some geographic variation.

The relatively high levels of morbidity suggested for the Neolithic may indicate difficulties in adjustment for the populations of northeastern Hungary. The increased sedentism and population density associated with agriculture and animal domestication may have been accompanied by elevated disease loads, nutrition problems and interpersonal violence that subsided somewhat during later periods in this area.

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