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DEMOGRAPHIC AND ENVIRONMENTAL ASPECTS OF EARLY BRONZE AGE POPULATION AT MELČICE IN SLOVAKIA

ABSTRACT: In this study 32 individuals from Melčice-Lieskové (District of Trenčín), in Western Slovakia were scored for basic anthropological features, including palaeodemographical aspects, body stature, palaeopathological aspects, prevalence of dental enamel hypoplasia (DEH), cribra orbitalia, dental caries, and buccal dental microwear patterns in order to discover basic characteristics of diet, and the extent of non-specific stressors (i.e. indicators of metabolic and nutritional disruptions) during the Early Bronze Age (16th–15th century BC, Maďarovce culture). The sample comprises four subadults (0–19 year-old), 25 adult individuals, and fragmentary human remains of four individuals with total number of 268 permanent and 14 deciduous teeth. The mean estimated body stature in adult males was 167 cm, in females 160 cm. Palaeopathology aspects reveal the normal findings most frequently associated with degenerative changes in skeletons. Values of caries intensity were (7.0) and its frequency (64.3). Higher values of caries intensity were found in males (7.5) than in the female population (6.9). These values showed lower caries intensity values within the examined Early Bronze Age population compared with previously studied skeletal samples from the Neolithic period in Moravia, Czech Republic. Dental enamel hypoplasia was present in high frequency (55.6%) compared to the Neolithic Moravian populations. In order to find out dietary practices, buccal dental microwear analysis was carried out on individuals with well-preserved enamel i.e. on 11 adult individuals. The results of buccal microwear analyses showed a mixed diet with a relative high ratio of meat consumption. Overall anthropological analysis suggests low indicators of environmental stressors related to the prevalence of dental caries, pre-mortem tooth loss and palaeopathological aspects, even if quite high scores for prevalence of dental enamel hypoplasia were noticed. Relative high values of demographical scores and good nutritional status confirmed the general good state of the population's fitness and ability to cope non-specific stressors.

KEY WORDS: Early Bronze Age – Demography – Body stature – Dental caries – Pre-mortem tooth loss – Dental Enamel Hypoplasia – Palaeopathological aspects – Buccal dental microwear – Diet – Western Slovakia

INTRODUCTION

The municipality of Melčice-Lieskové (District of Trenčín) is situated in the west of Slovakia in the Považské podolie valley at the foot of the White Carpathians (*Figure 1*). The position of Sedličky, where the studied graveyard was partially researched, is situated south-eastwards from the municipality. On the basis of the bronze grave artefacts, the graveyard at Melčice-Lieskové is dated to the Early Bronze Age – the Maďarovce Culture (16th–15th century BC), which is one of the best-researched cultures of that period, and well-known as a part of large cultural complex of Maďarovce-Böheimkirchen-Věteřov-group. Compared to the settlements, however, the graveyards are less well-known. They have only been recorded in the basin of the river Nitra so far; or in one case in the northern part of the Danube Lowland (Furmánek *et al.* 1991: 80). The locality of Melčice-Lieskové is the first discovered graveyard of the

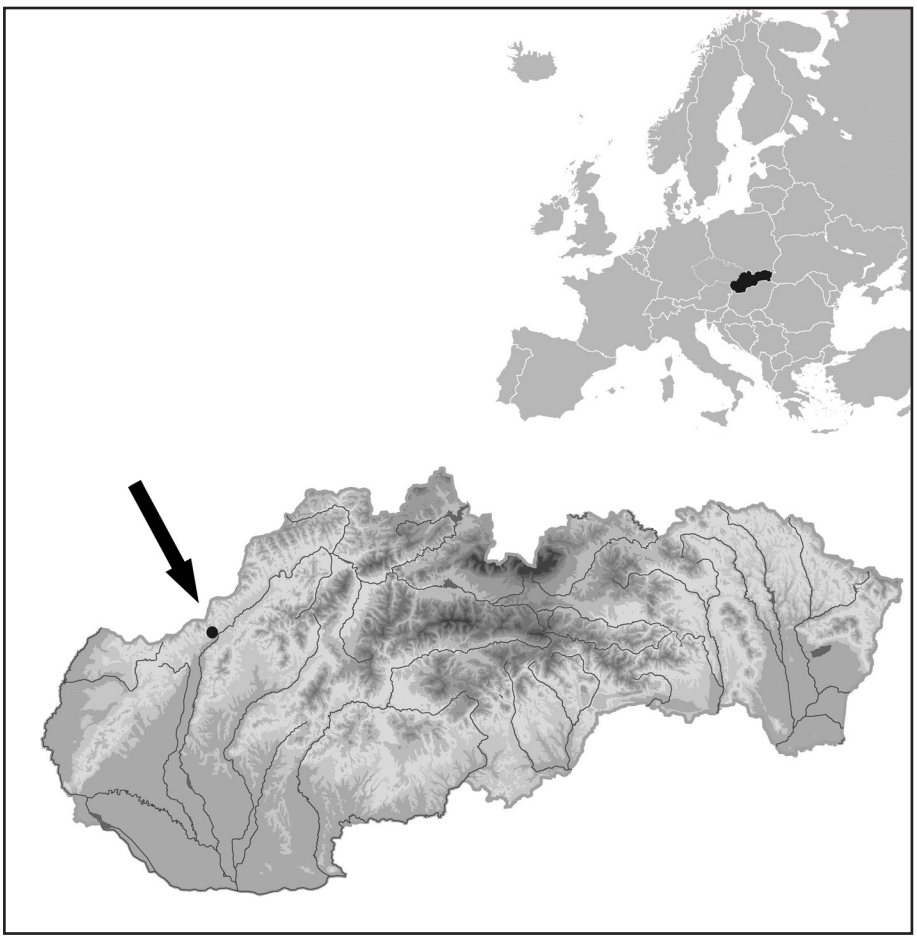

FIGURE 1. Location of Melčice-Lieskové site, District of Trenčín, Slovakia.

Maďarovce Culture in the region of Považie in the west of Slovakia. Its importance with respect to the development of a cultural country of the Early Bronze Age is emphasised by the proximity of the well-known contemporary fortified settlement of the Maďarovce Culture in the municipality of Ivanovce. We assume that the graveyard in Melčice and the aforementioned fortified settlement form one settlement area.

In the locality, 11 settlement pits, dated to the Late Bronze Age, and 32 graves from the Maďarovce Culture period were identified and subsequently exploited during the conservation research carried out by VIA MAGNA s.r.o., a private Slovak archeological company, in 2010. The individuals were laid in the graves in a crouched position with arms bent at the elbows and palms placed under the skull. The graves are mostly oriented in the east-west direction. A description of the movement of the skeletons in the grave pit is undoubtedly worth mentioning. Regarding the discovery – missing parts of skeletons (eight graves), damage to the anatomical position of the skeletons (10 graves); we can assume that the graves had been robbed as long ago as in the prehistoric period. It is not possible to determine the time between the burial and the grave-robbery, we may only determine that it took place after the decomposition of the organic parts of the body.

The grave artefacts do not deviate from the norm of known contemporaneous graveyards of the Maďarovce Culture (Bátora 2000). Each grave in Melčice contained at least one ceramic vessel placed next to the legs of the buried individual, except for grave 19 of an adult male (stratigraphic unit no. 1078), where two other vessels were found in the content of the grave pit. Besides ceramics, bronze pins with pierced heads and bronze rings were found in the graves and a bronze triangular dagger in a partially preserved organic case was found in grave 19, lying next to the male's breastbone. A little bronze axe with the remains of an organic case was found next to the head of the man from grave 19. Amber and bone beads discovered in the content of grave 19 and around the child's chest in grave 22 (stratigraphic unit no. 1087) are among the exceptional finds (*Figure 2*). The variety of the grave artefacts is completed with finds of animal bones in graves 19, 22 and 25.

The main aim of this paper is focused on a detailed anthropological analysis of an Early Bronze Age population found in Western Slovakia, whose skeletal material is quite unique due to the small number of known graveyards and its location within above described geographical area. Another interesting aspect is that graveyard in Melčice-Lieskové is the most northerly presence of populations linked with Maďarovce culture, as the other graveyards are located in south-western areas of Slovakia (e.g. Jelšovce polyculture site – see Bátora 2000, Bátora, Schultz 2001). As there are only some basic aspects of these inhabitants

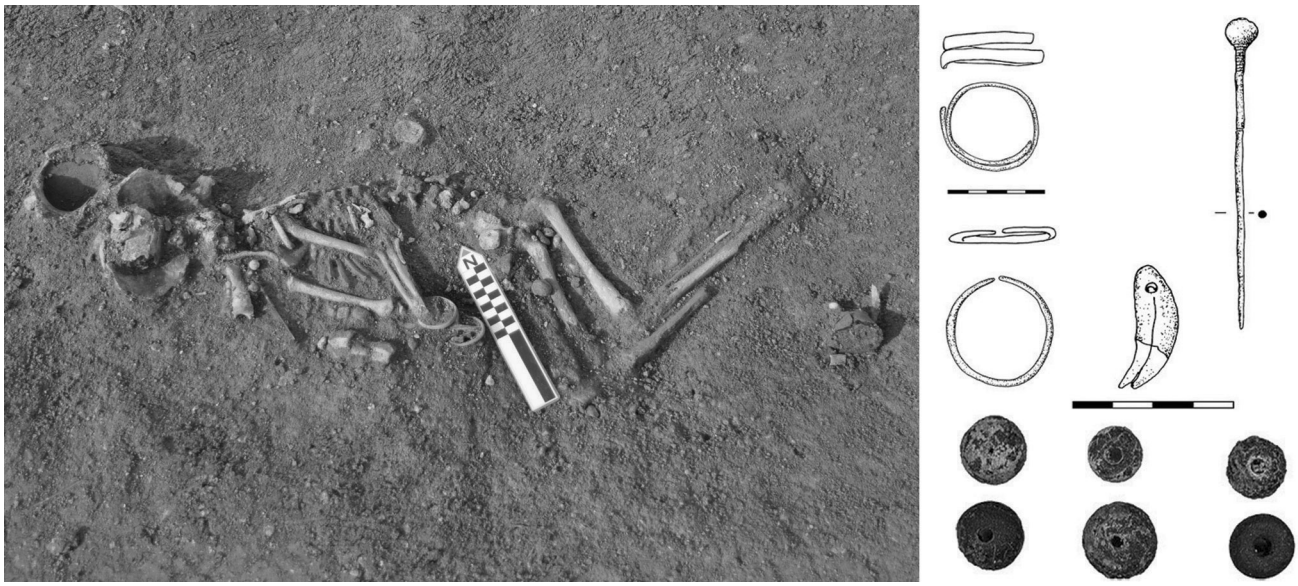

FIGURE 2. Child's grave 22 (stratigraphic unit no. 1087) with breads, animal tooth, and bronze objects (rings and pin).

known, we tried to focus not only on physical aspects of the then inhabitants, but also on the reconstruction of the living conditions of that time. Using skeletal and dental remains, we focused on the health status of individuals and reconstructed basic aspects of their diet.

MATERIAL AND METHODS

Final analyses of skeletal samples from Melčice-Lieskové consisted of 32 individuals (four individuals were researched when digging trenches 1–4, the remaining 28 individuals were buried in graves, which were researched during the ground plan excavation). The graves were partially damaged by agrarian activity. Eighteen graves in the graveyard were damaged by secondary intervention, either as a result of the recent agrarian activity or grave-robbers. The re-opening of eight graves is shown in that some parts of the skeletons are missing and marks of a pit dug by grave-robbers are preserved in the grave content in one case. Only two grave units remained intact.

A detailed skeletal and dental inventory was conducted following the procedures as recommended by Buikstra and Ubelaker (1994). Four different levels of completeness of skulls and postcranial skeletons were scored using method of Stloukal and Hanáková (1988) including scales from fragmentary skulls / postcranial skeletons to complete skeletons, on which complete metric analysis could be performed.

Sex and age-at-death were estimated using standard anthropological methods (Buikstra, Ubelaker 1994). Sex was estimated mainly from the morphology and metrics of the pelvic bones (Murail *et al.* 2005, Novotný 1979, 1986). In cases with an absence of pelvic bones, sex was determined using intra-population metric data collected from individuals with determined sex using the DSP method by Murail *et al.* (2005) and by considering cranial and postcranial morphology (Acsádi, Nemeskéri 1970, Černý, Komenda 1980, Čihák 1987, İşcan, Miller-Shaivitz 1984, Meindl, Lovejoy 1985, Novotný 1985, Novotný, İşcan 1991, Novotný *et al.* 1993, Steele 1976, Teschler-Nicola 1992). The ages-at-death of immature individuals were estimated from dental mineralisation and eruption whenever possible (Ubelaker 1978). Long bone size and morphology were considered in cases where there was an absence of teeth (Čihák 1987, Stloukal, Hanáková 1978). Age-at-death in adults was estimated using all available criteria, including the morphology of the pubic symphysis and auricular area of the pelvis, the obliteration pattern of the skull, dental macrowear values, *ante-mortem* dental loss, degenerative changes on vertebra, and other age-related indicators (Lovejoy 1985, Meindl, Lovejoy 1985, 1989). Processing of palaeodemographical data was performed using standards set out by Acsádi and Nemeskéri (1970).

Measurement of adult remains was performed using standard anthropological methods (Bräuer 1988, Buikstra, Ubelaker 1994). All measurements were taken on the left side; the right side was taken only if the left was not measurable. Data was collected both from individuals with a positive sex determination using the Murail *et al.* (2005), Novotný (1986) method as well as on all other adult individuals from this population without preserved pelvic bones, whose sex was confirmed retrospectively using the data collected from long bones measurements. Thus diminishing the interpopulation errors of the methods used for sex assessment. Stature was estimated from measurements of the maximum length of the long bones using the Sjøvold (1990) method.

Several palaeopathological indicators were examined in the skeletal series at Melčice-Lieskové: markers of

stress visible in subadults and adults. The observations of health, overall population fitness and the impact of environmental factors included the scoring of dental enamel defects (hypoplasia), *cribra orbitalia,* dental caries, *ante-mortem* loss of permanent teeth, vertebral osteophytosis, trauma (presence of injuries and healed fractures), age related degenerative changes on skeletons (e.g. evidence of osteophytosis), and abnormal periosteal bone formation (probably related to non-specific infection) following the methodological model set out by previously published papers (Aufderheide, Rodriguez-Martin 1998, Horáčková *et al.* 2004, Obertová, Wahl 2007, Ortner, Putschar 1981, Ubelaker *et al.* 2006). Health and overall population fitness was examined in individuals using markers of dental enamel hypoplasia and *cribra orbitalia*, which offers valuable information in piecing together a retrospective reconstruction of their behaviour and adaptation to the environment. The impact of stress on the population is reflected not only in decreased fitness and physical efficiency (reduced work rate), but also in diminished reproductive capacity (increased abortion rate and reduced viability of newborns). All these factors are reflected in a disturbed socio-economical balance of the entire population (Beňuš *et al.* 2010, Goodman, Armelagos 1989, Larsen 1997).

The state of preservation of alveoli and teeth is characterised by the comparative alveolar index CAI and comparative dental index CDI. CAI is characterised as a relation between the number of preserved alveoli and the number of all burials multiplied by 32 [CAI=A/(n×32)], and CDI is described as a relation between the number of preserved erupted teeth, the number of teeth lost intravitam (i.e. *ante-mortem*) and the number of all burials multiplied by 32 [CDI=(Z+E)/(n×32)] (Hanáková, Stloukal 1966). The occurrence of caries (caries frequency, F-CE) and caries intensity, I-CE) was analysed using the Stloukal's method (1963). The presence or absence of dental enamel hypoplasia was macroscopically examined on the labial surface of anterior teeth according to the DDE index (Corruccini *et al.* 1985, Ensor, Irish 1995, Goodman *et al.* 1992, Goodman, Rose 1990, Jarošová 2007, Jarošová, Dočkalová 2008, Littleton 2005, Obertová 2005, Santos, Coimbra 1999, Sarnat, Schour 1941, Ubelaker *et al.* 2006).

Dietary trends were reconstructed by quantifying enamel microwear patterns and assuming a correlation between diet and microwear patterns on the enamel surface of teeth. For each individual, negative and positive replicas of the molar and premolar buccal surface were made, and subsequently analysed by secondary electrons (SE) of a scanning electron microscope (SEM). The length (XT in μm), orientation (in degrees 0º–180º) and number of all observed striations (NT) in a 0.56 mm^2 square surface area were quantified using SigmaScan Pro 5.0 image analysis software. Ultimately, the results were compared with published datasets acquired from studying various modern hunter-gatherers, pastoral, and agricultural populations with different dietary habits (Galbany *et al.* 2004, Jarošová 2007, 2008, Jarošová *et al.* 2006, Lalueza *et al.* 1993, 1996, Lalueza Fox, Pérez-Pérez 1993). All statistics was calculated with STATISTICA 9.1 StatSoft Inc. (2010) package. The significance of all statistics was evaluated at the $p \leq 0.05$ level.

RESULTS AND DISCUSSION

Preservation of human remains

More than two thirds of the skulls from Melčice-Lieskové were impaired and only cranial fragments or teeth were presented. One third of skulls were preserved in pieces which allowed the determination of the type of bone, but unfortunately no skull was preserved in state, which would allow the performance of metric analysis after the reconstruction of skeletal material. The state of preservation of postcranial skeletons was markedly better preserved than skulls: almost half of the studied skeletons were suitable for basic metric analysis, even providing data for estimation of stature. Several skeletons were preserved only in a fragmentary state, which did not allow anthropological analyses.

Demography

The sample of 32 individuals from the Melčice-Lieskové site included 10 males, 11 females, nine individuals over 15 years of age with unknown sex, and two immature individuals (<15 years of age). There were four cases of incomplete human skeletal remains mixed with buried individuals: two cases, which belong to children and another two that were identified as adult human remains. A complete list of buried individuals from the Melčice-Lieskové population is presented in *Appendix 1*. In spite of the small number of individuals examined, and palaeodemographical analysis based on the Acsádi and

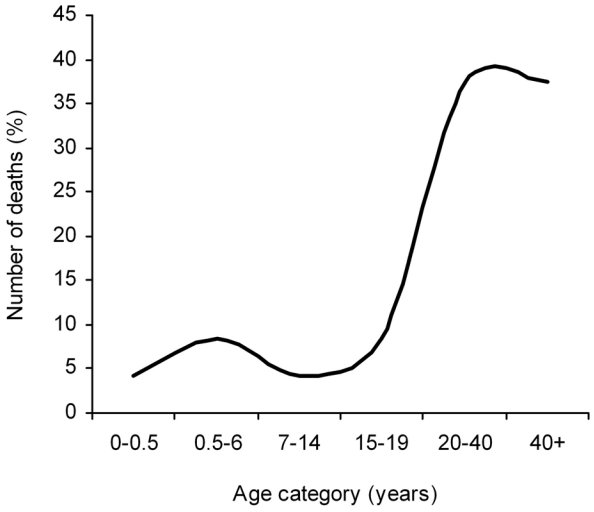

FIGURE 3. Relative number of deaths (d_x) at Melčice-Lieskové sample according to the age categories.

TABLE 1. Basic postcranial measurements for male and female adult sample from Melčice-Lieskové with estimations of body stature.

		Males						Females					
Bräuer 1988; Buikstra, Ubelaker 1994		**N**	**Mean**	**Median**	**Min**	**Max**	**SD**	**N**	**Mean**	**Median**	**Min**	**Max**	**SD**
Fe1	Femur: Maximum Length	4	465.5	466.0	435.0	495.0	33.5	6	420.5	421.0	405.0	435.0	13.3
Fe6	Femur: Anterior-Posterior Midshaft Diameter	8	29.8	29.4	27.3	35.9	2.7	10	26.1	26.1	22.7	28.6	1.8
Fe7	Femur: Medial-Lateral Midshaft Diameter	8	27.2	27.7	24.1	30.4	1.8	10	25.2	25.0	21.7	28.4	2.0
Fe8	Femur: Midshaft Circumference	8	90.0	87.5	86.0	108.0	7.4	10	80.3	79.5	73.0	86.0	4.1
Fe18	Femur: Sup.-Inf. Head Diameter	6	48.5	49.2	44.6	50.4	2.1	11	41.8	42.3	37.3	44.4	2.0
Fe19	Femur: Medial-Lateral Head Diameter	6	48.4	49.0	42.3	51.4	3.2	8	41.8	42.0	39.5	44.9	2.1
Fe20	Femur: Head Circumference	4	150.8	152.0	138.0	161.0	9.6	8	130.6	132.5	122.0	138.0	5.7
Ti1	Tibia: Maximum Length	1	366.0	366.0	366.0	366.0		2	361.5	361.5	350.0	373.0	16.3
Ti3	Tibia: Maximum Proximal Epiphyseal Breadth	6	74.2	74.4	69.1	78.7	3.7	5	58.2	64.3	32.8	66.0	14.3
Ti6	Tibia: Maximum Distal Epiphyseal Breadth	4	46.8	48.0	38.2	53.1	6.3	3	44.2	47.1	35.0	50.5	8.1
Ti8a	Tibia: Maximum Diameter at Nutrient Foramen	7	35.5	34.7	32.9	41.4	2.9	6	29.8	29.0	26.8	35.1	3.1
Ti10a	Tibia: Circumference at Nutrient Foramen	8	94.4	93.0	78.0	110.0	9.6	7	81.7	79.0	71.0	91.0	7.2
Ti10b	Tibia: Minimal Midshaft Circumference	8	81.6	78.5	73.0	103.0	9.5	8	70.5	70.0	62.0	79.0	5.6
Ta1	Talus: Lenght	7	55.7	55.0	52.2	60.8	2.7	4	49.2	49.6	46.0	51.6	2.7
Ta2	Talus: Breadth	7	42.5	42.3	41.0	44.0	1.2	4	37.6	37.0	36.0	40.2	1.8
Cal2	Calcaneus: Middle Breadth	2	44.2	44.2	41.4	46.9	3.9	3	38.0	38.0	37.1	38.8	0.9
Cal4a	Calcaneus: Middle High	2	50.1	50.1	49.6	50.6	0.7	3	44.4	44.2	42.5	46.5	2.0
	Body Stature	7	167.3	166.8	159.9	179.7	6.2	7	160.2	160.5	155.6	163.8	3.5

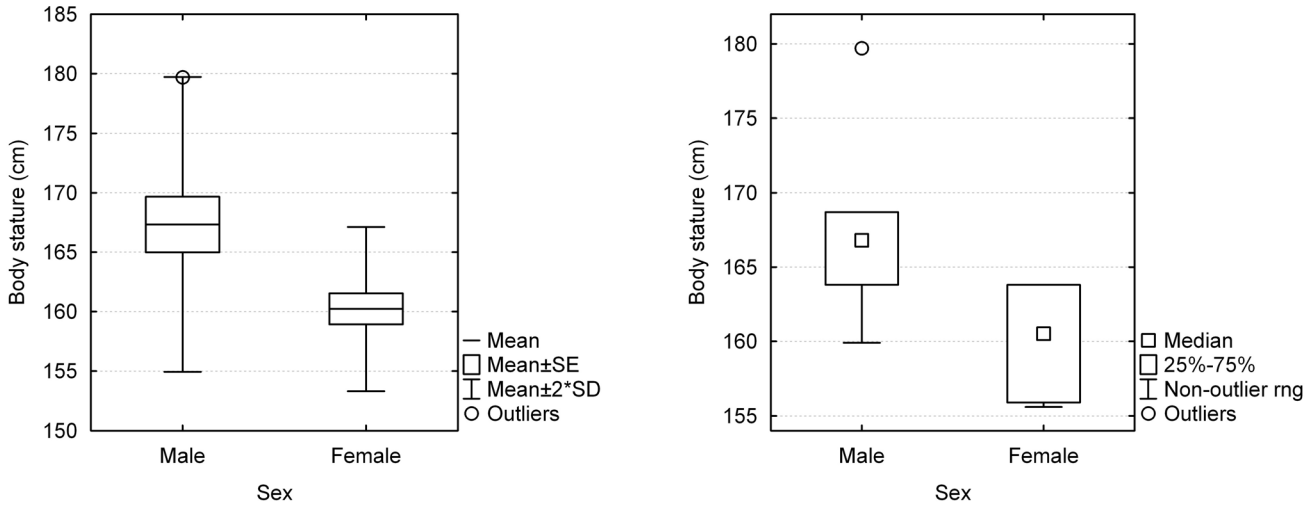

FIGURE 4. Body stature of male and female sample from Melčice-Lieskové. Left: The central line in each box indicates the sample mean. The boxes include mean±SE, and the whiskers represent mean±2*SD of observed values. Right: The central line in each box indicates the sample median. The boxes include 25 to 75 percentiles, and the whiskers represent non-outlier range of observed values.

Nemeskéri model (1970), we decided to present at least some basic data to provide at least a relative picture of the population, which allows an approximate comparison with Jakab's (2007) results of the bigger population at Jelšovce, a population linked with Maďarovce culture. When age estimations were possible, these individuals were included in analysis using broader age categories to increase the number of individuals included (n=24). The results confirmed life expectancy at birth as 31.3 years, life expectancy for 20 year-old individuals was 20 years, whereas estimation of life expectancy of individuals who exceeded 40 years was ten years. The relative number of individuals, who died in presented age categories (d_x), is shown in *Figure 3*. The maximum number of individuals died in the 20+ and 40+ years categories (37.5%), whereas in other age categories only one or two individuals were identified. That is the reason why the demographic data from the Melčice sample cannot be considered as relevant and as fully explaining the age distribution patterns within the population examined. Better understanding of the populations linked with Maďarovce populations is provided by the Jelšovce population with a sample of 321 individuals (Jakab 2007). Life expectancy of this population was slightly longer (e_0=31.2 years) than in the Melčice-Lieskové sample: Jakab calculated life expectancy of 21.1 years in 20 year-old individuals (e_{20}=21.1 years) and e_{40}=11.7 years. In spite of the fact, that the Jelšovce sample is ten times bigger, the calculations of demographical data (in terms of relative values, which does not necessarily provide a full population picture of the then living individuals) are similar to those of the Melčice sample.

Metric analysis

Due to the above described state of preservation, it was not possible to perform a cranial measurement on the Melčice-Lieskové population; only postcranial measurement analyses could be carried out. Due to the small amount of measured data for male and female samples, no population variation in skeletal morphology or asymmetry as result of environmental differences could be performed with statistical reliability. *Table 1* presents thus at least all data measured, separated for males and females from the Melčice-Lieskové population in order to provide first basic characteristic of sexual dimorphism within populations linked with Maďarovce culture from the Early Bronze Age population in Slovakia for future comparisons and analyses. According to the results of this analysis, a clear sexual dimorphism pattern was observed within the Melčice-Lieskové population. Concerning the extremes measured, the most robust skeleton of this population belongs to a male from trench no. 5, grave 4, with value of 118.1 on the *index pilastricus*.

Body stature

Body stature was estimated in seven adult males and in seven adult females of the Melčice-Lieskové population. The mean values of body stature of males was 167 cm, whereas mean body stature of females was 160 cm (*Table 1, Figure 4* and *5*). With a 95% confidence interval, the mean for body stature in the Melčice-Lieskové population is estimated with minimum values at 160 cm and maximum values of 167 cm (*Figure 5*) with the same value of both mean and median 164.8 cm for whole population. Upper

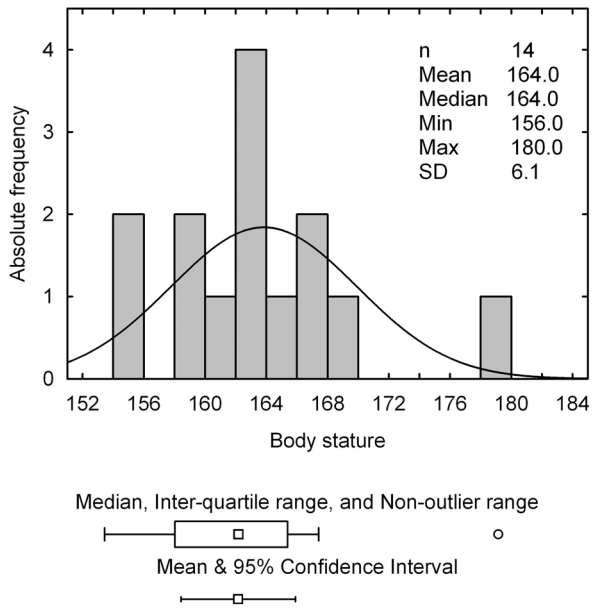

FIGURE 5. Body stature of all adult individuals at Melčice-Lieskové sample with basic statistic data.

and lower limits with a 95% confidence interval for the mean for body stature in male population were estimated in a range between 162 and 173 cm, the values for estimation of body stature within the female population were 157 and 163 cm. These estimations were performed due to the incomplete population sample studies and the strong probability of not excavating the whole buried population at the Melčice-Lieskové burial ground as above described situation. In spite of these factors, the data provided for body stature estimations can be treated as relevant and representative, when considering similar values for both mean and median within the population studied.

Basic palaeopathological aspects

In this study, the prevalence and distribution of *cribra orbitalia*, which represents abnormal bone formation / porosity of orbit, cannot be estimated as *cribra orbitalia* was observed in only one adult male (stratigraphic unit no. 1078, grave 19) from the Melčice-Lieskové population. In only a couple of examined individuals was an absence of *cribra orbitalia* observed, the majority of the population examined did not have the roof of the orbitae preserved, or only small pieces of orbitae remain, which were impossible to reliably score for *cribra obritalia*. No presence of trauma was identified within sample, even though their presence was expected. The most common findings were those related to the degenerative changes of skeleton representing all scales of their severity (e.g. vertebral osteophytosis, Schmorl's nodes in a female from stratigraphic unit no. 1093, grave 24 or abnormality of *caput mandibulae* in a male individual from trench 4, grave 3b). Abnormal periosteal lesions in terms of remodelled periosteal deposits, most likely attributed to the infection, were located on the surface of a partially preserved tibia and fibula of adult individual from stratigraphic unit no. 1057, grave 12. This case presents a very interesting finding, which is suitable for more detailed microscopical analysis as well as the bone formation of the inner surface of skull fragments found in the remains of a young female in grave 1 (stratigraphic unit no. 1011). No severe pathological changes were observed in the immature skeletal remains, which could be because of the small sample size and its incompleteness. The state of health in the children of the population from Melčice-Lieskové remains unknown. Common dental pathologies were found in the population including the occurrence of dental caries, dental enamel hypoplasia (discussed below), and alveolar resorption indicating periodontitis (e.g. in the adult male from stratigraphic unit no. 1072, grave 17). Unfortunately these findings were impossible to score for their frequency within the studied sample, which does not allow other conclusions or comparisons; only the above-listed examples were detected. To illustrate more detailed the health of Early Bronze populations, it is necessary to focus again on the Jelšovce sample, which was examined by prof. M. Schultz and his colleagues and provides detailed palaeopathological examination of a subadult sample connected with the Nitra and Únětice culture (i.e. predecessors of Maďarovce culture) and sets the health conditions of these individuals in a broader framework of Bronze Age within Central European populations (Schultz *et al.* 1998, Schultz 2001). Even though these papers are connected with more ancient Early Bronze populations, which did not include the Maďarovce sample from the Jelšovce site, and only children's skeletons were examined, there is no presumption that health of the examined samples differ from the succeeding population, linked with other Maďarovce populations living in the area of Southwestern Slovakia.

Dental caries

Dental caries (*caries dentis*) can be defined in terms of etiopatogenesis as a microbial disease of calcificated dental tissues characterised by the demineralisation of inorganic and destruction of organic components of dental tissues (Crawford 2002). Advanced caries can lead to loss in vitality of dental pulp and finally to tooth loss, or eventually to other pathological processes (Kilián *et al.* 1999). The emergence of caries depends on the susceptibility of dental tissues (histological and genetic factors, sex or age), the composition of oral microflora (dental plaque microorganisms are cariogenic), nutritional factors and time, i.e. the frequency and duration of interaction, which is, too, closely related with oral hygiene (Kilián *et al.* 1999). Palaeolithic and Mesolithic populations show the lowest caries rate; in Neolithic populations that began to settle down and change over to an agricultural way of life, cariosity gradually increased (Jarošová 2007, Jarošová, Dočkalová 2008). This was connected with a transition to

TABLE 2. Caries intensity (I-CE) in adults (20+ yrs) of analysed sample from Melčice-Lieskové according to sex (C, number of carious teeth; %C, caries incidence (the percentage of decayed teeth from the total number of preserved teeth); E, number of teeth lost *pre-mortem*; %E, the percentage of *pre-mortem* losses; A, number of preserved dental alveoli). Caries frequency (F-CE) in adults (20+ yrs) of analysed sample from Melčice-Lieskové according to sex. (nC, individuals with at least one caries; nE, individuals with at least one *pre-mortem* loss; nCE, individuals with both caries and *pre-mortem* losses).

	Males	**Females**	**All individuals**
Number of examined teeth (n)	150	102	261
C	5	1	6
%C	3.3	1.0	2.3
E	7	8	15
A	170	136	317
%E	4.1	5.9	4.7
I-CE	7.5	6.9	7.0
Number of examined individuals (n)	7	6	14
nE	3	2	5
%nE	42.9	33.3	35.7
nC	3	0	3
%nC	42.9	0.0	21.4
nCE	0	1	1
%nCE	0.0	16.7	7.1
intact	1	3	5
% intact	14.3	50.0	35.7
F-CE	85.7	50.0	64.3

another type of food, which in the course of centuries, in contrast to preceding periods, contained more sugar, was also more prepared and relieved of undesirable ingredients whereby the roughage content in food gradually reduced.

Study of the dentition or jaws was possible in 15 individuals and in two incomplete individuals (47.2%) from the total of all the individuals examined. The evaluation of dentition state was carried out in three immature individuals (<15 years of age) and 14 adults from the Early Bronze Age. The individuals from the remaining burials had to be excluded from the analysis, because the skeletal parts mentioned were either damaged or completely absent.

The state of preservation of alveoli and teeth in individuals from the Melčice-Lieskové population did not differ from previously studied anthropological samples (see Jarošová 2007) . In this studied series more than a half of the teeth (61.6%) and nearly 3/4 of the alveoli (70.8%) are available for further analyses. The occurrence of caries (caries frequency, F-CE) and caries intensity, I-CE) was analysed in three immature individuals with seven permanent and 14 deciduous teeth, and 14 adult individuals with 261 permanent teeth. Slightly higher values of caries intensity were found within the male population (7.5) than the female population (6.9) (*Table 2*). For comparison with previous populations from Neolithic samples located in Moravia (Czech Republic), i.e. close area to the of Melčice site, it can be stated that the I-CE of the oldest Neolithic phase (LBK) showed the highest value of 13.3 (%C=4.1; %E=9.2). Considering I-CE values of Final Neolithic Lengyel populations (I-CE 9.8: %C=2.5; %E=7.3) (Jarošová, Dočkalová 2008) it can be concluded that within Bronze Age population from Melčice-Lieskové the lowest values of caries intensity were found (7.0).

The caries frequency (F-CE), i.e. percentage of caries and intravital losses depending on the number of individuals, was evaluated in Melčice-Lieskové population at 64.3. One third of the individuals examined did not displayed any dental caries or intravital tooth loss (35.7). Higher values of caries intensity was found within the male population (85.7), than the female population (50.0) (*Table 2*). With regard to a small number of males and females in this investigated period, the F-CE values quoted are only of informative character.

Dental enamel hypoplasia

Dental enamel hypoplasia (DEH) can be defined, with regard to its emergence, as a defect of hard dental tissues reflecting non-specific stress indicators in recent, historical and palaeoanthropological populations, and offering a unique record of stress suffered in childhood, which can be subsequently observed also on the dentition of adult individuals. These enamel defects can be interpreted as displays of nutritional deficiencies and infectious diseases (El-Najjar *et al.* 1978, Goodman 1993, 1998, Hodges, Wilkinson 1990, Lukacs 1992, Malville 1997, Wright 1997).

The presence or absence of dental enamel hypoplasia had been macroscopically examined in nine individuals from

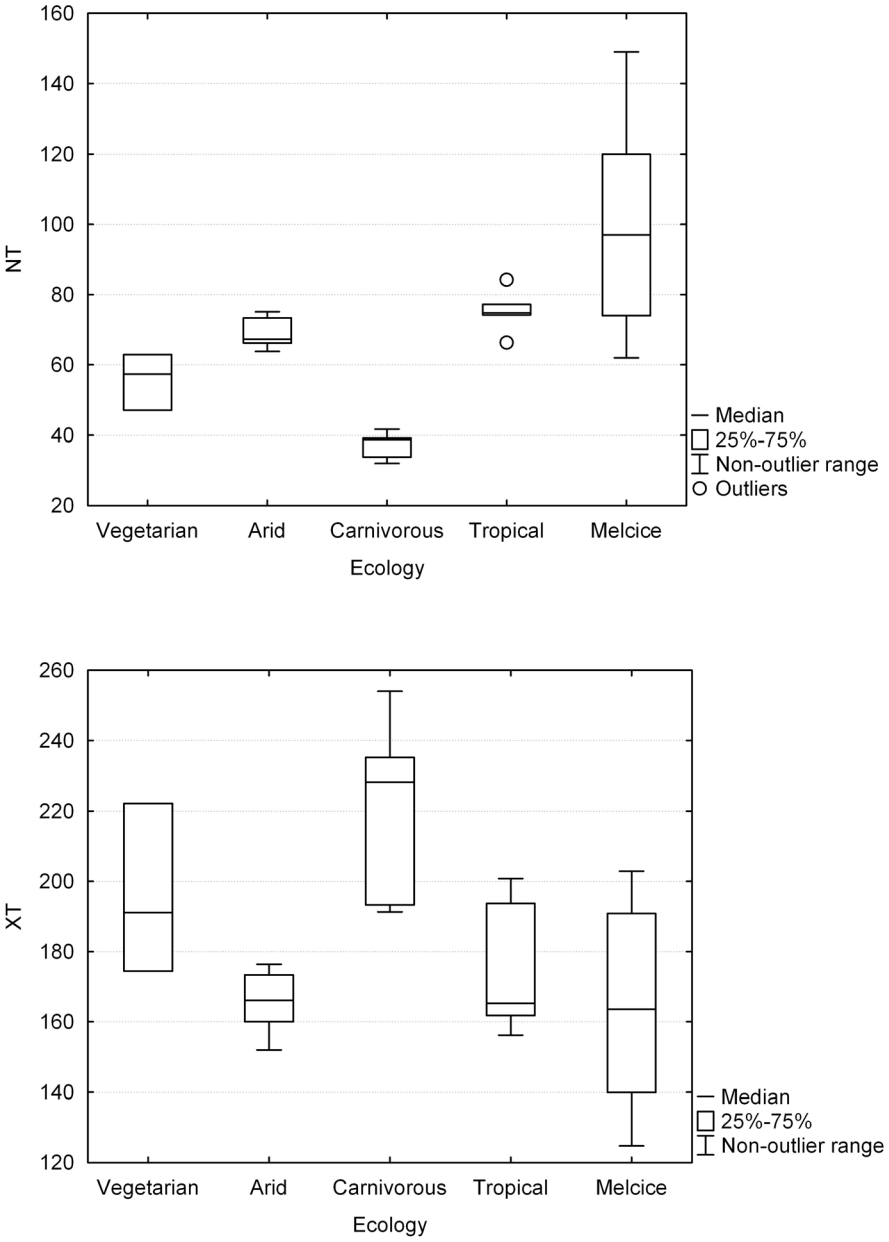

FIGURE 6. Boxplot showing the density of microstriations (NT) (top) and the length of microstriations (XT) (bottom) observed in the teeth of arid, tropical, vegetarian and carnivorous groups in comparison with the studied Melčice-Lieskové sample. The central line in each box indicates the sample median. The boxes include 25 to 75 percentiles, and the whiskers represent non-outlier range of observed values.

the Melčice-Lieskové population with anterior dentition present; in the rest of the individuals with preserved teeth it was not possible to perform this analysis due to the missing or unpreserved enamel surface. In five individuals, the presence dental enamel hypoplasia was detected (55.6%): in two females from four, lines of grooves were shown to be markers of acute DEH and in three males from five there was chronic DEH (continuous chronic enamel hypoplasia) or/and acute DEH forms of the linear type detected. No pits as acute form of DEH were detected in the Melčice-Lieskové population. When comparing these values with Neolithic samples (LBK 13.5%, LgK 18.8%) (Jarošová, Dočkalová 2008), it is possible to conclude that individuals from the Melčice-Lieskové population showed a lesser ability to cope with later attacks of non-specific stressors during the Bronze Age period than individuals from Neolithic populations. Because of the small number of males and females included in this analysis, the DEH values quoted are likely to be more of informative character, which do not necessarily reflect real values of DEH presence in Early Bronze Age populations.

Dental microwear analysis

In order to find out dietary practices, buccal dental microwear analysis was carried out on 11 individuals with well-preserved enamel. From all individuals suited to microwear analysis, six were determined as males, four as females, one individual was ambiguous, and no immature individual was included in microwear analysis. The analysis yielded a similar microwear pattern for the population from Melčice-Lieskové (*Table 3, Figure 6*) for male and female samples, which did not show sex related variability

TABLE 3 . Descriptive statistics of all 15 variables in the Melčice-Lieskové sample of buccal dental microwear.

	All individuals (n=11)				Males (n=6)				Females (n=4)			
	Mean	**Min**	**Max**	**SD**	**Mean**	**Min**	**Max**	**SD**	**Mean**	**Min**	**Max**	**SD**
NH	15.2	3.0	25.0	8.4	14.0	3.0	25.0	8.9	16.8	3.0	25.0	9.7
XH	144.1	55.7	214.1	45.2	153.3	55.7	214.1	57.0	142.7	115.4	161.2	20.0
SDH	104.5	26.1	223.6	57.5	119.6	34.7	223.6	67.5	91.5	26.1	137.0	47.2
NV	43.7	18.0	70.0	13.9	48.2	36.0	70.0	12.0	41.5	18.0	53.0	16.0
XV	179.9	115.3	221.0	36.7	186.6	139.7	220.7	32.5	162.3	115.3	221.0	44.0
SDV	130.3	48.5	182.7	37.6	141.5	94.3	158.7	24.7	114.5	48.5	182.7	55.7
NMD	21.4	5.0	61.0	15.7	16.5	5.0	29.0	10.5	27.5	11.0	61.0	23.0
XMD	151.8	107.8	212.5	36.9	168.6	124.9	212.5	29.7	115.3	107.8	125.6	7.6
SDMD	108.2	54.7	171.6	40.5	124.7	93.9	171.6	32.3	69.9	54.7	83.7	14.9
NDM	18.8	6.0	40.0	11.0	16.2	6.0	40.0	12.6	25.3	19.0	31.0	6.1
XDM	167.1	91.9	378.6	81.2	199.7	91.9	378.6	98.8	136.2	105.8	161.9	23.1
SDDM	126.4	61.1	260.5	64.4	163.2	71.0	260.5	66.5	87.6	71.6	107.6	18.3
NT	99.1	62.0	149.0	27.5	94.8	69.0	121.0	22.2	111.0	62.0	149.0	36.1
XT	165.1	124.8	202.9	26.4	178.6	139.9	202.9	25.3	144.3	124.8	163.6	17.9
SDNT	128.1	61.9	182.4	31.4	144.9	117.0	182.4	21.7	101.7	61.9	133.4	31.5
NH/NT	0.15	0.03	0.26	0.07	0.15	0.03	0.26	0.08	0.14	0.05	0.22	0.08
NV/NT	0.45	0.29	0.59	0.11	0.52	0.35	0.59	0.09	0.37	0.29	0.45	0.07

in the density, length and other patterns of microstriations, which presumably resulted in a different ratio of meat intake and vegetable meals. As concerns the NH/NT and NV/NT results (*Figure 7*), which indicate higher ratio of meat intake in males compared to the examined females, no significant difference at p=0.05 was shown by the non-parametric Kolmogorov-Smirnov test for 15 variables presenting the mean values for each individual's tooth: the length (X), standard deviation of the length (SD), and number (N) of all striations present (T) computed in four orientation categories from 0˚ to 180˚ – in 45-degree intervals, which were determined with respect to the given tooth's orientation: V, vertical; MD, mesio-occlusal to disto-cervical; DM, disto-occlusal to mesio-cervical; H, horizontal (see *Table 3*).

To illustrate further the population's affinities based on buccal microwear patterns, a multidimensional scaling of 15 variables has been performed and *Figure 8* shows the results obtained. The outcome of these results supports a mixed diet with relative high ratio of meat consumption within the Melčice population, as the mean data of sample groups with populations from arid areas and Inuits, i.e.

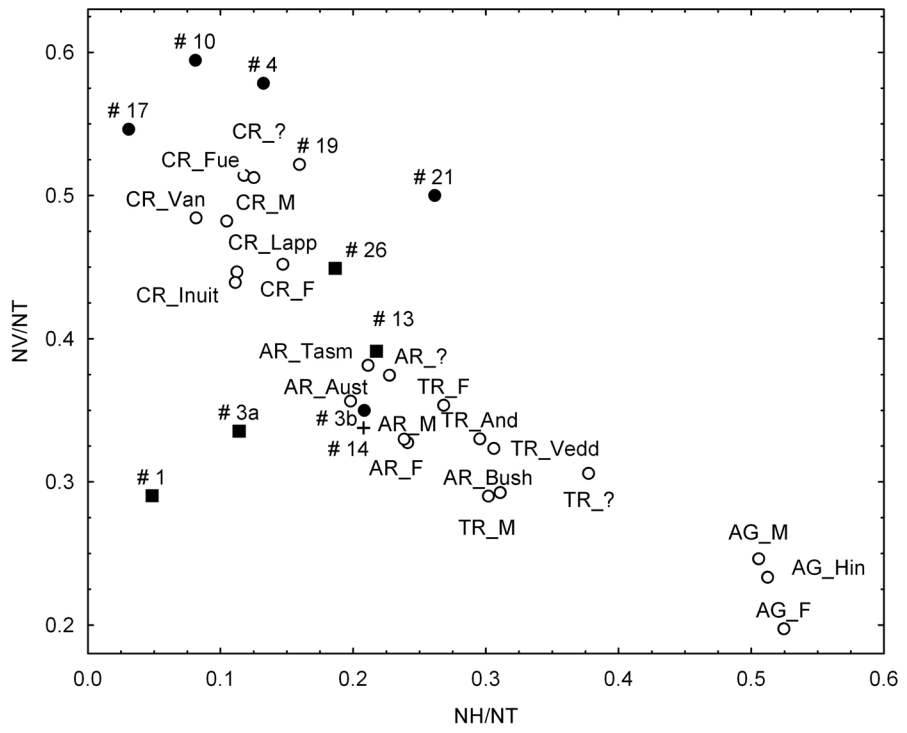

FIGURE 7. Scatterplot of NH/NT index with respect to NV/NT index for all individuals from the Melčice-Lieskové sample: males are marked in black round, females in black square, ambiguous individual in black cross, population with recently studied samples with known dietary pattern in white colour round (vegetarian agriculturalist, AG_Hin, Hindu; populations from tropical areas, TR_And, Andamanese; TR_Vedd, Veddahs; populations from arid areas, AR_Bush, Bushmen; AR_Tasm, Tasmanians; AR_Aus, Australian aborigines; carnivorous populations, CR_Fue, Fueguians; CR_Inuit, Inuits; CR_Van, Vancouver islanders; CR_Lapp, Lapps).

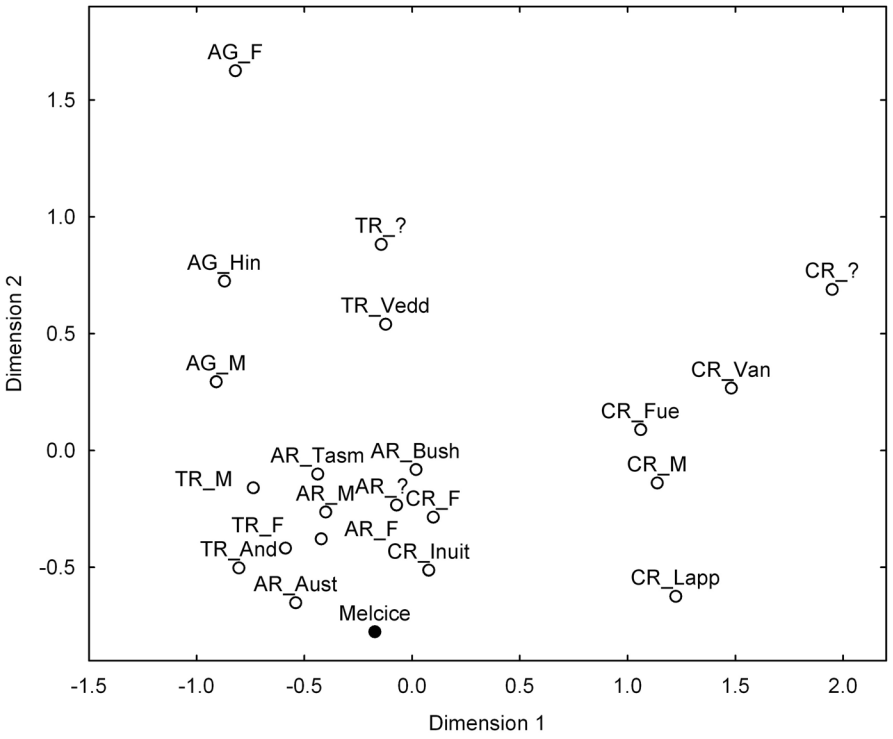

FIGURE 8. Multidimensional scaling – final configuration of recently studied populations according to sex (M, males; F, females) in comparison with Melčice-Lieskové sample; recently studied populations in white colour, Melčice-Lieskové sample in black colour.

carnivorous populations. These results have to be examined in relation with findings of osteological and climatic context to describe whole model of dietary strategies of this population.

When comparing a Bronze Age sample from similar chronological period, but different geographical area from East Spain, a slightly distinct dental microwear pattern was detected. Lower values of all striations (NT) and higher values of their length (XT) in examined dental enamel area in Slovak sample was discovered when comparing the data provided by Romero *et al.* (2004). However, no statistical differences were found in the intrapopulation variability of buccal microwear density (NT) and length (XT) of striations of both samples. As concluded by Romero *et al.* (2004), Bronze Age economies are based on agriculture and animal husbandry characterised by cereals and cultivated products as showed in results of buccal dental-microwear patterns. The Spanish groups examined lived on a mixed subsistence economy diet; only minor differences were observed within studied samples, which probably results from distinct agricultural processes and climatic influences (Araus *et al.* 1997, Romero *et al.* 2004).

Nutritional conditions and state of health was examined in Melčice-Lieskové population as well as the population's resistance/adaptation to environmental impacts showed overall good state of fitness and physical efficiency, which probably related to reproduction capacity as well. Compared to the data from previous populations, the DEH prevalence was much higher in the Melčice population than to the investigated Neolithic populations. In spite of this fact, the population from Melčice-Lieskové enjoyed very favourable living conditions, as proved by the ability to cope with later attacks of non-specific stressors on individuals of this population. The environmental impact on abortion rate or vitality of newborns in the examined Early Bronze population is not possible to estimate, because the finds of neonatal and infant skeletons are very rare, mainly because of performing of archaeological excavation in restricted areas, funerary customs, and taphonomical aspects which did not allow the preservation of all buried human skeletal remains. For all these reasons we cannot draw any demographic conclusions, which can be generalised to the Early Bronze Age populations. More representative population samples, which would comprise appropriate samples of both adults and children have to be examined to achieve a more accurate estimation of morbidity and mortality in connection with non-specific stressors.

CONCLUSION

The analysis of various anthropological patterns, carried out on Early Bronze Age individuals from Melčice-Lieskové (District of Trenčín, Slovakia) indicates favourable living conditions of the then people, linked with Maďarovce culture. The evaluation of dental condition was performed in a total of six subadults and 27 adult individuals with 268 permanent and 14 deciduous teeth. Values of caries intensity were even lower than in the Neolithic period, whereas prevalence of dental enamel hypoplasia was higher. The diet of the Melčice-Lieskové population was probably dependent on varied resources with high meat consumption. Body stature in the male population was estimated in a range between 162 and 173 cm, whereas estimations of

body stature within the female population were between 157 and 163 cm. Health condition and palaeodemographical data of this population provided a hypothesis for presence of ability to cope with attacks of non-specific stressors (i.e. indicators of metabolic and nutritional disruptions) within individuals of this populations. This research will allow future detailed analyses of Early Bronze Age populations and provide datasets for future comparisons suitable for building up a framework of osteological and climatic contexts to describe the whole model of dietary strategies in Central Europe.

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APPENDIX 1. List of examined individuals from Melčice-Lieskové sample (District of Trenčín, Slovakia). M, male; F, female; M?, F?, sex determined without using method by Murail *et al.* (2005) and Novotný (1986).

ME-SE-10 SJ (Stratigraphic unit/ /Grave number)	Presence of human bones	Sex	Age-at-death	Microwear analysis	Body stature	Human/animal bones not associated with buried individual
1000	Yes*	?	Adult?			*Human bones impossible to associate with the same individual
1011/Grave 1	Yes	F	20–40			
1014/Grave 2	Yes	?	25–40			
1017/Grave 3	Yes	?	?			
1018	No					Animal bones
1021/Grave 4	Yes	M	20–60			
1024/Grave 5	Yes	?	20+			
1027/Grave 6	Yes	?	?			
1033/Grave 7	Yes	M	45–55		159.9(±4.89)	
1036/Grave 8	Yes	M?	25–40			
1039/Grave 9	Yes	M	20+		167.8(±4.15)	
1045/Grave 10	Yes	M?	18–20	M3LR		
1048/Grave 11	Yes	F?	20–40			
1057/Grave 12	Yes	?	20–60			
1060/Grave 13	Yes	F?	45–50	M2UL		
1063/Grave 14	Yes	?	35–45	Pm4UR		2nd individual: teeth, inf III, 10–11 yrs
1066/Grave 15	Yes	F?	17–19		162.5(±4.15)	
1069/Grave 16	Yes	?	?			
1072/Grave 17	Yes	M	40–50	M2UR	163.8(±4.49)	2nd individual: pieces of human skull, inf I–II
1075/Grave 18	Yes	M?	20–60		164.6(±4.49)	
1078/Grave 19	Yes	M	35+	M1LL	168.7(±4.89)	
1081/Grave 20	Yes	F	20–60			
1084/Grave 21	Yes	M?	30–35	M1LR	166.8(±4.89)	2nd individual:os pubis + 3 pcs of vertebrae, adult individual
1086	No					Animal bones
1087/Grave 22	Yes	Child	4			
1090/Grave 23	Yes	F?	20–60		163.8(±4.49)	
1093/Grave 24	Yes	F	60+		159,5(±4.49)	Animal bones
1096/Grave 25	Yes	Child	3–4			Animal tooth
1099/Grave 26	Yes	F	40–50	M1UL	155.9(±4.49)	
1102/Grave 27	Yes	?	Adult?			
1105/Grave 28	Yes	?	Adult?			
1114	No					Animal bones
1119	No					Animal bones
1121	No					Animal bones
Grave 1, (trench)	Yes	F	20–25	M1LR	155.6(±4.49)	
Grave 2, (trench)	Yes	F	20–40		163.8(±4.49)	
Grave 3a, trench 4	Yes	F	50+	M1UR	160.5(±4.49)	2nd idividual (grave 3b, trench 4): mandible, M?, 45–50 yrs; microwear analyses performed on M1UL
Grave 4, trench 5	Yes	M	40–45	M1UL	179.7(±4.49)	Animal bones

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