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DIET AND DIVERSITY OF EARLY FARMERS IN NEOLITHIC PERIOD (LBK): BUCCAL DENTAL MICROWEAR AND STABLE ISOTOPIC ANALYSIS AT VEDROVICE (CZECH REPUBLIC) AND NITRA - HORNÉ KRŠKANY (SLOVAKIA)

ABSTRACT: Recently, there have been two international bioarchaeological projects focusing on LBK: "Biological and cultural identity of first farmers: Multiple bio-archaeological analysis of a central European cemetery (Vedrovice) project" known also as "Vedrovice bioarchaeology project" and "The first farmers of central Europe: diversity in LBK lifeways". We took a similar approach at a local level and analysed dental microwear pattern by comparing the results with already published stable isotopic data (carbon & nitrogen) (Richards et al. *2008, Smrčka* et al. *2005, 2008a and Whittle* et al. *2013) to deepen our knowledge about the dietary habits of individuals living and eating in the early LBK.*
Buccal dental microwear analysis as a short-term indicator of diet was carried out on a sample of 43 individuals from the Vedrovice site (Czech Republic) and of 49 individuals from the Nitra - Horné Krškany site (Slovakia) with well-preserved dental enamel to compare site-based diversity using dental microwear. Both sites belong among the earliest cemeteries in the Central European region (or in a broader sense, the Middle Danube area) as they are dated to Neolithic period, specifically the early phase of LBK, since the burials in Vedrovice and Nitra mostly spanned 53rd–52nd century cal BC (Pettitt, Hedges 2008, Griffiths 2013, Whittle et al. *2013). For each individual, replicas of the buccal surface of molars or premolars that showed clear microwear patterns were analysed by secondary electrons of a scanning electron microscope. Subsequently, results were compared with published datasets acquired from studies of various modern hunter-gatherers, pastoral, and agricultural populations with different dietary habits (Lalueza* et al. *1996). By comparing adult males and females (n = 33) within the Vedrovice sample including two cemeteries and settlement, no sex related differences were observed in dental microwear pattern, which is contrary to a previously published paper on a sample of 18 individuals buried at Vedrovice - Široká u lesa cemetery (Jarošová 2008), where a statistically significant sex related difference was observed, with a higher vegetal intake for females than males inferred. Similarly, no sex related differences between adults were observed within the Nitra population (n = 31).*

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However, an age-related variability was observed between adults and subadults within both studied samples with more obvious differences in the Vedrovice sample, which may have resulted from different ratios of meat and vegetable intake. Adults from Nitra had a distinct microwear pattern to adults from Vedrovice.
In another group of analysed individuals from Vedrovice and Nitra - Horné Krškany, slightly different results were observed in the published stable isotopic data: carbon and nitrogen isotopic data, as a long-term indicator of diet, proved no statistical difference between the diet of subadults and adults within both studied samples and no difference between diet of adult males and females in Nitra site. On the contrary, statistically significant differences were observed between adult males and females in Vedrovice in terms of nitrogen data indicating a higher protein based diet in males. The subject of this article is a detailed analysis of the two populations using different groups of individuals and methodologies; as wells as a comparison of selected individuals for which both types of analyses were conducted to elucidate the dietary habits of the two biggest LBK populations in Czech Republic and Slovakia.

KEY WORDS: Microwear – Diet – SEM – Linearbandkeramik (LBK) – Vedrovice – Czech Republic – Nitra - Horné Krškany – Slovakia – Isotopic analysis

INTRODUCTION

Stable isotope overview

There have been a number of papers describing the partial results of interdisciplinary research and synthesising existing knowledge; they have been dedicated to the issues of human behaviour and transition during the beginning of Neolithic in Central Europe. Recently, two international bioarchaeological projects focusing on LBK were published in the Anthropologie journal: in 2008 (46, 2–3) and 2014 (52, 1) *"Vedrovice bioarchaeology project"* (Lukes *et al.* 2008, Zvelebil, Pettitt 2008, 2013) and *"The first farmers of central Europe: diversity in LBK lifeways"* (see Bickle *et al.* 2014 and Bickle, Whittle (Eds.) 2013). "Biological and cultural identity of first farmers: Multiple bio-archaeological analysis of a central European cemetery (Vedrovice) project" (known also as the "Vedrovice bioarchaeology project") summarised the results of a collective research project relating to the ancestry of the Vedrovice community: the health condition; palaeodemography and nutrition of its inhabitants; their social status and social differentiation; and the transmission of cultural traditions inter-generationally and through contact as the major vehicle of culture change that brought about the development of the LBK culture (Zvelebil, Pettitt 2008). These results were followed by couple of papers summarizing the results (Zvelebil *et al.* 2010, 2012, Zvelebil, Pettitt 2013). The death of Marek Zvelebil ended the work on this topic.

A few years later, Alasdair Whittle and his team carried out a large bioarchaeological study of early Neolithic lifeways in central Europe, mainly based on the evidence of stable isotope analysis of hundreds of samples of humans and animals bones from cemeteries and settlements of the Linearbandkeramik (LBK) in Hungary, western Slovakia, Czech Republic - Moravia, Austria, southern Germany and France - Alsace. In their book, *"The first farmers of central Europe: diversity in LBK lifeways"* based on *"The Lifeways projec"* they approached questions of mobility, diet, health, burial evidence and social scales. In their paper, Bickle *et al.* (2014) analysed carbon, nitrogen, and strontium isotopes in a large sample of individuals from several Moravian and western Slovakian early Neolithic sites.

Buccal dental microwear overview

By focusing on the region of Moravia and western Slovakia, we would like to contribute to the knowledge of food intake in LBK and how it affected social scales in Vedrovice and Nitra - Horné Krškany. To analyse the composition of the ingested food and consumption behaviour in bioarchaeological populations, we used microscopic analysis of tooth enamel. This method was chosen because dietary trends can be reconstructed by quantifying enamel microwear patterns. By assuming a correlation between ingested diet and microwear patterns on the enamel surface of teeth, we focus on buccal dental microwear analysis proven as independent of seasonal variations and reliable indicator of overall dietary habits due to the longer-term "turnover" effect in comparison to occlusal microwear pattern (Pérez-Pérez 1990, 2004; Pérez-Pérez *et al.* 1994; Lalueza *et al.* 1996; Estebaranz *et al.* 2012, Romero *et al.* 2012, 2013, etc. and for comparison see also a "Last Supper" effect in Grine 1986). Proven findings show that there is a tendency for less striations and a higher frequency of vertical striations on the dental surfaces in carnivore populations than in vegetarian ones (Lalueza *et al.* 1996). The high incidence of abrasive particles in plant foods (phytoliths) result in higher scratch densities and an increasingly horizontally-oriented, vestibular microwear pattern in agricultural populations (Lalueza *et al.* 1996). The embedding of phytoliths in enamel surfaces and their classification has been demonstrated in research by Lalueza Fox and his colleagues (1994) in a modern human sample from La Olmeda, Spain. There have also been studies in non-human subjects, where phytoliths embedded in enamel surface have been described (see eg. Ciochon *et al.* 1990, Daegling, Grine 1994, Henry *et al.* 2012, Madella *et al.* 2002). Based on an earlier study focused on buccal dental microwear (Jarošová 2008), we have decided to sample as much dental microwear data as possible from the rest of individuals at the Vedrovice site and perform completely new sampling of the maximum number of individuals from the Nitra - Horné Krškany site to compare microwear data including inter- and intra-population variability of these two LBK sites with results of carbon and nitrogen isotopic analysis.

MATERIAL

Vedrovice site

The archaeological site is located near Moravský Krumlov, Znojmo district in south Moravia (Czech Republic) on the edge of the Bohemian Massif (*Figure 1*), where Precambrian and Palaeozoic rocks contribute to the loess soils (Richards *et al.* 2008). The site was excavated from the mid-1970s for one decade by Vladimír Ondruš (Ondruš *et al.* 2002). The sites consist of a Neolithic cemetery with a settlement "Široká u lesa" and a cemetery "Za Dvorem" discovered in the area of the present-day Vedrovice village, and dated to the early phase of LBK cemetery (Podborský 2002a).

The inhumations in the "Široká u lesa" cemetery at Vedrovice were deposited over the course of the 53rd century BC and, perhaps, a little into the early 52nd century BC, a period spanning five or six generations. Modelling of the phasing of the burials, based on ceramic typology, suggests that a major transition occurred around 5200 BC (Pettitt, Hedges 2008). Analysis of the associated pottery suggested that the main part of the cemetery belonged to phase Ib1–Ib2–IIa (Čižmář 2002). Contemporaneity of the cemetery and settlement area was established by earlier pottery studies (Čižmář 2002, Ondruš *et al.* 2002, Lukes 2006; for details see Lukes *et al.* 2008, 119), however the Široká u lesa settlement and Za Dvorem cemetery have not been radiocarbon dated yet.

Graves at the Široká u lesa cemetery identified as rich were predominantly those of mature men (Podborský 2002b, 335), or of adult men (Květina 2004, 385). The richness and type of grave goods differed between males, females and children (see Podborský 2002a, Květina 2004, see also John 2005). Factor analysis enhanced by the application of GIS, performed by Květina (2004) on the Vedrovice material identified several dimensions that inform on the composition of grave goods at Vedrovice. In addition to age and gender, this involves at least two levels of social variability. The more richly equipped graves, associated with older individuals or those with an orientation to the southwest, are thought to belong to community leaders or "elders". The other social dimension reflects the horizontal subdivision of the community into smaller social units based on kinship and age, which Květina called "social identity" (Květina 2004, 389) – for details see (Zvelebil, Pettitt 2008, Table 2 at page 203). In further elucidation of analyses found in Podborský (2002b) and also in Květina (2004), Zvelebil and Pettitt (2008, 203) suggest also a tendency for the richness of grave goods at Široká u lesa cemetery to increase with age for locally born males and females. With immigrants, however, the pattern is different: it is noticeable that only mature and old individuals of either sexes possess grave goods at all.

This outstanding skeletal sample curated in Moravian Museum in Brno (Czech Republic) represents one of the largest archaeological/anthropological Neolithic populations in the area of Middle Danube basin. A large number of researchers have published results of their work performed on Vedrovice skeletal material: palaeodemography (Crubézy *et al.* 1997), osteoarthritis and enthesopathies (Crubézy *et al.* 2002), dental analysis (Frayer 2004, Jarošová, Dočkalová 2008), archaeological background (Lukes *et al.* 2008, Zvelebil, Pettitt 2008, 2013, Zvelebil *et al.* 2010, 2012), radiocarbon analysis (Pettitt, Hedges 2008, Griffiths 2013), aDNA (Bramanti 2008), occlusal microwear (Nystrom 2008), buccal microwear (Jarošová 2008), isotopic analysis (Smrčka *et al.* 2005, 2008a, b, Richards *et al.* 2008), trace element analysis (Smrčka *et al.* 2006, 2008c), palaeopathology (Smrčka, Tvrdý 2009). All data on individual's sex and age-at-death was adapted from previous estimations made by Marta Dočkalová – Zdeněk Čižmář (Dočkalová, Čižmář 2007, 2008, Dočkalová 2008), Malcolm Lillie (Lillie 2008) and revised by Z. Tvrdý for the purpose of this paper. In summary, Vedrovice sample comprises of 110 individuals (33 subadults, 26 males, 47 females, 4 undeterminable adults) (see Appendix 1). Additional sampling for stable isotope and radiocarbon analysis was carried out by L. Fibiger and P. Bickle in 2009 and 2010 following on from the work of Marek Zvelebil *et al.* (Whittle *et al.* 2013, Bickle *et al.* 2013 – chapter 4).

Nitra - Horné Krškany site

The city of Nitra is situated in western Slovakia on the border of the Carpathian Mountains and the Middle Danube plain (*Figure 1*). The Nitra site is situated on loess soils, which are found intermittently along the edge of the Carpathians Mountains (Pavúk 1972, 5). A Neolithic burial ground dated to the Early Phase of the Linear Pottery Culture (phase II of LBK) was discovered on Priemyslová Street in the suburb of Horné Krškany during the rescue research conducted by Juraj Pavúk in 1964–1965 (Pavúk 1972). Whittle with colleagues (Whittle *et al.* 2013, 137) expected Nitra to fall within the local strontium ratio range for loess soils, even though the site is situated on the border between two major geologies with the crystalline Tribeč Mountains and the Danubian plain.

Results of radiocarbon dating in the Oxford laboratory are reported in detail in Griffiths (2013, appendix B1). The chronological modelling of radiocarbon results determined the beginning of the cemetery with a 95.4% probability to 5370–5220 cal BC and the end to 5210–4980 cal BC (Whittle *et al.* 2013, 143).

Twenty-one of 74 graves in Nitra - Horné Krškany had no goods at all (38%) which is average for LBK cemeteries (Whittle *et al.* 2013, 142). The most abundantly furnished graves were those of older women and especially those of older men, in the originally estimated age ranges of 40–50 and 50–60 years (Pavúk 1972, 71), which could hint at principles of seniority, or notions of succession (Whittle *et al.* 2013, 143).

Skeletal remains from the Nitra cemetery are curated at the Moravian Museum in Brno (Czech Republic). As bones and teeth were in moderate or poor condition (see also Whittle *et al.* 2013, 143) with

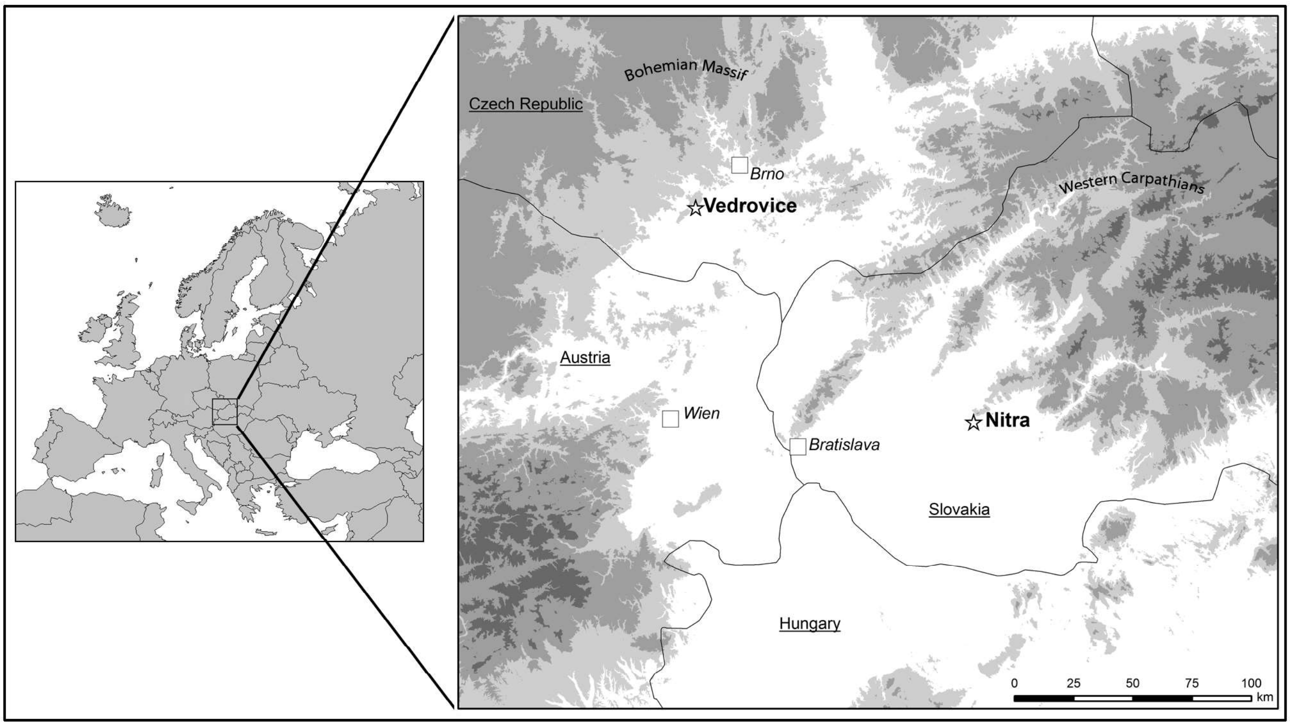

FIGURE 1. Map of LBK sites Nitra - Horné Krškany (Slovakia) and Vedrovice (Czech Republic - Moravia), (digitised by P. Neruda).

surface erosion during the post-excavation period, these were preserved using a synthetic resin made by polymerising vinyl acetate, as was common then, resulting in a shiny surface on nearly all human skeletal remains. J. Jelínek carried out basic demographic analysis (see Pavúk 1972). Several researchers subsequently published papers about palaeodemography (Crubézy *et al.* 1997), osteoarthritis and enthesopathies (Crubézy *et al.* 2002) and dental analysis (Frayer 2004) of Nitra LBK sample. Osteological, dental analysis, examination of health condition, sampling for stable isotope and radiocarbon analysis was carried out by L. Fibiger and P. Bickle (Whittle *et al.* 2013, Bickle *et al.* 2013 – chapter 4). A. Ash (Ash *et al.* 2016) studied health, nutrition and weaning of the first farmers based on manifestations of non-specific stress such as cribra orbitalia, porotic hyperostosis. Finally, a recent detailed study containing a catalogue of osteological material with demographic and metric data was published by Z. Tvrdý (2016) according to which Nitra - Horné Krškany comprises of 77 individuals (28 subadults, 19 males, 27 females, 3 indeterminable adults) (see *Appendix 1*).

METHODS

Methods for buccal dental microwear

In previous analyses of buccal microwear, no intra-individual variability has been found between posterior tooth type for each individual. Therefore, *inter*-group variability appears to be significantly higher than *intra*-group variability in humans (Pérez-Pérez *et al.* 1994). Statistically-significant intra-individual differences have been observed only in a recent study made on an Australopithecus afarensis sample (Estebaranz *et al.* 2009). Tooth selection for each individual in the LBK sample depended on the preserved tooth type and the state of its enamel surface observed at a macroscopic and then microscopic level. If well preserved buccal enamel was present on several teeth of a single individual, then preference was given to the first and second upper-left molars as in previous studies made by I. Jarošová (eg. Jarošová *et al.* 2006, 2016). Otherwise, left and upper teeth were preferred whenever possible, but in many cases one individual was sampled several times until the best preserved tooth enamel was found.

The osteological material at Vedrovice (n = 110) and at Nitra - Horné Krškany (n = 77) was unfortunately very damaged by various macroscopic and microscopic taphonomic processes that affected both surfaces of dental enamel and bones. In the current analysis, 43 individuals (39.1%) from Vedrovice and 49 individuals (63.6%) from Nitra - Horné Krškany were included in the dental microwear analysis (see *Appendix 1, Table 1*). [Note: for comparison – so far it has been possible to examine human samples from Czech Republic on microwear pattern ranging from 7% (Dolní Věstonice, Jarošová 2007) to 40% (Prague-Zličín, Jarošová *et al.* 2016); the rate of the well-preserved hominin teeth included in microwear analysis is slightly lower: 14.8% (Martínez *et al.* 2016) or 21.5% (Estebaranz *et al.* 2009) of the teeth studied]. The rest of the individuals have to be excluded from dental microwear analysis due to poor preservation, dental pathologies including, but not limited to dental calculus, dental caries and intravital losses. (Note: if there was a single caries in the dentition on right side, the sampled tooth for proper microwear pattern was taken from the left side. If there were only isolated teeth with undetermined intravital / post-mortem losses, any teeth affected by dental caries were excluded from analysis). Another reason of the exclusion was microscopic damage found on the enamel surface that could be attributed to post-mortem taphonomic processes, which affected the enamel surfaces and made it impossible to perform dietary reconstruction (Martínez, Pérez-Pérez 2004). The damage patterns observed within the studied LBK samples at the microscopic level using SEM (scanning electron microscope) included eroded surfaces with an irregular aspect, in some cases with a high density of parallel striations, or patches of slightly-damaged enamel, or an eroded enamel surface exhibiting incremental growth lines, known as perikymata. All the observed types of damage present at the microscopic level were known examples and had already been described in detail elsewhere (see Martínez, Pérez-Pérez 2004). Thus, the final analysed teeth sample from Vedrovice cemetery consisted of 9 (20.9%) subadults, 22 (51.2%) adult females, 11 (25.6%) adult males and 1 adult (2.3%) with well-preserved enamel surfaces. The final analysed teeth sample from Nitra cemetery consisted of 15 (30.6%) subadults, 18 (36.7%) adult females, 13 (26.5%) adult males and 3 adults (6.1%) (*Table 1*). Especially for Nitra sample, we used alcohol (ethanol) to remove polymerising vinyl acetate from the surface of tooth selected for microwear analysis (see *Figure 2a, b*). Subsequently, when analysing the surface of the teeth on microscopic level, well-preserved tooth enamel surface was found.

TABLE 1. Demographics of 92 studied individuals for buccal dental microwear from the Neolithic Vedrovice, Czech Republic (n = 43) and Nitra - Horné Krškany, Slovakia (n = 49).

Sex / age	0–6 yrs	7–14 yrs	15–19 yrs	20–35 yrs	35–50 yrs	50+ yrs	Total	Adults	Subadults
Vedrovice F				10	10	2	22	22	
Vedrovice M			1	7	2	1	11	11	
Vedrovice ?	7	2		1			10	1	9
Vedrovice total	**7**	**2**	**1**	**18**	**12**	**3**	**43**	**34**	**9**
Nitra HK F			1	7	9	1	18	18	
Nitra HK M			2	2	9		13	13	
Nitra HK ?	6	9	3				18	3	15
Nitra HK total	**6**	**9**	**6**	**9**	**18**	**1**	**49**	**34**	**15**
LBK total	**13**	**11**	**7**	**27**	**30**	**4**	**92**	**68**	**24**

Negative impressions of the tooth's buccal surface were obtained using polyvinylsiloxane Affinis Regular Body (Coltène®); afterwards, the bicomponent polyurethane resin Feroca Feropur PR55 + ER55 was used to make positive moulds (Galbany *et al.* 2004). Finally, the tooth replicas were sputter-coated with a 400 Å gold layer using SCD Balzers Unions 040 and then proceeded to SEM imaging.

SEM images were obtained with a Scanning Electron Microscope Tescan Vega TS 5136XM at Masaryk University, Brno. Micrographs were taken at 226× magnification on the medial third of the buccal surface of the tooth crown (Pérez-Pérez *et al.* 1994). All images were obtained under SEM standardised conditions with low electron acceleration (10–15 KV), working distance (WD) ranging between 15–25 mm, and secondary electron mode. (Note: the 226× magnification was calculated because of the wide-angled scanning window of the Tescan Vega. These micrographs are compatible with 100× magnification of the SEM Cambridge Stereoscan 120 at the SCT, University of Barcelona as images from both SEM have the same length: 1 pixel = 1.1547 µm). All SEM pictures were digitalised using SEM Vega TC Software Image Processing, obtaining 1024×1024 pixel images that were subsequently enhanced with Adobe Photoshop v.8.0, and a 0.56 mm^2 enamel patch was cropped (648×648 pixels) in all images for surface area standardisation (Pérez-Pérez *et al.* 1994, Lalueza *et al.* 1996, Galbany *et al.* 2004, Jarošová *et al.* 2006; *Figure 2*).

SigmaScan Pro 5.0, image analysis software, was used to quantify microwear patterns for the length (X), standard deviation of the length (SD), and number (N) of all observed striations present in a 0.56 mm^2 square surface area were computed and 4 categories of orientation from 0° to 180° – in 45-degree intervals – were determined with respect to the given tooth's orientation: V = vertical; MD = mesio-occlusal to distocervical; DM = disto-occlusal to mesio-cervical; and H =horizontal. Mean values for each individual's tooth were characterised by a sum of 15 variables (Pérez-Pérez 1990, Lalueza, Pérez-Pérez 1993, Lalueza *et al.* 1993, 1996, Pérez-Pérez *et al.* 1994, 1999, 2003). All micrographs from both LBK samples were analysed by one single researcher, Ivana Jarošová, to eliminate inter-observer error (see Galbany *et al.* 2005, Estebaranz *et al.* 2009). All statistics were calculated and graphs obtained using the STATISTICA 10.0 StatSoft Inc. package, IBM SPSS Statistics 19.0, and PAST v2.17c. The significance of all statistical data was evaluated at the $p \leq 0.05$ level.

As comparative population for buccal dental microwear we used modern hunter-gatherers, pastoralists, and agriculturists, all of whom have arisen from different ecological conditions and may have gained their food from all parts of the world (Lalueza *et al.* 1996). According to ecological criteria that, as indicated, correspond with the geographical latitude from which these people come, these populations can be divided into four broad groups: (1) agriculturalist / vegetarian (Hindus, n = 20: 7 females, 13 males); (2) mixed-diet, hunter-gatherer populations from tropical forests (Andamanese and Veddahs, n = 27: 14 females, 9 males, 4 ambiguous); (3) carnivorous, hunter-gatherer and pastoralist populations, including

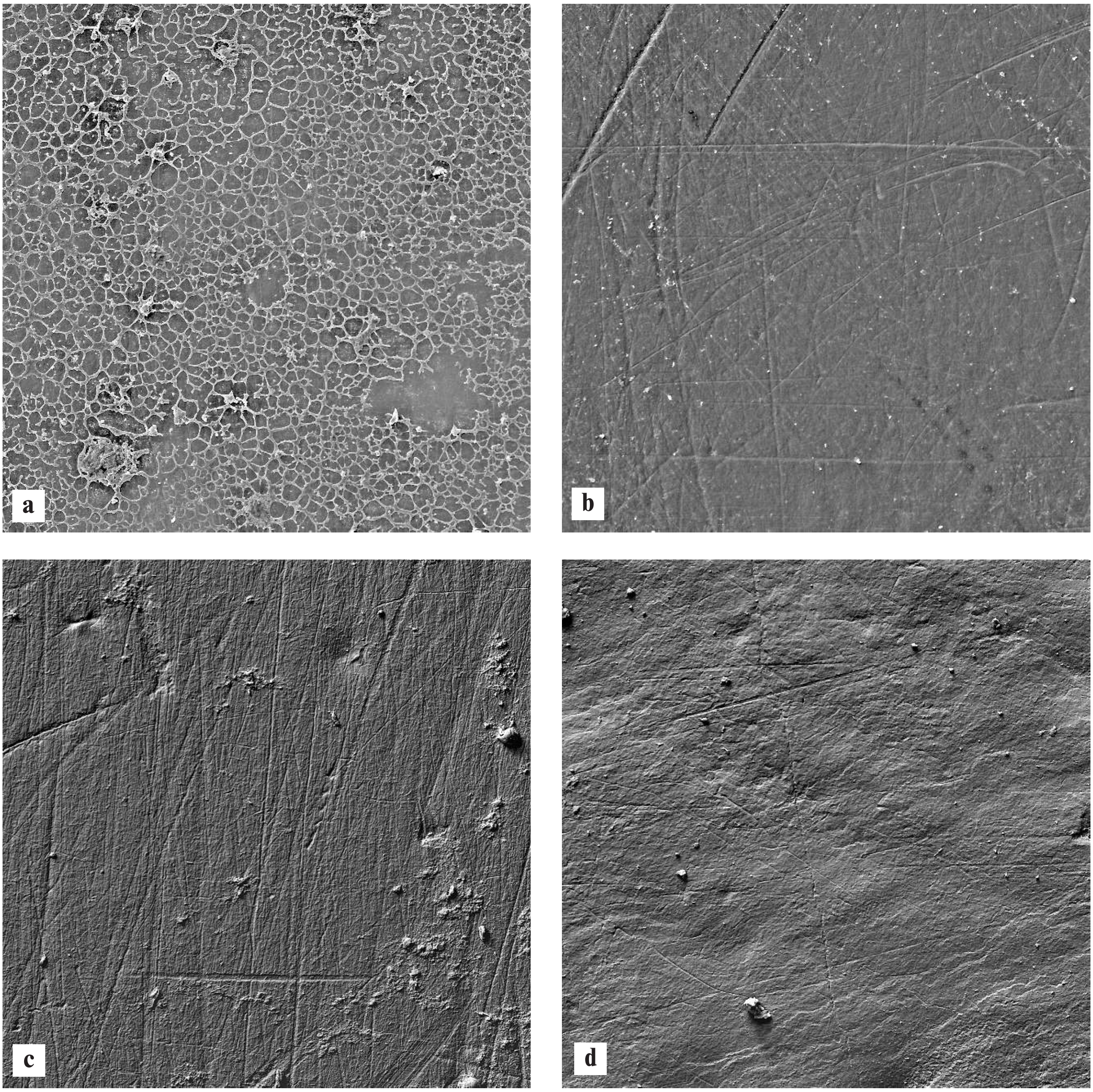

FIGURE 2. SEM images of selected individuals from Vedrovice, Czech Republic and Nitra - Horné Krškany, Slovakia. Each square enhanced with Adobe Photoshop CS and surface analysed covers 0.56 mm^2 of buccal enamel surface. Occlusal surface faces the top of micrograph. (a) child (8 years), no. 13b/64, Nitra, tooth m2LL, surface of the tooth covered with polymerising vinyl acetate; (b) child (8 years), no. 13b/64, Nitra, tooth m2LL, cleaned surface of the tooth after removing polymerising vinyl acetate with alcohol (ethanol); (c) Young male (20–25 yrs), no. 73/79, Vedrovice - Široká u lesa, graveyard, tooth Pm4LL; (d) Adult female (25–35 yrs), no. 75/79, Vedrovice - Široká u lesa, graveyard, tooth M2LR with slightly visible perikymata on buccal enamel surface.

TABLE 2. Statistical overview of two different laboratories used by 3 different authors (Richards *et al.* 2008, Smrčka *et al.* 2005, 2008a, and Whittle *et al.* 2013) for processing human samples from Vedrovice and Nitra - Horné Krškany for $\delta^{13}C$ and $\delta^{15}N$ isotope analysis (distribution of age categories for purpose of stable isotope data: newborn = neonate up to 5 months, infant = 6 months until less than three years, child = over three years until 14 years). Abbreviations: SD, Std. Deviation; SEK, Std. Error of Kurtosis; SES, Std. Error of Skewness; Var., Variance.

Reference	stable isotope	No. of tested individuals	Mean	Median	Min	Max	SD	SEK	SES	Skewness	Var.
Richards *et al.* 2008: VEDROVICE	$\delta^{13}C$‰	56 (all)	-19.72	-19.70	-21.40	-18.70	0.4028	0.6283	0.3190	-1.1669	0.1622
14 subadults (2 newborns & 1 infant & 11 children), 42 adults	$\delta^{15}N$‰		9.87	9.80	8.90	13.30	0.6452	0.6283	0.3190	2.6903	0.4163
Smrčka *et al.* 2005: VEDROVICE	$\delta^{13}C$‰	10 (all)	-21.02	-20.80	-21.90	-20.50	0.4780	1.3342	0.6870	-0.7919	0.2284
7 subadults (2 newborns & 5 children), 3 adults	$\delta^{15}N$‰		10.15	9.90	8.80	12.00	1.0146	1.3342	0.6870	0.5042	1.0294
Smrčka *et al.* 2008: VEDROVICE	$\delta^{13}C$‰	17 (all)	-21.28	-21.29	-22.40	-19.94	0.6194	1.0632	0.5497	0.2956	0.3836
5 subadults (=children), 12 adults	$\delta^{15}N$‰		10.11	10.10	9.00	10.90	0.5761	1.0632	0.5497	-0.4723	0.3318
Whittle *et al.* 2013: VEDROVICE	$\delta^{13}C$‰	33 (all)	-19.83	-19.80	-20.60	-19.20	0.3575	0.7984	0.4086	-0.6795	0.1278
8 subadults (=children), 25 adults	$\delta^{15}N$‰		9.33	9.30	8.50	10.80	0.4862	0.7984	0.4086	0.7019	0.2364
selected sample Whittle *et al.* 2013: VEDROVICE	$\delta^{13}C$‰	16 (selected sample)	-19.73	-19.70	-20.50	-19.20	0.2892	1.0908	0.5643	-1.0426	0.0836
7 subadults (=children), 9 adults	$\delta^{15}N$‰		9.12	9.15	8.50	10.30	0.4916	1.0908	0.5643	0.9218	0.2416
selected sample Smrčka *et al.* 2005, 2008: VEDROVICE	$\delta^{13}C$‰	16 (selected sample)	-21.26	-21.27	-22.40	-19.94	0.6610	1.0908	0.5643	0.1830	0.4369
7 subadults (=children), 9 adults	$\delta^{15}N$‰		9.83	9.90	8.80	10.90	0.6213	1.0908	0.5643	-0.1730	0.3860
Whittle *et al.* 2013: NITRA	$\delta^{13}C$‰	60 (all)	-20.13	-20.20	-21.00	-19.10	0.3286	0.6085	0.3087	0.6233	0.1080
17 subadults (3 infants & 14 children), 43 adults	$\delta^{15}N$‰		10.40	10.30	9.30	13.00	0.7948	0.6085	0.3087	1.7069	0.6317

Fueguians (mainly hunting and fishing), Inuits (exclusively hunting strategies), Vancouver Islanders (mainly fishing and hunting), and Lapps (predominantly reindeer herding) (n = 62: 24 females, 30 males, 8 ambiguous); and (4) mixed diet, hunter-gatherer populations from arid and mesothermal environments, including Bushmen, Australian Aborigines, and Tasmanians (n = 44: 14 females, 18 males, 12 ambiguous) (Lalueza, Pérez-Pérez 1993, Lalueza *et al.* 1996). Except for three juvenile Bushmen skulls, only adult individuals were studied, in order to control age variability of the striation pattern (Lalueza *et al.* 1996).

Methods for carbon and nitrogen isotope analysis

Carbon and nitrogen isotope analysis determine diets in the last 10-15 years of life depending on which bone is sampled (see Hedges *et al.* 2007). We used data from all individuals buried at Vedrovice and Nitra - Horné Krškany (see *Appendix 1*), which have been published so far together with methods used to process human samples (Richards *et al.* 2008, Smrčka *et al.* 2005, 2008a, Whittle *et al.* 2013) and compared these results with results of buccal dental microwear.

Richards *et al.* 2008 undertook carbon and nitrogen analysis to reconstruct human diets in 57 individuals buried at Vedrovice, but for our purposes we can use only 56 (14 subadults and 42 adults) as individual 86/78 was impossible to link with any Vedrovice burial. Smrčka *et al.* 2005 analysed 10 individuals (7 subadults and 3 adults) and Smrčka *et al.* 2008a analysed 17 individuals (5 subadults and 12 adults) with carbon and nitrogen analysis. Whittle *et al.* 2013 processed 33 individuals (8 subadults and 25 adults) from Vedrovice and 60 individuals (17 subadults, 43 adults) from Nitra - Horné Krškany to reconstruct diet using $\delta^{13}C$ and $\delta^{15}N$ isotopes. The isotopic data produced from animal remains are available in cited papers of all authors, but are not included for purpose of our paper. *Table 2*

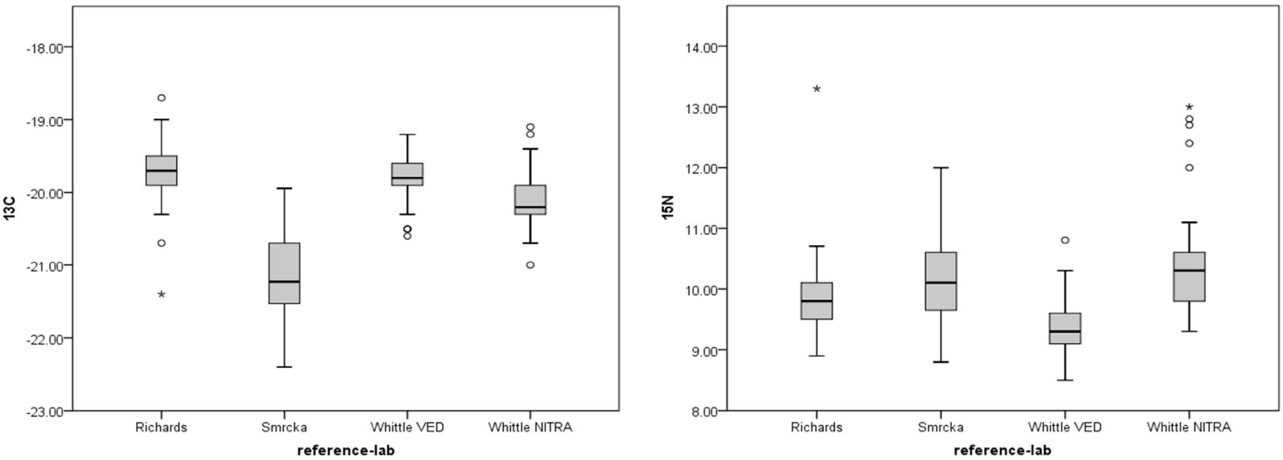

FIGURE 3. Boxplots of two different laboratories used by different authors (Richards *et al.* 2008, Smrčka *et al.* 2005, 2008a, and Whittle *et al.* 2013); note: teams of Richards and Whittle used the same laboratory in Oxford for processing human samples from Vedrovice and Nitra - Horné Krškany for $\delta^{13}C$ (a) and $\delta^{15}N$ (b) isotope analysis.

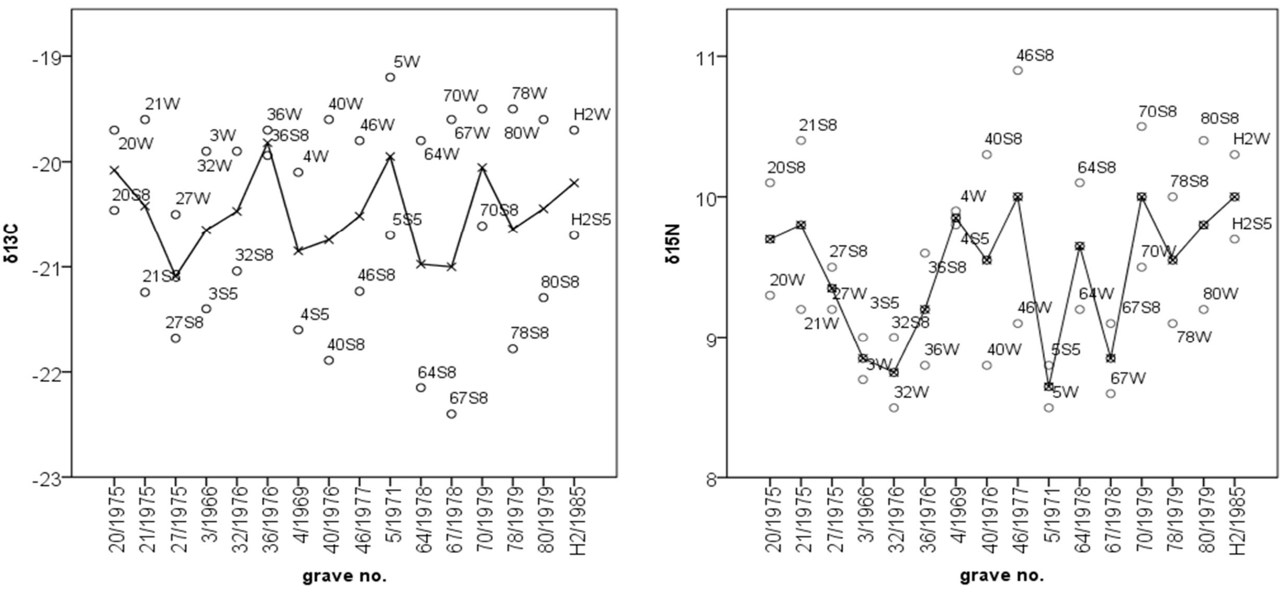

FIGURE 4. Comparison of 16 individuals tested for $\delta^{13}C$ (a) and $\delta^{15}N$ (b) isotopes using two laboratories for processing human samples from the same individual buried at Vedrovice (W = data after Whittle *et al.* 2013, S5 = data after Smrčka *et al.* 2005, S8 = data after Smrčka *et al.* 2008a). Interpolation line added to show trends in measured data. For data source, see *Appendix 1*.

provides brief statistical overview of 2 different laboratories (note: team of Richards and Whittle used the same laboratory in Oxford) used by 3 different authors (Richards, Smrčka and Whittle) according to the papers they published and number of individuals analysed. As it is possible to see, the highest values of $\delta^{13}C$ variance represent laboratory used by Smrčka *et al.* 2008a and the highest values of $\delta^{15}N$ variance represent laboratory used by Smrčka *et al.* 2005 within Vedrovice sample (*Figure 3*). When we excluded newborns and infant with strong breastfeeding signal (7/72, 8/74, 17/75, 81b/79 and 93b/80) from the

TABLE 3. Mean values with standard deviations of selected variables according to three examined groups within and between Vedrovice (VED) and Nitra - Horné Krškany (NITRA HK) samples: M = adult males 15+ years; F = adult females 15+ years; child = subadult individuals 0–14 years; Ad = adult individual over 15 years. Group no. 1, all individuals tested for buccal microwear analysis only (dataset of combined data from Jarošová 2008, Jarošová *et al.* 2008 and original data from this paper). Group no. 2, all individuals tested for stable isotope analysis only (dataset of combined data from Richards *et al.* 2008 and Whittle *et al.* 2013). Selected group no. 3, individuals tested for both buccal microwear analysis and stable analysis.

Group no. 1	NT	XT	SD NT	SD XT	NH	NV	SD NH	SD NV	NH/NT	NV/NT	SD NH/NT	SD NV/NT
NITRA HK M (n=13)	94.23	175.06	22.70	44.34	14.92	46.77	10.36	14.54	0.1515	0.4945	0.0793	0.0873
VED M (n=11)	80.36	133.74	35.94	36.18	16.45	28.55	7.85	19.40	0.2216	0.3249	0.1071	0.1769
NITRA HK F (n=18)	88.22	161.00	26.56	43.97	18.00	35.94	9.24	20.13	0.2155	0.3981	0.1235	0.1706
VED F (n=22)	80.64	150.86	21.12	34.66	19.73	25.55	10.99	14.13	0.2448	0.3188	0.1171	0.1413
NITRA HK child (n=15)	100.13	152.98	26.01	25.22	19.47	46.07	10.00	18.52	0.2039	0.4503	0.1328	0.1483
VED child (n=9)	61.44	123.49	39.14	26.78	13.33	17.00	9.49	13.43	0.2277	0.2591	0.1017	0.1124
NITRA HK Ad (n=34)	89.53	167.69	24.20	43.06	17.15	39.41	9.51	18.07	0.1976	0.4337	0.1127	0.1456
VED Ad (n=34)	80.71	145.47	26.01	35.07	18.68	26.71	9.90	15.62	0.2369	0.3223	0.1110	0.1492
Selected group no. 3	NT	XT	SD NT	SD XT	NH	NV	SD NH	SD NV	NH/NT	NV/NT	SD NH/NT	SD NV/NT
NITRA HK M (n=9)	91.44	185.13	22.18	41.96	14.78	43.78	11.77	11.91	0.1529	0.4819	0.0900	0.0935
VED M (n=10)	80.50	131.43	37.88	37.28	16.00	29.30	8.12	20.28	0.2172	0.3308	0.1119	0.1853
NITRA HK F (n=18)	88.22	161.00	26.56	43.97	18.00	35.94	9.24	20.13	0.2155	0.3981	0.1235	0.1706
VED F (n=19)	79.11	147.47	20.83	29.07	18.37	25.68	10.72	15.24	0.2345	0.3231	0.1212	0.1484
NITRA HK child (n=12)	103.75	146.30	24.45	22.38	17.42	51.92	8.86	12.46	0.1663	0.5059	0.0842	0.0843
VED child (n=4)	56.50	143.93	48.27	22.69	13.50	15.50	11.68	14.48	0.2578	0.2429	0.0526	0.0818
NITRA HK Ad (n=28)	88.46	169.89	24.73	43.46	16.96	38.36	9.86	17.66	0.1974	0.4287	0.1144	0.1506
VED Ad (n=30)	79.80	142.40	26.77	31.94	17.63	27.10	9.66	16.60	0.2286	0.3273	0.1143	0.1563

Group no. 2	$\delta^{13}C$	$\delta^{15}N$	SD $\delta^{13}C$	SD $\delta^{15}N$
NITRA HK M (n=14)	-20.04	10.36	0.21	0.52
VED M (n=22)	-19.63	9.97	0.26	0.41
NITRA HK F (n=27)	-20.16	10.26	0.23	0.66
VED F (n=42)	-19.81	9.50	0.36	0.40
NITRA HK child (n=17)	-20.11	10.75	0.50	1.09
VED child (n=22)	-19.80	9.75	0.53	1.03
NITRA HK Ad (n=43)	-20.13	10.27	0.24	0.61
VED Ad (n=67)	-19.75	9.64	0.33	0.46
Selected group no. 3	$\delta^{13}C$	$\delta^{15}N$	SD $\delta^{13}C$	SD $\delta^{15}N$
NITRA HK M (n=9)	-20.01	10.44	0.20	0.48
VED M (n=10)	-19.76	9.90	0.19	0.53
NITRA HK F (n=18)	-20.16	10.10	0.23	0.33
VED F (n=19)	-19.81	9.53	0.34	0.37
NITRA HK child (n=12)	-20.15	10.64	0.40	1.03
VED child (n=4)	-19.68	8.98	0.17	0.28
NITRA HK Ad (n=28)	-20.10	10.20	0.23	0.41
VED Ad (n=30)	-19.79	9.64	0.29	0.46

variance analysis, we still see the highest variance for both $\delta^{13}C$ (0.339) and $\delta^{15}N$ (0.388) in laboratory used by Smrčka, while Oxford laboratory variance is at least twice lower in tested stable isotope data (for $\delta^{13}C$ 0.094–0.128 and for $\delta^{15}N$ 0.187–0.236).To describe in detail two different datasets, we have tested all 16 individuals from Vedrovice, where sampling and laboratory processing was performed by Smrčka and his colleagues (Smrčka *et al.* 2005, 2008a) and subsequently by Whittle and his team (Whittle *et al.* 2013) on the same individual and the same type of bone. Results were not homogeneous: both laboratories have captured the same trends in data distribution, which is very valuable, but unfortunately with difference of up to two units (‰). Moreover, paired t-test confirmed statistically significant differences between results of Whittle and Smrčka in the sample of 16 individuals (*Figure 4*). Smrčka and his colleagues obtained data in all individuals with greater variance in comparison to Whittle, respectively

TABLE 4. List of variables with statistically significant differences using non-parametric tests of the three examined groups within and between Vedrovice (VED) and Nitra - Horné Krškany (Nitra HK) samples: Ad = adult individual over 15 years; SubAd = subadult individuals 0–14 years; M = adult males 15+ years; F = adult females 15+ years. The most interesting variables of microwear analysis marked bold. For explanation of group no. 1, no. 2 and selected group no. 3 *see Table 3.*

		Kolmogorov-Smirnov Test: significant at p< .05	**Mann-Whitney U Test: significant at p< .05**
Group no. 1:	VED Ad (n=34) vs VED SubAd (n=9)	SDH, **NT**	XH, SDH, NMD, SDMD
	NITRA HK Ad (n=34) vs NITRA HK SubAd (n=15)	XV, XMD	no statistical significant difference
	VED Ad (n=34) vs NITRA HK Ad (n=34)	**NV**, XMD, SDMD, NDM**, XT,**SDNT	**NV**, XMD, SDMD, NDM, **XT**,SDNT
	VED SubAd (n=9) vs NITRA HK SubAd (n=15)	**NV, NT, XT**	XH, SDH, **NV**, SDMD, **NT, XT**, SDNT
	VED F (n=22) vs VED M (n=11)	no statistical significant difference	no statistical significant difference
	NITRA HK F (n=18) vs NITRA HK M (n=13)	no statistical significant difference	no statistical significant difference
	NITRA HK F (n=18) vs VED F (n=22)	SDMD	SDMD
	NITRA HK M (n=13) vs VED M (n=11)	XMD,SDNT	**NV**, XMD, NDM, **XT**,SDNT
Group no. 2:	VED Ad (n=67) vs VED SubAd (n=22)	no statistical significant difference	no statistical significant difference
	NITRA HK Ad (n=43) vs NITRA HK SubAd (n=17)	no statistical significant difference	no statistical significant difference
	VED Ad (n=67) vs NITRA HK Ad (n=43)	$\delta^{13}C$, $\delta^{1}5N$	$\delta^{13}C$, $\delta^{15}N$
	VED SubAd (n=22) vs NITRA HK SubAd (n=17)	$\delta^{13}C$, $\delta^{15}N$	$\delta^{13}C$, $\delta^{15}N$
	VED F (n=42) vs VED M (n=22)	$\delta^{15}N$	$\delta^{15}N$
	NITRA HK F (n=27) vs NITRA HK M (n=14)	no statistical significant difference	no statistical significant difference
	NITRA HK F (n=27) vs VED F (n=42)	$\delta^{13}C$, $\delta^{15}N$	$\delta^{13}C$, $\delta^{15}N$
	NITRA HK M (n=14) vs VED M (n=22)	$\delta^{13}C$, $\delta^{15}N$	$\delta^{13}C$, $\delta^{15}N$
Selected group no. 3:	VED Ad (n=30) vs VED SubAd (n=4)	δ^{15} N	NMD, SDMD, δ^{15} N
	NITRA HK Ad (n=28) vs NITRA HK SubAd (n=12)	XV, SDV, XMD, **XT**	**NV**, XMD, SDMD, **NT, XT**
	VED Ad (n=30) vs NITRA HK Ad (n=28)	XMD, SDMD, **XT,** SDNT, $\delta^{13}C$, $\delta^{15}N$	**NV,** XMD, SDMD, **XT**,SDNT, $\delta^{13}C$, $\delta^{15}N$
	VED SubAd (n=4) vs NITRA HK SubAd (n=12)	**NV**, $\delta^{15}N$	**NV**, NMD, SDMD, $\delta^{13}C$, $\delta^{15}N$
	VED F (n=19) vs VED M (n=10)	no statistical significant difference	no statistical significant difference
	NITRA HK F (n=18) vs NITRA HK M (n=9)	$\delta^{15}N$	XV, $\delta^{15}N$
	NITRA HK F (n=18) vs VED F (n=19)	NMD, SDMD, **XT**, $\delta^{13}C$, $\delta^{15}N$	SDMD, $\delta^{13}C$, $\delta^{15}N$
	NITRA HK M (n=9) vs VED M (n=10)	XMD,SDNT	XV, XMD, **XT**,SDNT, $\delta^{13}C$

standard deviation within Vedrovice sample (*Table 2*), regardless of whether it was a sample of a subadults or an adult individual. As we are not familiar with detailed procedure of obtaining stable isotope data and issues of its overestimation or undervaluation, we chose for the purpose of our article data from Oxford laboratory with less variance (i.e. Richards *et al.* 2008 and Whittle *et al.* 2013). As soon as we know how to harmonise the shift between datasets made by Smrčka *et al.* (2005, 2008a) and Whittle *et al.* 2013 originating from two different laboratories and data processing, we plan to revaluate the outcomes of this paper.

Methods and data used for comparison of dental microwear with stable isotope of human samples from Nitra - Horné Krškany were taken from Whittle *et al.* 2013. As the same laboratory as the Vedrovice samples was used by Whittle *et al.* (2013), the difference between Vedrovice and Nitra datasets are linked with different stable isotope results obtained than in methodology bias. $\delta^{15}N$ variance in Nitra sample is quite high, and most probably originates in breastfeeding signal of six infants/children, who died before the age of 3 years.

RESULTS

In order to reconstruct the past diets of humans buried at Vedrovice and Nitra - Horné Krškany we have divided the datasets into three groups to test them for intra- and inter-population variability: first, we tested all individuals from both LBK sites for buccal dental microwear only, second all analysed data for carbon and nitrogen analysis taken from Richards *et al.* 2008 and Whittle *et al.* 2013 were tested separately from the first group. Third, we tested selected groups of individuals from both sites, whose individuals were tested for both buccal dental microwear pattern and stable isotope data. Mean values of selected variables with standard deviations for all three tested groups are provided in *Table 3* and a summary of the statistically significant variables resulting from non-parametric tests within three tested groups are listed in *Table 4*. Non-parametric tests were used as our microwear and stable isotope data are independent variables and their distribution has not met the assumption of normality in all cases as we have included in analysis all individuals to introduce full biological diversity within our studied samples. As variances and normality of our data differs, non-parametrics tests were used: the two sample Kolmogorov-Smirnov (analogue to the two-sample t test with unequal variances) and Mann-Whitney U-Test (analogue to the two-sample t-test with equal variances). This choice has its limits and advantages. The K-S examines a single maximum difference between two distributions, but provides no insight as to what caused the difference. The hypotheses for K-S are not rooted in a mean or median (measures of central tendency). M-W U-test is based on ranks and has good efficiency, especially for symmetric distributions. The sample drawn from the population is random. Its null hypothesis asserts that the medians of the two samples are identical.

Group no. 1: All individuals tested for buccal microwear patterns

The examined individuals for buccal dental microwear from Vedrovice (n = 43) and Nitra - Horné Krškany (n = 49) (see *Appendix 1*) reflect the ingested food within approximately a period of a few months before their death (depends on abrasivity of diets) (see the "turnover effect" stability of buccal microwear patterns in Romero *et al.* 2012), Thus, this analysis can be considered as a short-term diet indicator in

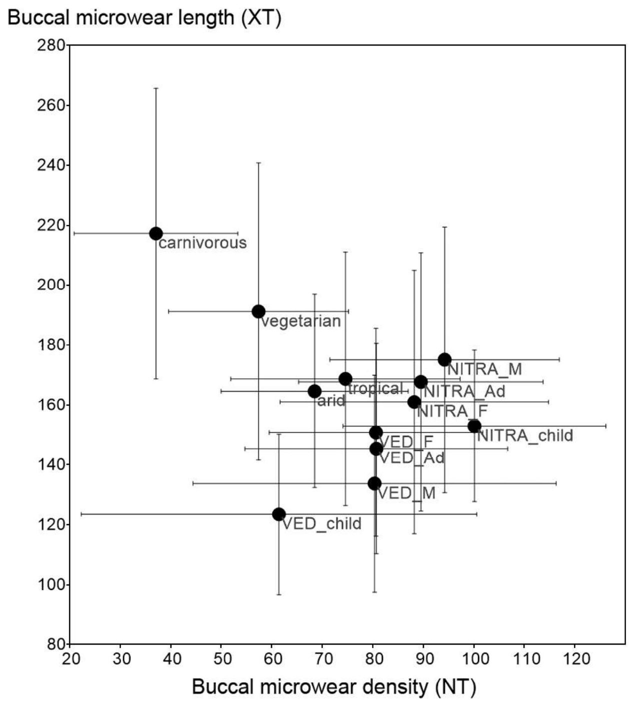

FIGURE 5. Bivariate plot comparing buccal microwear density (NT) and length (XT, in μm) related to the dietary abrasiveness between subadult (3–14 years) and adult populations (over 15 years) analysed (group no. 1). Error bars denote ± standard deviation. For data source, see *Table 3*.

comparison to results obtained by analysis of stable carbon and nitrogen isotopes (please note that term "a short-term" diet indicator in context of buccal dental microwear is relative as it covers in fact period of several months in comparison to the occlussal dental microwear, which is rather seasonal). It is also important to take into account when describing this analysis that identified food preferences obtained through buccal dental microwear can change throughout the life of the individual, e.g. through a change in social status reflected in food composition.

When considering the Vedrovice sample, we have tested all individuals from settlement and both cemeteries (Široká u lesa (n = 36) and Za Dvorem (n = 7) as a whole as these individuals are considered to live contemporaneously and we consider the difference in demographic composition between these groups rather in burial rite than in two separate populations.

Mean values of basic dental microwear data with standard deviation values of the studied population from Vedrovice and Nitra are shown in *Table 3*. Mean values of the density of microstriations (NT) in the adult modern human hunter-gatherer groups ranged between 32.0 and 74.8 (Lalueza *et al.* 1996), whereas our LBK sample reached higher values (NT for adult Vedrovice population was 81.14 and for adult Nitra population 89.53, *Table 3*). This result may be indicative of more abrasive diet in the LBK sample in comparison to recent populations with known diet. A more abrasive diet was suggested for individuals buried at Nitra site than within the Vedrovice sample, but without a statistically significant difference. By comparing the average striation lengths (XT), the adult Vedrovice population approaches XT = 144.95 μm, whereas the adult Nitra population has values of XT = 167.69 μm. The Nitra sample falls into the ratio for a mixed-diet of arid and tropical populations, where

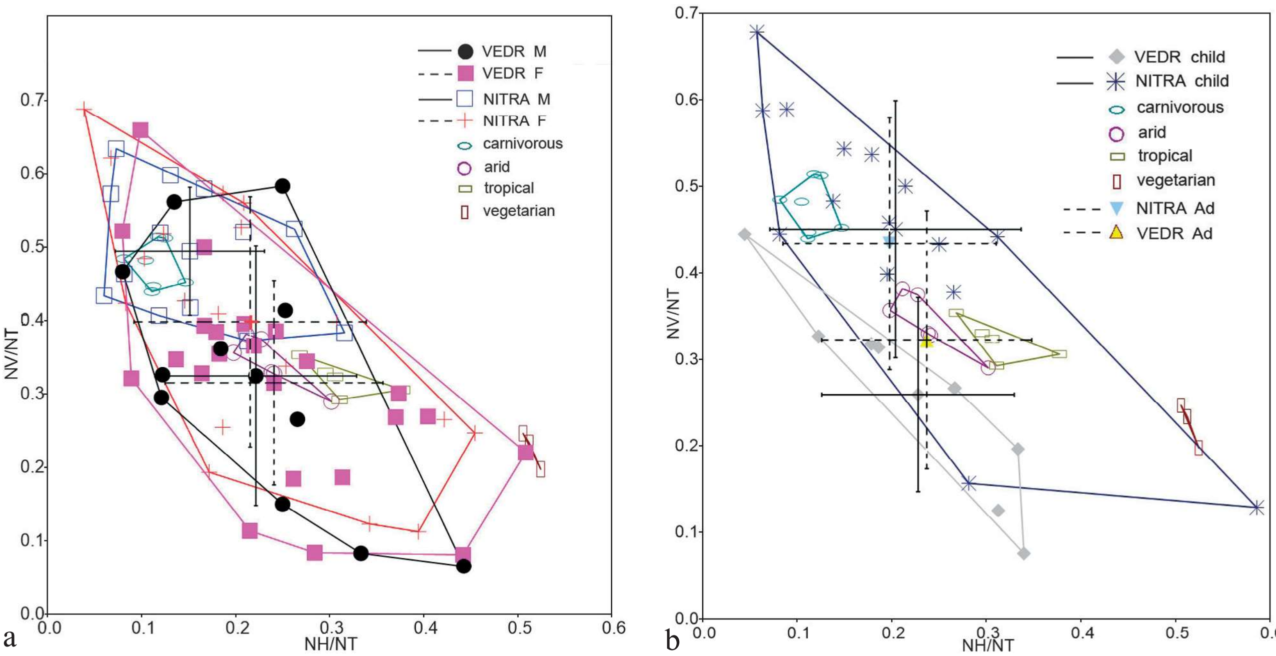

FIGURE 6. Scatterplot of NH/NT index with respect to NV/NT index for all adult (a) and subadult (b) individuals from the Vedrovice and Nitra population: M (adult males over 15 years old), F (adult females over 15 years old) (group no. 1), populations with recently studied samples with known dietary pattern: vegetarian agriculturalist (Hindu); populations from tropical areas (Andamanese, Veddahs); populations from arid areas (Bushmen, Tasmanians, Australian aborigines); carnivorous populations: (Fueguians, Inuits, Vancouver islanders, Lapps); for data source see Lalueza *et al.* 1996. Convex hull showing the areas occupied by studied groups, using different colours, representing the smallest convex polygon that contains all points. The populations with known diets are presented as mean values only, whereas the population from Vedrovice and Nitra shows raw data. Bivariate plot between males and females (a) and those adult (15+ years) and subadult (3–14 years) populations (b) analysed. Error bars denote ± standard deviation. For data source, see *Table 3*.

average values of XT approach 164.6 and 168.7 µm respectively, whereas the adult Vedrovice sample is slightly below expected values, but still within SD range (see Lalueza *et al.* 1996, *Figure 5*). In sum, by comparing both the NT and XT values of both LBK samples, we see a tendency towards a lower striation density (NT) and shorter scratches (XT) in adults at Vedrovice compared to the adults in Nitra sample, which can also be observed in the subadults of both LBK sites.

By using the non-parametric two sample Kolmogorov-Smirnov test, statistically significant differences at $p < 0.05$ were found between adults from Nitra and Vedrovice, which means that the composition of their diet differed mainly in number of vertical striations (NV was higher in Nitra sample) and average length of all striations (XT was shorter in Vedrovice sample) apart from other variables (XMD, SDMD, NDM, SDNT) which explain rather variability of dental microwear pattern that can be associated with food processing by chewing. Subadults (3–14 years) from both LBK samples differ significantly in number of vertical striations (Nitra sample has twice higher NV), average length of all striations (XT) and food abrasiveness (NT was nearly twice lower at Vedrovice). This means a predominance of soft diet for nine Vedrovice children over 3 years of age and certain highly abrasive foods in the diet of the fifteen children at Nitra. When comparing the average number of vertical striation (NV) values, respectively index NH/NT and NV/NT (*Figure 6b*) subadults in Nitra most probably have a higher meat intake in their diet than subadults at Vedrovice. This conclusion applies to children over three years of age because since this age, deciduous molars are already fully used for chewing and processing food and therefore also suitable for the analysis of buccal dental microwear.

In previously-analysed populations, a different buccal microwear pattern was observed between groups of adults and infants (Pérez-Pérez *et al.* 1994, Pinilla Pérez *et al.* 2011, Jarošová 2007, Jarošová *et al.* 2016). When comparing intra-population variability of adults and infants / subadults (3–14 years) within both LBK samples, we see a statistically significant difference in diet abrasiveness (NT) in the Vedrovice sample (softer food composition in subadults), but the diet of adults and subadults in Nitra seems to be rather of the same composition without any difference of abrasiveness, differing only in length of vertical striation (XV), which is difficult to clearly interpret in terms of ingested food. By comparing NV/NT a NH/NT in subadults of both LBK populations, we see a tendency to higher number of vertical striations and lower numbers of horizontal striation in the Nitra subadult sample in comparison to Vedrovice. This indicates a meaty diet for Nitra infants and mixed diet at Vedrovice (*Figure 6b*).

When focusing on gender social scales, there were no statistically significant differences found in the diets of adult males and females within the Vedrovice and Nitra samples confirmed by both Kolmogorov-Smirnov test and Mann-Whitney U test at significance of $p < 0.05$. When comparing females and males between both groups, the composition of the diet of adult women at Vedrovice and Nitra seem to be almost identical. However, the uniformity of the male diet at Vedrovice and Nitra cannot be fully confirmed as both non-parametrics tests differ in their significance: no difference was detected by Kolmogorov-Smirnov test, but Mann-Whitney U test found statistically significant differences in the number of vertical striations (NV) and average length of all striations (XT) (*Figure 5* and *6a*). To infer the ratio of meat intake in both adult populations, we used the NH/NT and NV/NT indices and compared them to populations with known diets (*Figure 6a*).

Mean values of NH/NT and NV/NT indices in both adult males and females within the **Vedrovice sample** suggest an identical mixed diet. By observing the standard deviations of the NH/NT and NV/NT indices values, we see similar high values in both males and females, i.e. diversity in food type. For three of all the examined eleven men it is possible to infer a meaty diet (46/77, 73/79 and 76/79, i.e. young adult males in age 20–35 years); for two males we see microstriations which could be linked to a vegetarian diet (23/75 and H2/85, i.e. adolescent and young adult male); and for six of the eleven adult males from Vedrovice we see a buccal microwear pattern similar to arid and tropical populations with mixed diet (10/74, 57/78, 66/78, 69/78, 95/80 and 99/81, i.e. men of all age categories between 20 to 50+ years). The standard deviation values for the twenty-three women at Vedrovice are almost the same as for the male sample: part of the female population showed the wear traces predominantly from the meaty component of the diet (eg. 70/79, 72/79 and 93a/80, i.e. females of the age range between 20 to 50 years), while the majority – seventeen women – had a mixed diet (22/75, 38/76, 45/77, 62/78, 64/78, 67/78, 80/79, 81a/79, 91/80, 97/80, 100/81, 101/81, 102/81, 104/81, H1/85, H10/89 and H11/97, i.e. all age categories: seven of age 20–35 years, eight of age 35–50 years and two in age over 50 years), or even vegetarian (42/77 and 75/79, i.e. women in their thirtieth decade) (*Figure 6a*).

As concerns the **grave goods at Vedrovice**, we provide here only a general excursion into this very complex topic. Our aim is just to observe trends between the diet and attributes of social status in terms of grave goods (data described in detail in Ondruš *et al.* 2002 and Podborský 2002a and listed also in Whittle *et al.* 2013), assuming grave goods also reflect the social status of the deceased during his/her life. Among men with a predominance of meaty food we have three young adult males with varied grave goods from a single chipped stone (73/79) to fully furnished graves with polished and chipped stones accompanied by worked antler (76/79) or Spondylus and ceramics (46/77). Two males with an inferred vegetarian diet represent a contrasting couple, with an adolescent with ceramics (23/75) and chipped stone and young adult male with polished stone, 12 beads of Spondylus (H2/85). The six males with an inferred mixed diet, represent a group poles apart in terms of grave goods. Their accompanying objects are very heterogeneous – with ceramics (99/81), in combination with chipped stone (66/78), or with chipped and polished stones (57/78), or fully furnished grave with polished and grinding stone, 18 Spondylus beads, worked bone and unworked pebble (69/78). For Vedrovice women with a predominance of meaty food according dental microwear, the most common grave goods were Spondylus (20 beads in grave 70/79, 1 bead in grave 93a/80 or at least two other shells in grave no. 72/79) and ceramics, accompanied with ochre in grave 72/79. The two vegetarians among adult females in Vedrovice are identical, with only Spondylus in their graves (42/77 and 75/79). The majority of women with mixed diet were varied in their grave goods: the majority of them have simple unfurnished graves (22/75, 38/76, 64/78, 67/78, H1/85); sherds or ceramics (97/80, 45/77), polished stone (H10/89), grinding stone (101/81), chipped stone (80/79), or event flint (104/81) that was randomly given as grave goods, but quite often it was Spondylus (102/81) alone or with ceramics (100/81). A couple of adult women have fully furnished graves with ceramics, Spondylus, chipped stone and other minor grave miscellania (62/78, 81a/79, 91/80). We focus our observations on **middle-aged / adult group with fully furnished graves** in Vedrovice. Podborský (2002b), Květina (2004) and Zvelebil, Pettitt (2008) are consistent in their considerations which individual can be considered as with abundant grave gifts at Vedrovice - Široká u lesa: 39/76 (child), 15/75, 19/75, 46/77, 69/78 (men), 36/76, 70/79 (women) (note: Podborský (2002b) and Květina (2004) considered skeletons 36/76 and 70/79 as males, but the sex of both of these individuals was re-determined and these skeletons are no longer male, but a number recent studies identified them as female: see Zvelebil, Pettitt 2008, Lillie 2008, Jarošová 2008, Whittle *et al.* 2013. If this re-assessment from male to female skeletons (36/76 and 70/79) is correct, with which both authors of this article agree, we have also fully furnished graves of middle-aged females at Vedrovice Široká u lesa and not only the privileged position of men as considered before (see Podborský 2002b and Květina 2004). Moreover, Podborský (2002b) and Zvelebil, Pettitt (2008) add into exceptionally rich grave equipment another five graves 54/78, 57/78, 79/79 (men), and two women: 83/80 and 91/80. In sum, there are twelve main graves with exceptionally rich grave equipment and another two burials with remarkable grave goods (adult at 12/74 and female 86/80 – see Podborský 2002b) identified at Široká u lesa. Within them Podborský (2002b, 301) identified seven clusters of individuals, which were structured in similar pattern and Zvelebil recognised one more cluster (Zvelebil, Pettitt 2008). In Vedrovice Za Dvorem cemetery three fully furnished individuals were identified: H2/85 (male), H8/88 (child) and H9/88 (unique rich burial of female) (Podborský 2002b). We created group of individuals with abundantly equipped graves containing all selected individuals to test their diet. We were unfortunately not able to collect microwear data for the majority of important individuals according to the grave goods (eg. 12/74, 15/75, 19/75, 36/76, 39/76, 54/78, 79/79, 83/80, 86/80, H8/88 and H9/88). According to food type, we have at our disposal only six individuals: 46/77, 57/78, 69/78, 70/79, 91/80, H2/85. The food of these four adult males and two adult females differs, as discussed above. With exception of H2/85 (Za Dvorem cemetery, which has the least equipped grave among all the richly equipped), all individuals from Široká u lesa cemetery with abundant grave goods have mixed (3) or meaty diet (2). When we test the roughness of diet composition by comparing total number of all striations (NT) in men and women with fully furnished graves in comparison to average NT values of all adult individuals (NT=80.71) within the Vedrovice sample, a softer diet was demonstrated only for two men (69/78 and H2/85) of the total number of six. In general, in young adult males (20–35 years) we see a meaty diet and mixed food in the same frequency, there is only one possible case of a mixed diet with a significant portion of vegetal components in his diet (H2/85). Among this age group we see individuals who can be considered as rich/fully furnished in terms of Neolithic grave goods (see above). Middle aged males (35–50 years) predominantly had a mixed diet (but we have only 2 males in this group). Only one male over 50 years old had a mixed diet. Women's diet was diverse no matter what somebody gave them after death as grave goods; the most common among other grave goods was Spondylus, which was found more often in female graves without any clear dominance according to the type of food or age category: in all age categories we see a predominance of a mixed diet. In the Vedrovice sample, meaty diets can be considered as something unusual in a dominance of mixed diet concept of this site. In contrast, meat in the diet cannot be linked to the fully furnished graves, as we have only couple of individuals among the males and females in this sample. At the Vedrovice site we cannot thus link a meaty diet with fully furnished graves, and hence high social status.

Even if no statistically significant difference was observed also between adult males and females within **Nitra sample**, mean values of NH/NT and NV/NT indices suggest meaty foods were eaten by males and a rather mixed diet for females. When observing the standard deviation of the NH/NT and NV/NT indices values, we see quite small values in the males, which suggests food uniformity in the male sample from Nitra. The prevalence of the meaty diet was identified in all examined eleven males, with exception of two males around 30 years of age (no. 62/65 and 72/65) with unfurnished graves. The values of the standard deviations in women are almost double that of the male sample, from which we can see diversity in the diets of women, with part of the female population with the high meaty component (eg. 1/64, 4/64a, 9/64, 20/65, 24/65, 33/65, 37/65, 39/65 and 44/65, i.e. females of the age range between 20 to 50 years), while another part had the mixed diet (6/64, 22/65, 35/65, 48/65, i.e. all age categories), or even vegetarian (53/65, 61/65, 64/65, 70/65, i.e. mainly women around the age of 40 years) (*Figure 6a*).

As concerns **the grave goods at Nitra** (see Pavúk 1972, Whittle *et al.* 2013) buried with men who consumed a predominance of meaty food, we have two adolescent males (3/64 and 69/65), whereas the rest of nine males died in middle age (35–50 years). Among middle aged males, two (45/65 and 63/65) have unfurnished graves, whereas the majority of males have a number of precious or uncommon types of grave goods including Spondylus, polished stone and ceramics (no. 2/64, 8/64, 34/65, and 58/65) or at least polished stone tools (26/65) or ochre (7/64) or mix of human and animal teeth (19/65). The two adolescents (3/64 and 69/65) have only ceramics in their graves. In women in the age category 20–50 years with predominance of meaty food according dental microwear, the most common grave goods were ceramics (1/64, 9/64 (?), 24/65, 44/65), only in the grave of woman (35–50 years) no. 39/65 was Spondylus and sherds found, but in many cases was the grave was simply unfurnished (20/65, 33/65, 37/56, i.e. women who died at age 20–35 years). No data on grave goods are available for 4/64a. Women in all age categories with mixed diet have very similar grave goods as those with meat diet: sherds (22/65(?)), ceramics (32/65) with added Spondylus (6/64, 35/65 – old and middle-aged women) or unfurnished (48/65). All four women with an inferred vegetarian diet have ceramics in their graves (53/65, 61/65, 64/65 and 70/65 – moreover two of them – middle-aged women – were additionally equipped with ochre (64/65) or Spondylus (70/65). We tested a group of individuals with rich equipped graves according to their diet. In the Nitra sample, we have at our disposal only four middle aged males 2/64, 8/64, 34/65, 58/65 who all present richly equipped graves at the Nitra cemetery. The diet of these men was unified – in all cases, the meaty component prevailed according to the dental microwear analysis. When we test the diet in terms of the roughness of its composition by comparing total number of all striations (NT) in males with fully furnished graves in comparison to average NT values of all adult individuals (NT = 89.53) within Nitra sample, a softer diet was demonstrated only by two men (8/64 and 58/65) out of a total of four.

To conclude, we consider a meaty diet as something common at Nitra, linked to both to the furnished and unfurnished graves. A middle-aged (35–50 years) male at Nitra had a significant portion of meat in their diet and also fully furnished graves, but there were also cases of adolescents with meaty diet and common grave goods. There were also two young adult males with unfurnished graves and a mixed diet who were shifted from the main pattern at this site. Women's diet was diverse and independent to grave goods – ceramics or unfurnished graves were most common, while Spondylus was very rare. Pavúk (1972) indicates that only 10 burials in Nitra were equipped with Spondylus (i.e. 13.5%), whereas at Vedrovice - Široká u lesa cemetery it was 25 graves (29.4%) (Podborský 2002b, 310). Moreover, the grave goods of females in Nitra are more impoverished than in males. In general, more precious objects were given to middle-aged or old men and also women, but the luxuriance and number of the objects were lower in Nitra in comparison to Vedrovice grave goods. The populations buried at Vedrovice and Nitra do not seem to be comparable in terms of grave goods and diet. From this we suggest that there were different eating habits and hence social scales based around status at the two cemeteries. A softer diet indicating a higher social status has not been proved for either the Vedrovice or the Nitra sample, which is in contrast to Prague-Zličín population dated to the Migration period (5th century AD) (see Jarošová *et al.* 2016).

Group no. 2: All individuals tested for stable isotopes

The individuals tested for carbon and nitrogen isotopes from Vedrovice (n = 89) and Nitra - Horné Krškany (n = 60) (see *Appendix 1*) reflect the food eaten within the period of at least the last several years of an individual's life (e.g. human femoral bone collagen isotopically reflects an individual's diet over a much longer period of time than 10 years: see collagen turnover rates for adults and subadults in Hedges *et al.* 2007; see also Tykot 2004, 2006), which can be considered as a long-term diet indicator in comparison to period of food composition results obtained by buccal dental analysis.

The carbon and nitrogen data from the LBK site of Vedrovice indicate that all adults and subadults (n = 57) had a very similar diet, largely C3 based, with most of the dietary protein coming from animal (meat or milk) sources, likely domesticated animals (cattle of sheep) (Richards *et al.* 2008, 192). The weaning of a few infants occurred before the age of three in this population (Richards *et al.* 2008, 192). As high values of $\delta^{15}N$ are not present at Vedrovice, it is very unlikely that freshwater fish was a significant component of the diet of the Vedrovice humans (Richards *et al.* 2008, 172). No input from millet in diet was confirmed (Richards *et al.* 2008, 176).

We used non-parametric tests in order to summarise statistically significant differences within the dataset of combined data from Richards *et al.* 2008 and Whittle *et al.* 2013. Mean values of the $\delta^{13}C$ and $\delta^{15}N$ ratios with the number of individuals included in analysis are summarised *Table 3* and *Figures 7, 8*. No statistically significant differences between adults and subadults was found within the tested sample of individuals from Vedrovice and Nitra - Horné Krškany. Males have a significantly higher average of $\delta^{15}N$ than females in across the whole site of Vedrovice (Whittle *et al.* 2013,

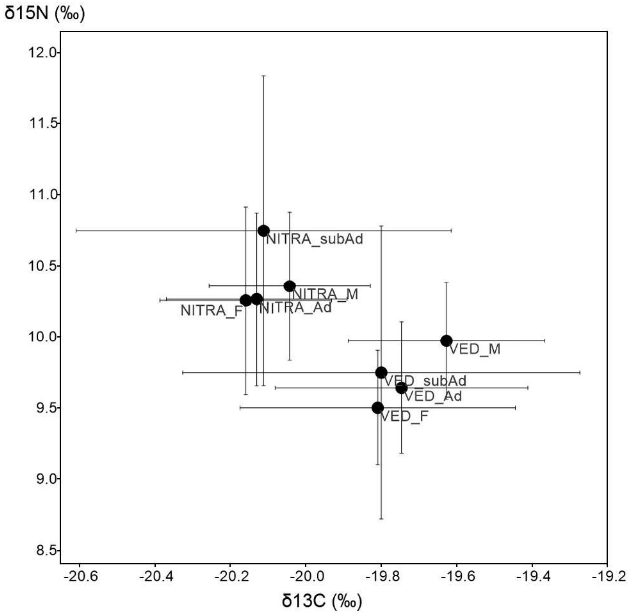

FIGURE 7. Bivariate plot comparing $\delta^{13}C$ (in ‰) and $\delta^{15}N$ (in ‰) related to the dietary composition of Vedrovice and Nitra for all subadult (0–14 years) and adult (15+ years) populations analysed for stable isotopes (group no. 2). Error bars denote ± standard deviation. For data source, see *Table 3*.

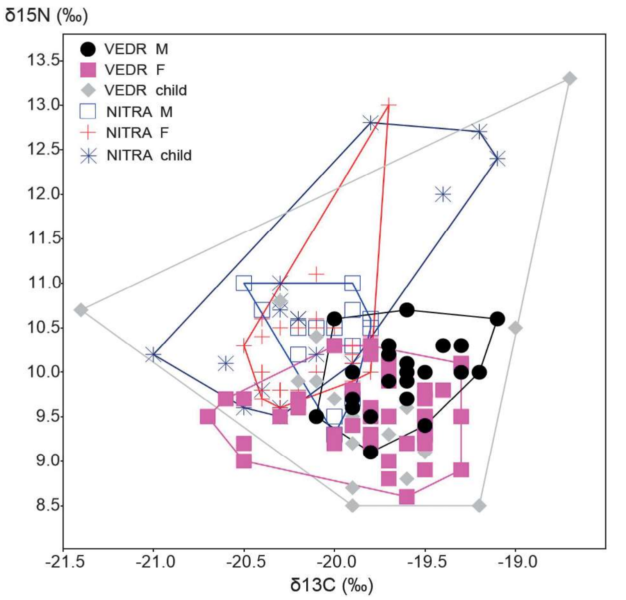

FIGURE 8. Scatterplot of $\delta^{13}C$ (in ‰) with respect to $\delta^{15}N$ (in ‰) for all individuals tested for isotopic data from Vedrovice and Nitra population: M (adult males over 15 years old), F (adult females over 15 years old), and child (subadults 0–14 years) (group no. 2). Convex hull showing the areas occupied by studied groups, using different colours. Vedrovice and Nitra raw data are presented.

119), but no statistically significant difference between males and females was found in the Nitra - Horné Krškany sample – as the difference between male and female in $\delta^{15}N$ values was lower at Nitra than at Vedrovice (*Figure 7*). When comparing adults from Vedrovice and Nitra, statistically significant differences in both $\delta^{13}C$ and $\delta^{15}N$ were found. The same result was obtained when comparing subadults at both sites (*Table 4*). This could indicate that there was a different diet at both LBK sites, which can also be influenced by different food sources in their area. As noted Whittle *et al.* 2013 (p. 151), high overall $\delta^{15}N$ values in adult human and animal samples at Nitra are high for the region, so this probably reflects an environmental (how forested the landscape was) rather than a dietary difference. As expected, the highest degree of variation for both isotopes was the groups of subadults, including breastfeeding neonates, infants and weaned children at both LBK sites as seen in standard deviation of $\delta^{15}N$ (over 1.0) and $\delta^{13}C$ (over 0.50). Detailed analysis of a nursing signal in infant group (under the age of three) is described in Whittle *et al.* 2013. As the infants are still influenced by a nursing/breastfeeding signal, they were excluded from analysis comparing protein-rich diet with abundantly equipped graves.

The mean value of $\delta^{15}N$ in adult males (n = 22) was 9.97 and in adult females (n = 42) 9.50 in the **Vedrovice sample**. In the standard deviation of $\delta^{15}N$ values we see the same diversity in food type in both females and males. To identify individuals with a protein-rich diet, we chose the sum of the $\delta^{15}N$ average of the adult population and its standard deviation (this assumption does not follow any recommendation published, but should just serve to distinguish the individuals with the highest $\delta^{15}N$ values within one population): 4 adult men in age 20–50 years (57/78, 59/78, 71/79, 73/79) and 3 adult females (31/76, 48/77, 93a/80) were identified as individuals with values higher than 10.11 for δ15N values (note: all men and women identified as with protein-rich diet were sampled by Richards *et al*. 2008 only; no individual with protein-rich diet sampled by Whittle *et al*. 2013; additionally there were two women 9/74 and 81a/79 sampled by Smrčka *et al*. 2005, 2008 with values of $\delta^{15}N$ fulfilled criteria for protein-rich diet). If we use the $\delta^{15}N$ average for the adult Vedrovice population (9.64), the number of individuals with a higher value than is the average will increase to 32 out of 67, or even to 38 when including data from Smrčka *et al.* 2005 and 2008a. In the Vedrovice sample we have ten adult individuals of all age categories with fully furnished graves (as described above – see Podborský 2002b, Květina 2004 and Zvelebil, Pettitt 2008) with high protein intake in their diet: two males 57/78 and H2/85 fulfilled criteria for protein-rich diet and fully furnished graves (and additionally possibly also two males 19/75, 69/78 when considering data from Smrčka *et al.* 2008); and another six adults with fully furnished graves had higher $\delta^{15}N$ values than is average for this population (15/75, 54/78, 79/79 (men), 86/80, 91/80, H9/88 (women) at both Vedrovice cemeteries. The rest of the five individuals with abundant grave goods (12/74, 36/76, 46/77, 70/79, 83/80) have lower values of $\delta^{15}N$ than is the average for the Vedrovice adult population according to Whittle *et al.* 2013. In summary, in the Vedrovice sample, we cannot confirm that all males and females examined for stable isotopes with fully furnished graves had a high protein intake in their diet as there were also individuals with abundant grave goods and lower $\delta^{15}N$ values than is average value for adult population, and thus having a low-protein intake in their diet.

The mean $\delta^{15}N$ value in adult males (n = 14) was 10.36 and in adult females (n = 27) 10.26 in the **Nitra sample**. In the standard deviation of the $\delta^{15}N$ values, we see a slightly higher diversity in animal protein intake in females, whereas males present a uniformity of diet at Nitra. To identify individuals with a protein-rich diet, we chose the sum of the $\delta^{15}N$ average value of the adult population and its standard deviation. Two men aged 35–50 years (8/64 and 77/65) and one young woman 20–30 years old (57/65) had $\delta^{15}N$values higher than 10.88. If we consider the $\delta^{15}N$ average value for the adult population at Nitra (10.27) as break point, the number of individuals with a higher value than is the average will increase to 22 out of 43 adults. In the Nitra sample, we have one male 8/64, who fulfilled criteria for protein-rich diet and fully furnished grave (as described above – see Pavúk 1972) and another two males with abundantly furnished graves, who had higher $\delta^{15}N$ values than is average for this population (no. 35/65 and 58/65). In sum, all three males examined for stable isotopes with fully furnished graves have higher $\delta^{15}N$ values confirming higher protein intake linked to higher social status. Unfortunately, the findings from such a small sample cannot be generalised to the LBK population as a whole and we put this forward only for consideration.

Group no. 3: Selected individuals tested for both buccal microwear pattern and stable isotopes

The selected group of individuals (composed of individuals with available microwear and stable isotope data) from Vedrovice (n = 34) and Nitra - Horné Krškany (n = 40) were tested for their dental microwear pattern and stable isotopes (combined data from Richards *et al.* 2008 and Whittle *et al.* 2013) in order to show possible differences of their dietary habits according to distinct methods covering a short-term and long-term period. We excluded all neonates and infants under the age of three years as this age groups are affected by a nursing signal and their deciduous teeth are not in full occlusion to reflect buccal microwear pattern. The mean values of all data with the number of individuals included in the analysis is summarised in *Table 3*. Pearson paired correlation showed statistically significant differences (at p = 0.01) between $\delta^{13}C$ and striation density (NT; r = -0.305) and between $\delta^{15}N$ and number of vertical striations (NV; r = 0.302), confirming higher number of vertical striations in individuals with protein-rich diet. No other statistically significant differences were found between group of stable isotope variables and microwear data. Further, we used non-parametric tests in order to summarise statistically significant differences. In the Vedrovice sample, there are statistically higher $\delta^{15}N$ values in adults than in subadults and buccal microwear data are uniform; this result can be distorted by the very small number of examined children. In contrast, in the Nitra sample the stable isotope data are uniform and statistically significant differences between adults and subadults were only present in the microwear data – subadults have a higher number of vertical striations (NV), a more abrasive diet (NT) with shorter scratches (XT) than adults (*Table 4*). At Nitra, males have significantly higher $\delta^{15}N$ values than females. No statistically significant differences in microwear and stable isotope data between males and females were found in the selected Vedrovice sample. This can be interpreted as suggesting an unchanging long-term higher protein intake in Nitra males compared to the lower protein ratio of Nitra females. Males and females at Vedrovice have a uniform diet from both the short- and long-term points of view with stable protein/mean intakes. When comparing all adults from Vedrovice and Nitra, statistically significant differences were found: higher $\delta^{15}N$ with lower $\delta^{13}C$ (*Figure 9*) together with higher number of vertical striation (NV) and longer striations (XT) was found in the Nitra sample (*Figure 11, 12a*). A similar result was obtained when comparing subadults at both sites: higher $\delta^{15}N$ with lower $\delta^{13}C$ together with significant higher number of vertical striation (NV) in children

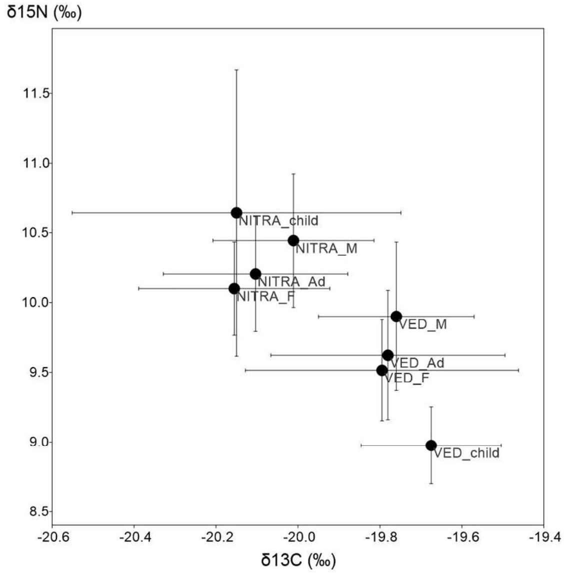

FIGURE 9. Bivariate plot comparing $\delta^{13}C$ (in ‰) and $\delta^{15}N$ (in ‰) related to the dietary composition of Vedrovice and Nitra selected subadult (3–14 years) and adult (15+ years) populations analysed for both buccal microwear analysis and stable isotope (group no. 3). Error bars denote ± standard deviation. For data source, see *Table 3*.

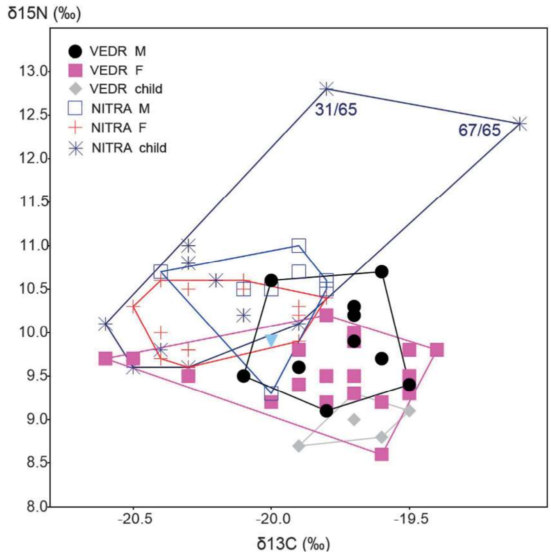

FIGURE 10. Scatterplot of $\delta^{13}C$ (in ‰) with respect to $\delta^{15}N$ (in ‰) for selected individuals (group no. 3) tested for both isotopic data and buccal dental microwear from Vedrovice and Nitra population: M (adult males over 15 years old), F (adult females over 15 years old), and child (subadults 3–14 years). Convex hull showing the areas occupied by studied groups, using different colours.

from Nitra (eg. two three-year-old children 31/65 and 67/65, both with a probable strong nursing signal, have not only a very high $\delta^{15}N$, but also a high number of vertical striations compared to horizontal ones – both of these results suggest high protein/meat intake: see *Figures 10* and *12b*). In summary, we can say that both of these methods are in accordance and confirm higher protein/meat intake in the Nitra subadult and adult sample in comparison to the Vedrovice population. This confirms that diet composition was different at both LBK sites.

DISCUSSION

The previous analysis of 18 individuals (13 adult females and five adult males) from the Vedrovice site (Jarošová 2008) yielded a distinct microwear pattern linked with inter-group sex and age-related variability. In spite of uncertain food preparation technology associated with early agriculturalist techniques, it was possible to conclude that diet in the Vedrovice sample was mostly based on vegetal/cereal intake in its character and consisted mainly of some grain-based components, whereas meat was eaten only sporadically. By comparing sex related differences, a higher vegetal intake by females in comparison to the male population was concluded. A few years later, by analysing full Vedrovice sample, we see that sample size affect the results obtained. By comparing the complete Vedrovice sample with the Nitra sample in this paper, our perceptions of the composition of LBK diet inferred through buccal dental microwear have now changed.

Both LBK populations, like other prehistoric populations provide only limited information on early agricultural techniques, the food composition (how plants and meat were mixed for typical meals), processing techniques (e.g. evidences of ancient stone grinders / mills), quantity and subsistence of consumed food (for detail study of this topic please refer to Bickle 2016). For both studied LBK populations we have evidence of human body height, health status, enthesopathies, anthropometric data and assessment of muscle topography and even a small animal bones assemblage at the Vedrovice site, but it is difficult to understand the entire complex relationship between the different datasets provided by skeletal material and many questions remain still unanswered.

The observed high amounts of abrasive particles (NT) in the diet in all examined groups of adults and subadults in the Nitra population might have originated from certain highly abrasive foods or from the type of food preparation technology. The extensive microwear pattern in the Nitra sample might be explained by the coarsely-processed foods, which include relatively large amounts of exogenous impacts of grits in the buccal microwear pattern (for detailed information, see Salazar-García *et al.* 2016, Romero, De Juan 2007). In contrast, the population of Vedrovice – and the children in particular – had a very soft diet compared to the population of Nitra. If we combine the results of dental microwear and stable isotopes in the children of both LBK populations, it seems that the high proportion of proteins proved in diet through high nitrogen values in the Nitra population is not only caused by the breastfeeding signal of infants, but could be also result of a meaty diet in children over 3 years old, which was suggested by dental microwear as well. Children at Vedrovice have lower $\delta^{15}N$ values and also a reduced ratio of vertical striations combined with a higher number of

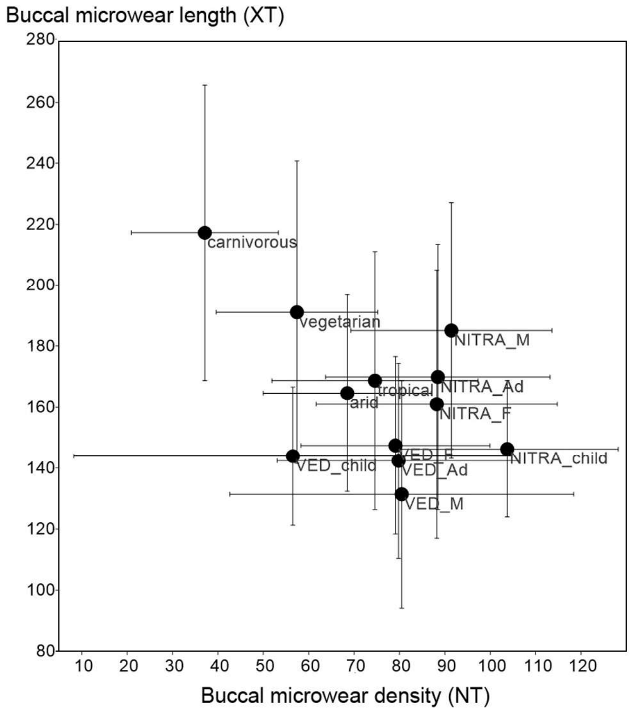

FIGURE 11. Bivariate plot comparing buccal microwear density (NT) and length (XT, in μm) related to the dietary abrasiveness between selected subadult (3–14 years) and adult populations (15+ years) analysed (group no. 3). Error bars denote ± standard deviation. For data source, see *Table 3.*

horizontal striations in the dental microwear. Both results are consistent and indicate a lower ratio of protein in the diet of the Vedrovice children (i.e. both lower breastfeeding signal and a lower proportion of meat). Results of the adult population were consistent with results obtained for subadult populations at both LBK sites, even if intra-group variability was detected on short- and long-term basis, mainly between adult males and females. According to our analyses, we cannot fully confirm sex-related differences at the Vedrovice and Nitra sites, as only few data points were confirmed as statistically significant. Buccal microwear pattern did not prove statistically significant difference at any of studied sites, between males and females even if higher meat intake was suggested for males at both sites. Differences in the higher $\delta^{15}N$ ratio were also confirmed at both sites for males, but statistical significance seems to vary more based on the number of individuals included in analysis than on a clear contrast between males and females at both early LBK sites. These sex-related differences can be explained by the higher status of men in early LBK society, but another explanation could be the labour role of males and females in LBK society, with men eating meat while hunting and females were eating mixed food while preparing cooked meals. As we were unable to confirm men's higher social status clearly through fully furnished graves linked with high meat intake for any of our studied early LBK populations (at Nitra there was only small group of fully furnished graves and at Vedrovice both males and females had abundantly furnished graves), we cannot thus accept male dominance as the only interpretation for higher meat/protein intake. When a selected group of individuals (composed of individuals with available microwear and stable isotope data) are included in the analysis, we have achieved clear agreement between the data from the stable isotope and buccal microwear as we confirmed different diet composition at both LBK sites with higher protein/meat intake in the Nitra sample than in the Vedrovice population, whose diet was rather mixed.

In our case, we have seen that statistical significance depends not only on sample size (number of individuals included in analysis), but also on individuals' selection (changing dietary habits during an individual's life), which shape differences between examined groups of stable isotope and microwear data and provide us with different perceptions and understandings of the variability within and between

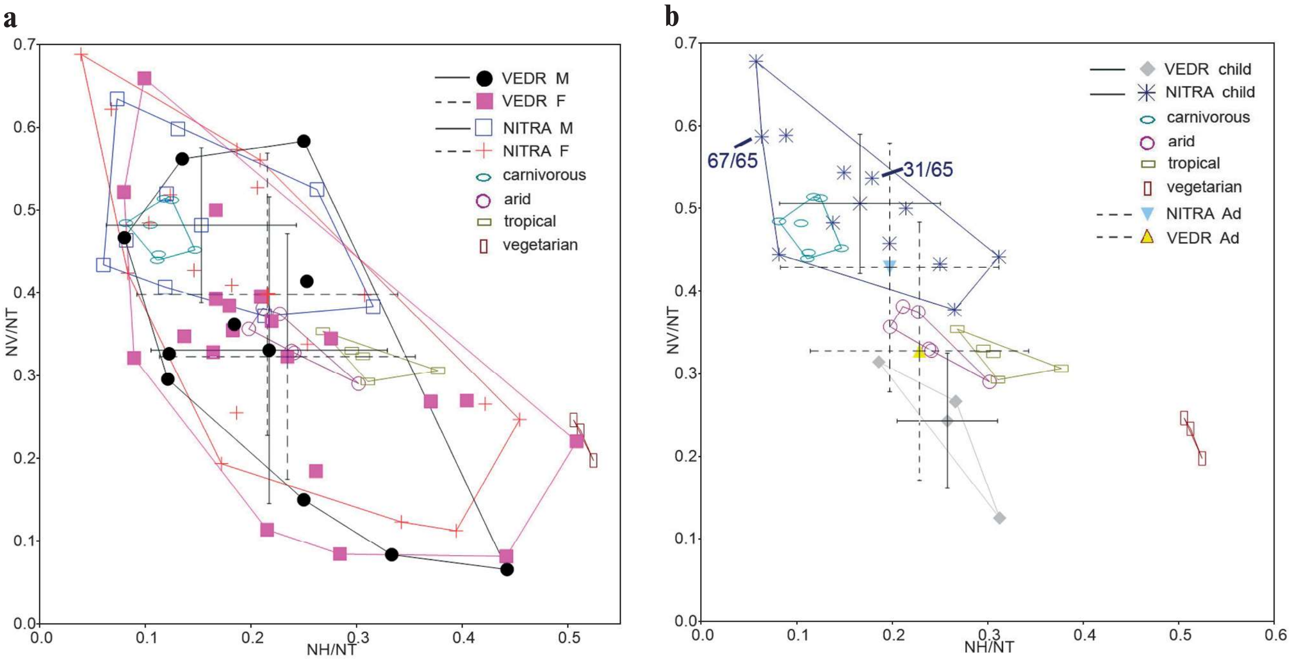

FIGURE 12. Scatterplot of NH/NT index with respect to NV/NT index for selected adult (a) and subadult (b) individuals from the Vedrovice and Nitra population: for detail description see *Figure 6*. Bivariate plot comparing NH/NT index with respect to NV/NT index between males and females (a) and those adult (15+ years) and subadult (3–14 years) populations (b) analysed (group no. 3). Error bars denote ± standard deviation. For data source, see *Table 3*.

the LBK populations. When interpreting such data, we should be cautious about accepting the results obtained. Although we have been able to at least partially elucidate the eating habits of individuals from the early stage of LBK in Moravia and western Slovakia, there is still a large number of questions that remain unanswered: why two populations of the same LBK period have different eating habits? Was it due to a different climate that had impact on cereal crop production in Nitra? Or do we see here simply diversity in personal food choice or cultural practices at both early LBK sites? Or were the data affected by bias introduced in various methods and interpretation? We will keep these discussions open to other researchers, who can build on our findings.

CONCLUSIONS

As confirmed by previous studies based on stable isotopic analysis, all individuals from examined LBK sites were pure C3 feeders, dependent mainly on C3-based terrestrial fauna. C4 plants (eg. millet) and marine sources were excluded. Freshwater fish, if any, was not a significant component of the diet at the Vedrovice and Nitra sites. To summarise the results obtained from buccal microwear data analysis by comparing both tested LBK sites, we identified more abrasive diet for individuals buried at Nitra site than those in the Vedrovice sample, even if a statistically significant difference was found only in subadults (3–14 years). There was also a tendency towards a lower striation density (NT) and shorter scratches (XT) in adults (15+ years) at Vedrovice compared to the adults in the Nitra sample, which was also observed in subadults. When the tested composition of diet was compared between adults at Vedrovice and Nitra, the difference was mainly found in the number of vertical striations (NV) and average length of all striations (XT), which points to a different proportion of meat in the diet. Subadults also followed this pattern through their statistically significant data. When testing intra-population variability of adults and children (3–14 years) within both LBK samples, a statistically significant difference in diet abrasiveness (NT) in the Vedrovice sample was observed, but the diet of adults and subadults at Nitra seems to be rather of the same composition. No statistically significant differences were found in the diet of adult males and females in the Vedrovice and Nitra samples. In spite of this, we found a significant degree of food uniformity was linked with high meat intake in the male sample from Nitra, while the population of Vedrovice can be characterised by a diversity in diet for both adult males and females. Regarding the population of women of Nitra, their group suggest dominance of meat in their food, but the mixed composition of their diet is not rare. In addition to that, a big variability in grave goods, age and eaten food was found at both sites, but in general, the majority of middle-aged or even old men and women at Vedrovice site with abundantly furnished graves enjoyed during their lives both access to meat and a mixed diet. No dominance with increasing meat intake as they grew older was detected. In the Nitra sample, we detect a small group of males with fully furnished graves and a high protein diet; graves of females in spite of their high meat intake were furnished only with common grave goods or unfurnished. A softer diet relating to higher social status was not shown in any LBK sites. When we compared results obtained through buccal microwear pattern and stable isotope analysis, these were in accordance: we confirmed different diet composition at both LBK sites with higher protein/meat intake in the Nitra sample in comparison to the Vedrovice population, whose diet was rather of mixed composition with lower protein/meat intake.

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APPENDIX 1. List of examined individuals from Vedrovice and Nitra - Horné Krškany (Ved. = Vedrovice, Široká u lesa; Ved-Z. = Vedrovice, Za dvorem; Nit. = Nitra – Horné Krškany; S = settlement; C = cemetery). Abbreviations: MCRW = buccal dental microwear analysis of premolars or molars; MCRW Ref = microwear reference (1 = Jarošová 2008, 2 = Jarošová *et al.* 2008, 3 = this paper); bone = sampled bone for stable isotopes analysis; $\delta^{13}C$ / $\delta^{15}N$ ref. = reference for stable isotopes (1 = Richards *et al.* 2008, 2 = Whittle *et al.* 2013, 3 = Smrčka *et al.* 2005, 4 = Smrčka *et al.* 2008); FFG = fully furnished (rich) graves.

Site	Grave no.	Inv. No.	Sex	Age (years)	Age (cat.)	subAd - Ad	MCRW	MCRW Ref	Stub	NH	XH	NV	XV	NT	XT	NH/NT	NV/NT	Diet inf. NH - NV - NT ratio	bone	$\delta^{13}C$‰	$\delta^{15}N$‰	$\delta^{13}C/\delta^{15}N$ ref	FFG
Ved. S	1/1963	A 1624	child	6-9 months	0-6 yrs	subAd	no teeth for mcrw																
Ved. S	2/1963	A 1625	child	5 yrs	0-6 yrs	subAd	m2UR	2	250	23	110.74	41	129.45	129	110.25	0.1783	0.3178	mixed	rib	-20.6	9.5	3	
Ved. S	3/1966	A 1633	child	9 yrs	7-14 yrs	subAd	m2UL	2	251	16	131.47	27	231.20	86	175.75	0.1860	0.3140	mixed	rib	-19.9 -21.4	8.7 9.0	2, 3	
Ved. S	4/1969	A 1636	child	8 yrs	7-14 yrs	subAd	N/A												rib	-20.1 -21.6	9.9 9.8	2, 3	
Ved. S	5/1971	A 1626	child	6-7 yrs	7-14 yrs	subAd	N/A												rib	-19.2 -20.7	8.5 8.8	2, 3	
Ved. S	6/1972	A 1627	child	3 yrs	0-6 yrs	subAd	m2UL	2	252	18	84.73	4	61.11	53	84.05	0.3396	0.0755	mixed/?	rib	-20.9	10.7	3	
Ved. C	7/1972	A 17 533	child	newborn (4-5 months)	0-6 yrs	subAd	no teeth for mcrw												rib	-21.2	12	3	
Ved. C	8/1974	A 1632	child	newborn (3-4 months)	0-6 yrs	subAd	no teeth for mcrw												rib	-20.5	11.3	3	
Ved. C	9/1974	A 1628	f	50-60 yrs	50+ yrs	Ad	N/A												rib	-21.9	10.7	3	
Ved. S	10/1974	A 1629	male	40-50 yrs	35-50 yrs	Ad	M1LL	2	253	28	167.75	55	140.47	152	138.51	0.1842	0.3618	mixed	rib	-19.9	9.6	2	
Ved. C	11/1974	A 1630	male	45-55 yrs	35-50 yrs	Ad	N/A												rib	-20.7	10	3	
Ved. C	12/1974	A 1631	?	adult		Ad	N/A												long bone	-19.6	9.3	2	(x)
Ved. C	13/1975	A 2277	f	adult		Ad	N/A													-19.7	10.1	1	
Ved. C	14/1975	A 2278	f	35-45 yrs	35-50 yrs	Ad	N/A													-19.3	10.1	1	
Ved. C	15/1975	A 2279	male	35-40 yrs	35-50 yrs	Ad	N/A													-19.2	10.0	1	x
Ved. C	16/1975	A 2280	child	3 yrs	0-6 yrs	subAd	N/A													-19.9	9.7	1	
Ved. C	17/1975	A 2281	child	1 y	0-6 yrs	subAd	no teeth for mcrw													-18.7	13.3	1	
Ved. C	18/1975	A 2282	child	6-8 yrs	7-14 yrs	subAd	N/A												rib	-21.46	10.0	4	
Ved. C	19/1975	A 2283	male	30-40 yrs	35-50 yrs	Ad	taphonomic postmortem defects on microscopic level	1	197										rib	-21.32	10.9	4	x
Ved. C	20/1975	A 2284	child	3-4 yrs	0-6 yrs	subAd	m1UL	3	299	4	136.85	4	114.72	15	140.82	0.2667	0.2667	mixed	rib	-19.7 -20.46	9.3 10.1	2, 4	
Ved. C	21/1975	A 2285	f	30-40 yrs	35-50 yrs	Ad	taphonomic postmortem defects on microscopic level	1	198										long bone rib	-19.6 -21.24	9.2 10.4	2, 4	
Ved. C	22/1975	A 2286	f	35-45 yrs	35-50 yrs	Ad	M2UR	1	184	13	104.93	33	111.57	95	101.61	0.1368	0.3474	mixed		-19.8	9.5	1	
Ved. C	23/1975	A 2287	male	17-20 yrs	15-19 yrs	Ad	M3LL	1	185	27	102.47	4	113.75	61	97.23	0.4426	0.0656	vegetarian		-20.0	10.6	1	
Ved. C	24/1975	A 2288	child	5 yrs	0-6 yrs	subAd	N/A													-19.9	9.2	1	
Ved. C	25/1975	A 2289	male	adult		Ad	N/A													-19.5	10.0	1	
Ved. C	27/1975	A 2291	f	20-25 yrs	20-35 yrs	Ad	N/A												rib	-20.5 -21.68	9.2 9.5	2, 4	

Site	Grave no.	Inv. No.	Sex	Age (years)	Age (cat.)	subAd - Ad	MCRW	MCRW Ref	Stub	NH	XH	NV	XV	NT	XT	NH/NT	NV/NT	Diet inf. NH - NV - NT ratio	bone	$\delta^{13}C$‰	$\delta^{15}N$‰	$\delta^{13}C/\delta^{15}N$ ref	FFG
Ved. C	28/1976	A 2290	child	4-5 yrs	0-6 yrs	subAd	N/A													-19.9	10.0	1	
Ved. C	29/1976	A 2293	f	18-20 yrs	15-19 yrs	Ad	N/A												rib	-20.5	9.0	2	
Ved. C	30/1976	A 2294	child	10-14 yrs	7-14 yrs	subAd	N/A													-19.5	9.5	1	
Ved. C	31/1976	A 2292	f	adult		Ad	N/A													-20.0	10.3	1	
Ved. C	32/1976	A 2295	child	12-14 yrs	7-14 yrs	subAd	N/A												rib	-19.9 -21.04	8.5 9.0	2, 4	
Ved. C	35/1976	A 2296	?	adult/maturus (?)		Ad	N/A												long bone	-19.9	9.3	2	
Ved. C	36/1976	A 2297	f	45-50 yrs	35-50 yrs	Ad	N/A												rib	-19.7 -19.94	8.8 9.6	2, 4	x
Ved. C	37/1976	A 2298	child	11 yrs	7-14 yrs	subAd	taphonomic postmortem defects on microscopic level	3	186											-19.6	9.6	1	
Ved. C	38/1976	A 2302	f	20-30 yrs	20-35 yrs	Ad	Pm4LL	1	187	17	142.17	33	205.77	93	167.41	0.1828	0.3548	mixed		-20.3	9.5	1	
Ved. C	39/1976	A 2299	child	3-4 yrs	0-6 yrs	subAd	N/A													-19.0	10.5	1	x
Ved. C	40/1976	A 2300	child	8-9 yrs	7-14 yrs	subAd	m1LR	3	285	29	126.06	29	179.31	109	136.98	0.2661	0.2661	mixed	long bone	-19.6 -21.89	8.8 10.3	2, 4	
Ved. C	42/1977	A 2301	f	+/- 30 yrs	20-35 yrs	Ad	M1LL	1	188	30	153.79	13	164.12	59	135.17	0.5085	0.2203	vegetarian		-19.5	9.8	1	
Ved. C	43/1977	A 2304	child	14 yrs	7-14 yrs	subAd	N/A													-20.0	9.7	1	
Ved. C	44/1977	A 2303	child	3-5 yrs	0-6 yrs	subAd	N/A													–19.9	9.5	1	
Ved. C	45/1977	A 2305	f	30-45 yrs	35-50 yrs	Ad	M2UL	1	199	17	156.53	27	131.51	70	131.38	0.2429	0.3857	mixed	rib	-21.46	9.7	4	
Ved. C	46/1977	A 2306	male	20-35 yrs	20-35 yrs	Ad	M1LL	1	200	12	100.57	50	156.75	89	140.18	0.1348	0.5618	meaty diet	rib	-19.8 -21.23	9.1 10.9	2, 4	x
Ved. C	48/1977	A 2307	f	18-20 yrs	15-19 yrs	Ad	N/A													-19.8	10.3	1	
Ved. C	50/1977	A 2308	male	adult		Ad	N/A													-19.8	9.5	1	
Ved. C	51/1977	A 2309	f	45-55 yrs	35-50 yrs	Ad	N/A													-20.7	9.5	1	
Ved. C	54/1978	A 2988	male	20-25 yrs	20-35 yrs	Ad	N/A													-19.6	10.1	1	x
Ved. C	55/1978	A 2989	child	10 yrs	7-14 yrs	subAd	N/A																
Ved. C	56/1978	A 2990	child	3 yrs	0-6 yrs	subAd	N/A													-19.8	9.1	1	
Ved. C	57/1978	A 2991	male	40-50 yrs	35-50 yrs	Ad	M2LL	1	189	16	102.58	39	131.79	132	116.23	0.1212	0.2955	mixed		-19.6	10.7	1	x
Ved. C	59/1978	A 2992	male	25-30 yrs	20-35 yrs	Ad	taphonomic postmortem defects on microscopic level	1	190											-19.4	10.3	1	

Site	Grave no.	Inv. No.	Sex	Age (years)	Age (cat.)	subAd - Ad	MCRW	MCRW Ref	Stub	NH	XH	NV	XV	NT	XT	NH/NT	NV/NT	Diet inf. NH - NV - NT ratio	bone	$\delta^{13}C$‰	$\delta^{15}N$‰	$\delta^{13}C/\delta^{15}N$ ref	FFG
Ved. C	61/1978	A 2993	f	40-50 yrs	35-50 yrs	Ad	N/A												rib	-19.8	9.3	2	
Ved. C	62/1978	A 2994	f	30-45 yrs	35-50 yrs	Ad	M1UL	1	191	11	162.33	22	177.23	67	140.25	0.1642	0.3284	mixed		-19.9	9.4	1	
Ved. C	63/1978	A 2995	male	40-45 yrs	35-50 yrs	Ad	N/A													-19.9	10	1	
Ved. C	64/1978	A 2996	f	18-25 yrs	20-35 yrs	Ad	Pm4LL	3	286	5	79.33	18	145.74	56	133.00	0.0893	0.3214	mixed	rib	-19.8 -22.15	9.2 10.1	2, 4	
Ved. C	66/1978	A 2997	male	30-35 yrs	20-35 yrs	Ad	M2UR	3	287	22	174.91	36	200.21	87	175.56	0.2529	0.4138	mixed		-19.7	9.9	1	
Ved. C	67/1978	A 2998	f	35-45 yrs	35-50 yrs	Ad	M2LL	1	202	17	144.92	12	194.95	65	159.49	0.2615	0.1846	mixed	rib	-19.6 -22.4	8.6 9.1	2, 4	
Ved. C	68/1978	A 2999	f	50 + yrs	50+ yrs	Ad	N/A												rib	-19.5	9.5	2	
Ved. C	69/1978	A 3000	male	20-30 yrs	20-35 yrs	Ad	M2UL	1	203	21	164.28	21	171.19	79	156.85	0.2658	0.2658	mixed	rib	-20.76	10.8	4	x
Ved. C	70/1979	A 3001	f	≤ 50 yrs	35-50 yrs	Ad	M2UR	1	204	9	182.23	59	160.33	113	161.15	0.0796	0.5221	meaty diet	rib	-19.5 -20.61	9.5 10.5	2, 4	x
Ved. C	71/1979	A 3002	male	35-45 yrs	35-50 yrs	Ad	N/A													–19.3	10.3	1	
Ved. C	72/1979	A 3003	f	30-40 yrs	35-50 yrs	Ad	Pm3UR	1	192	9	106.05	60	153.20	91	129.89	0.0989	0.6593	meaty diet		–19.5	9.3	1	
Ved. C	73/1979	A 3004	male	20-25 yrs	20-35 yrs	Ad	Pm4LL	3	288	21	145.94	49	237.68	84	199.25	0.2500	0.5833	meaty diet		–19.7	10.2	1	
Ved. C	74/1979	A 3005	f	50 + yrs	50+ yrs	Ad	N/A												rib	-19.3	9.5	2	
Ved. C	75/1979	A 3006	f	25-35 yrs	20-35 yrs	Ad	M2LR	3	289	38	130.11	7	62.50	86	102.81	0.4419	0.0814	vegetarian		–19.5	9.3	1	
Ved. C	76/1979	A 3007	male	30-35 yrs	20-35 yrs	Ad	Pm4LR	1	205	6	116.29	35	192.16	75	151.29	0.0800	0.4667	meaty diet	rib	-19.5	9.4	2	
Ved. C	77/1979	A 3008	male	40-50 yrs	35-50 yrs	Ad	taphonomic postmortem defects on microscopic level	1	193											-19.3	10.0	1	
Ved. C	78/1979	A 3009	child	6-7 yrs	7-14 yrs	subAd	m1LL	3	290	5	122.46	2	180.29	16	122.17	0.3125	0.1250	mixed	rib	-19.5 -21.78	9.1 10.0	2, 4	
Ved. C	79/1979	A 3010	male	25-35 yrs	20-35 yrs	Ad	N/A													-19.6	10.0	1	x
Ved. C	80/1979	A 3011	f	35-50 yrs	35-50 yrs	Ad	M3LR	1.3	206	18	118.16	34	196.76	86	167.92	0.2093	0.3953	mixed	rib	-19.6 -21.29	9.2 10.4	2, 4	
Ved. C	81a/1979	A 3012a	f	20-30 yrs	20-35 yrs	Ad	M2LL	1	207	31	297.81	25	236.44	83	247.14	0.3735	0.3012	mixed	rib	-21.11	10.5	4	
Ved. C	81b/1979	A 3013	child	newborn	0-6 yrs	subAd	no teeth for mcrw													-20.1	10.4	1	
Ved. C	82/1979	A 3013	male	50 + yrs	50+ yrs	Ad	N/A													-19.1	10.6	1	
Ved. C	83/1980	A 11227-246	f	60 + yrs	50+ yrs	Ad	N/A												rib	-19.5	9.2	2	x

Site	Grave no.	Inv. No.	Sex	Age (years)	Age (cat.)	subAd - Ad	MCRW	MCRW Ref	Stub	NH	XH	NV	XV	NT	XT	NH/NT	NV/NT	Diet inf. NH - NV - NT ratio	bone	$\delta^{13}C$‰	$\delta^{15}N$‰	$\delta^{13}C/\delta^{15}N$ ref	FFG
Ved. C	84/1980	A 11224-226	child	10-12 yrs	7-14 yrs	subAd	N/A													-20.2	9.9	1	
Ved. C	86/1980	A 11268-304	f	25-30 yrs	20-35 yrs	Ad	N/A													-19.9	9.8	1	(x)
Ved. C	87/1980	A 11305-311	f	adult		Ad	N/A													-19.5	9.7	1	
Ved. C	88/1980	A 11312-343	male	20-30 yrs	20-35 yrs	Ad	N/A												rib	-19.9	9.7	2	
Ved. C	89/1980	A 11344-353	f	adult		Ad	N/A													-20.0	9.3	1	
Ved. C	90/1980	A 11354-363	f	adult		Ad	N/A													-19.7	9.5	1	
Ved. C	91/1980	A 11364-403	f	18/20-30 yrs	20-35 yrs	Ad	M3LR	1	194	18	107.88	30	129.25	82	121.80	0.2195	0.3659	mixed		-19.4	9.8	1	x
Ved. C	93a/1980	A 11404-415	f	18-25 yrs	20-35 yrs	Ad	Pm3UL	3	292	8	203.48	24	246.37	48	226.42	0.1667	0.5000	meaty diet		-19.8	10.2	1	
Ved. C	93b/1980	A 11416-438	child	newborn	0-6 yrs	subAd	no teeth for mcrw													-21.4	10.7	1	
Ved. C	94/1980	A 11443-469	f	18-25 yrs	20-35 yrs	Ad	N/A												rib	-19.7	9.0	2	
Ved. C	95/1980	A 11470-71	male	50-60 yrs	50+ yrs	Ad	M2UL	3	293	6	132.45	16	141.74	49	121.89	0.1224	0.3265	mixed		-19.6	9.7	1	
Ved. C	96/1980	A 11472-489	child	3-5 yrs	0-6 yrs	subAd	N/A													-19.5	9.8	1	
Ved. C	97/1980	A 11490-524	f	30-40 yrs	35-50 yrs	Ad	M3UL	3	294	14	120.18	30	201.95	78	150.39	0.1795	0.3846	mixed		-19.7	9.5	1	
Ved. C	98/1981	A 11525-11541	?	30-40 yrs	35-50 yrs	Ad	N/A																
Ved. C	99/1981	A 11542-564	male	30 yrs	20-35 yrs	Ad	M3LL	3	295	10	74.46	6	124.56	40	84.34	0.2500	0.1500	mixed		-20.1	9.5	1	
Ved. C	100/1981	A 11565-600	f	+/- 30 yrs	20-35 yrs	Ad	M3LL	1	195	40	195.82	29	177.47	108	174.67	0.3704	0.2685	mixed		-19.7	10.0	1	
Ved. C	101/1981	A 11601-634	f	45-55 yrs	35-50 yrs	Ad	M1LL	1	196	36	256.67	24	145.17	89	176.51	0.4045	0.2697	mixed		-19.7	9.9	1	
Ved. C	102/1981	A 11635-672	f	40-45 yrs	35-50 yrs	Ad	M2LR	3	296	8	117.37	10	216.90	29	152.57	0.2759	0.3448	mixed		-20.0	9.2	1	
Ved. C	103/1981	A 11673-703	f	50 + yrs	50+ yrs	Ad	N/A																
Ved. C	104/1981	A 11704-733	f	50 + yrs	50+ yrs	Ad	M2LR	3	297	27	128.06	8	84.69	95	130.02	0.2842	0.0842	mixed		-19.9	9.8	1	
Ved. C	105/1981	A 11734-766	?	16-18 yrs	15-19 yrs	Ad	Pm3UL	3	298	20	131.56	32	212.65	86	155.78	0.2326	0.3721			-19.7	9.0	1	
Ved. C	106/1982	A 11767 -789	f	16-18 yrs	15-19 yrs	Ad	N/A													-19.5	8.9	1	
Ved. C	107/1982	A 11790-820	f	18-20 yrs	15-19 yrs	Ad	N/A													-19.3	8.9	1	
Ved. C	108/1982	A 17535	male	adult		Ad	N/A													-19.6	9.9	1	

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Ved-Z. pit 37	H1/1985	A 18232	f	20-25 yrs	20-35 yrs	Ad	M2LL	3	279	14	111.73	33	141.53	84	127.05	0.1667	0.3929	mixed	rib	-20.5	9.7	2	
Ved-Z. C	H2/1985	A 18233	male	25-30 yrs	20-35 yrs	Ad	M2LL	3	280	12	104.87	3	73.89	36	89.84	0.3333	0.0833	vegetarian/ mixed	rib	-19.7 -20.7	10.3 9.7	2, 3	x
Ved-Z. feature 56	H3/1986	A 18234	child	1.5-2 yrs	0-6 yrs	subAd	no teeth for mcrw																
Ved-Z. C	H5/1988	A 18007	child	3 yrs	0-6 yrs	subAd	m1LR	3	281	2	30.68	20	118.68	45	95.47	0.0444	0.4444	meaty diet					
Ved-Z. C	H6/1988	A 18008	f	50 + yrs	50+ yrs	Ad	N/A												rib	-20.2	9.6	2	
Ved-Z. C	H7/1988	A 18009	f	35-45 yrs	35-50 yrs	Ad	N/A												rib	-19.8	9.6	2	
Ved-Z. C	H8/1988	A 18010	child	13-15 yrs	7-14 yrs	subAd	N/A												rib	-20.3	10.8	2	x
Ved-Z. C	H9/1988	A 18011	f	18 yrs	15-19 yrs	Ad	N/A												rib	-20.2	9.7	2	x
Ved-Z. C	H10/1989	A 18257	f	20-25 yrs	20-35 yrs	Ad	M2UL	3	300	17	144.20	9	225.37	79	143.78	0.2152	0.1139	mixed	rib	-20.6	9.7	2	
Ved-Z. S/C?	H11/1997	A 22667	f	50 + yrs	50+ yrs	Ad	M1LL	3	282	37	157.80	22	138.47	118	138.60	0.3136	0.1864	mixed					
Ved-Z. S	H12/1996	A 22668	child	4 yrs	0-6 yrs	subAd	m1LR	3	283	17	102.36	10	153.63	51	124.67	0.3333	0.1961	mixed					
Ved-Z. S	H13/1997	A 22669	child	3 yrs	0-6 yrs	subAd	m1LL	3	284	6	85.37	16	156.93	49	121.27	0.1224	0.3265	mixed					
Ved-Z. feature 6	H14/1997	A 22670	male	18-20 yrs	15-19 yrs	Ad	N/A																
Nit. C	1/64	1463	f	20-24 yrs	20-35 yrs	Ad	Pm4UR	3	573	34	152.11	87	157.74	165	141.54	0.2061	0.5273	meaty diet	rib	-20.2	9.7	2	
Nit. C	2/64	1465	male	40-50 yrs	35-50 yrs	Ad	M2UL	3	574	23	154.15	80	184.46	138	179.88	0.1667	0.5797	meaty diet					x
Nit. C	3/64	1464	male?	16-17 yrs	15-19 yrs	Ad	M1LR	3	575	5	100.66	36	123.10	83	133.25	0.0602	0.4337	meaty diet	rib	-20.0	9.3	2	
Nit. C	4/64	1466	male	30-40 yrs	35-50 yrs	Ad	no teeth for mcrw												rib	-20.0	9.5	2	
Nit. C	4/64a	1467	f	20-30 yrs	20-35 yrs	Ad	Pm3UR	3	576	19	143.82	51	154.47	91	148.45	0.2088	0.5604	meaty diet	rib	-19.9	10.3	2	
Nit. C	5/64	1468	?	16-17 yrs	15-19 yrs	Ad	M1LL	3	577	18	163.23	33	237.38	66	192.74	0.2727	0.5000		metacar pal	-20.0	9.9	2	
Nit. C	6/64	1469	f	50-60 yrs	50+ yrs	Ad	M2LL	3	578	12	201.07	27	158.78	66	154.33	0.1818	0.4091	mixed	rib	-20.1	10.5	2	
Nit. C	7/64	1470	male?	40-45 yrs	35-50 yrs	Ad	M2LL	3	579	6	94.26	51	138.61	89	117.78	0.0674	0.5730	meaty diet					
Nit. C	8/64	1471	male	45-50 yrs	35-50 yrs	Ad	Pm3LR	3	580	9	111.66	39	164.32	75	140.50	0.1200	0.5200	meaty diet	rib	-19.9	11.0	2	x
Nit. C	9/64	1472	f	35-40 yrs	35-50 yrs	Ad	M1UL	3	581	10	165.99	47	200.77	97	198.92	0.1031	0.4845	meaty diet	long bone	-20.4	9.7	2	
Nit. C	13/64a	1473	child	6 yrs	0-6 yrs	subAd	unclear datation; atypical microwear pattern	3	582														

Site	Grave no.	Inv. No.	Sex	Age (years)	Age (cat.)	subAd - Ad	MCRW	MCRW Ref	Stub	NH	XH	NV	XV	NT	XT	NH/NT	NV/NT	Diet inf. NH - NV - NT ratio	bone	$\delta^{13}C$‰	$\delta^{15}N$‰	$\delta^{13}C/\delta^{15}N$ ref	FFG
Nit. C	13/64b	1473	child	8 yrs	7-14 yrs	subAd	m2LL	3	583B	24	271.79	49	150.37	123	183.75	0.1951	0.3984	mixed					
Nit. C	13/67c	1473	child	0 - 6 months	0-6 yrs	subAd	no teeth for mcrw																
Nit. C	14/64	1474	f	24-30 yrs	20-35 yrs	Ad	postmortem defects; no other tooth suitable for microwear	3	584										rib	-20.4	9.8	2	
Nit. C	15a/65	1475	child	1 y	0-6 yrs	subAd	no teeth for mcrw												rib	-21.0	10.2	2	
Nit. C	15b/65	1475	f?	adult		Ad	no teeth for mcrw												rib	-19.7	13.0	2	
Nit. C	16/65	1476	?	30 yrs	20-35 yrs	Ad	no teeth for mcrw												rib	-20.7	9.6	2	
Nit. C	17/65	1478	male	50 + yrs	50+ yrs	Ad	high score for dental occusal wear		N/A										rib	-19.9	10.3	2	
Nit. C	18/65	1477	f?	25-35 yrs	20-35 yrs	Ad	taphonomic postmortem defects on macroscopic level		N/A										rib	-20.4	10.4	2	
Nit. C	19/65	1479	male	35-45 yrs	35-50 yrs	Ad	M2UL	3	585	6	75.23	52	243.14	82	207.71	0.0732	0.6341	meaty diet	rib	-19.9	10.7	2	
Nit. C	20/65	1480	f	24-30 yrs	20-35 yrs	Ad	M1LL	3	586	10	218.40	42	188.56	81	186.22	0.1235	0.5185	meaty diet	rib	-19.9	9.9	2	
Nit. C	21/65	1482	male?	50-60 yrs	50+ yrs	Ad	high score for dental occusal wear		N/A														
Nit. C	22/65	1483	f	45-55 yrs	35-50 yrs	Ad	M3UR	3	587	19	88.95	26	110.34	102	119.93	0.1863	0.2549	mixed	rib	-20.4	10.0	2	
Nit. C	23/65	1481	child	11-12 yrs	7-14 yrs	SubAd	M1LL	3	588	26	130.49	45	195.39	104	155.40	0.2500	0.4327	meaty diet / mixed	rib	-20.3	9.6	2	
Nit. C	24/65	1484	f	35-40 yrs	35-50 yrs	Ad	M1LR	3	589	14	144.39	43	211.93	75	179.81	0.1867	0.5733	meaty diet	rib	-20.3	10.5	2	
Nit. C	25/65	1485	male	50 + yrs	50+ yrs	Ad	high score for dental occusal wear		N/A										rib	-20.2	10.5	2	
Nit. C	26/65	1486	male	35-45 yrs	35-50 yrs	Ad	Pm4LL	3	590	14	176.26	64	183.86	107	162.01	0.1308	0.5981	meaty diet	rib	-20.1	10.5	2	
Nit. C	27/65	1487	f	50 + yrs	50+ yrs	Ad	no teeth for mcrw												rib	-20.4	10.0	2	
Nit. C	28/65	1488	child	6 months	0-6 yrs	subAd	no teeth for mcrw												cranium	-19.2	12.7	2	
Nit. C	29/65	1489	child	10 yrs	7-14 yrs	SubAd	M1LR	3	591	5	255.38	59	142.73	87	157.28	0.0575	0.6782	meaty diet	rib	-20.5	9.6	2	
Nit. C	30/65	1490	child	6-7 yrs	7-14 yrs	subAd	m2LR	3	592	12	167.21	42	191.22	87	153.27	0.1379	0.4828	meaty diet	rib	-19.9	10.1	2	
Nit. C	31/65	1491	child	3 yrs	0-6 yrs	subAd	m1LL	3	593	22	96.62	66	176.34	123	148.86	0.1789	0.5366	meaty diet	rib	-19.8	12.8	2	
Nit. C	32/65	1492	f	18-20 yrs	15-19 yrs	Ad	M1LR	3	594	16	27.99	18	19.00	93	20.81	0.1720	0.1935	mixed	rib	-20.5	10.3	2	
Nit. C	33/65	1493	f?	24-35 yrs	20-35 yrs	Ad	M1UL	3	595	5	79.94	46	221.47	74	201.05	0.0676	0.6216	meaty diet	rib	-20.3	9.8	2	
Nit. C	34/65	1494	male	35-40 yrs	35-50 yrs	Ad	M1UR	3	596	9	188.37	51	236.63	110	187.58	0.0818	0.4636	meaty diet	rib	-19.8	10.5	2	x
Nit. C	35/65	1495	f	45-55 yrs	35-50 yrs	Ad	M1UR	3	597	18	137.66	24	128.62	71	135.80	0.2535	0.3380	mixed	rib	-19.9	10.1	2	
Nit. C	36/65	1498	f	50 + yrs	50+ yrs	Ad	no teeth for mcrw												rib	-20.2	10.5	2	
Nit. C	37/65	1499	f	24-30 yrs	20-35 yrs	Ad	M1LR	3	598	13	149.22	38	155.08	89	135.44	0.1461	0.4270	meaty diet	rib	-20.3	9.8	2	

Site	Grave no.	Inv. No.	Sex	Age (years)	Age (cat.)	subAd - Ad	MCRW	MCRW Ref	Stub	NH	XH	NV	XV	NT	XT	NH/NT	NV/NT	Diet inf. NH - NV - NT ratio	bone	$\delta^{13}C$‰	$\delta^{15}N$‰	$\delta^{13}C/\delta^{15}N$ ref	FFG
Nit. C	38/65	1501	child	6-7 yrs	7-14 yrs	subAd	m2LL	3	599	26	328.49	37	139.46	98	180.30	0.2653	0.3776	mixed	rib	-20.6	10.1	2	
Nit. C	39/65	1503	f?	40-50 yrs	35-50 yrs	Ad	M2LR	3	600	3	107.29	53	230.50	77	201.60	0.0390	0.6883	meaty diet	rib	-19.8	10.0	2	
Nit. C	40/65	1504	child	4 yrs	0-6 yrs	subAd	m2LL	3	601	41	249.77	9	99.14	70	196.33	0.5857	0.1286	vegetarian					
Nit. C	41/65	1506	child	13-14 yrs	7-14 yrs	SubAd	M1LL	3	602	19	122.50	69	171.41	127	150.31	0.1496	0.5433	meaty diet	rib	-20.1	10.2	2	
Nit. C	42/65	1507	child	6-7 yrs	7-14 yrs	subAd	m2LR	3	603	18	114.87	10	166.02	64	159.03	0.2813	0.1563	mixed					
Nit. C	43/65	22865	?	adult		Ad	no teeth for mcrw																
Nit. C	44/65	1508	f?	45-50 yrs	35-50 yrs	Ad	M2LL	3	604	12	148.26	61	213.16	144	189.21	0.0833	0.4236	meaty diet	rib	-20.4	10.6	2	
Nit. C	45/65	1509	male?	40-50 yrs	35-50 yrs	Ad	M2LL	3	605	12	97.62	33	110.84	79	108.18	0.1519	0.4177	meaty diet					
Nit. C	46/65	1510	?	adult		Ad	no teeth for mcrw																
Nit. C	47/65	1511	child	1.5 y	0-6 yrs	subAd	no teeth for mcrw												cranium	-19.4	12.0	2	
Nit. C	48/65	1512	f	20-24 yrs	20-35 yrs	Ad	M1LL	3	606	24	188.74	31	160.08	78	165.14	0.3077	0.3974	mixed	rib	-20.3	9.6	2	
Nit. C	49/65	1513	child	4-5 yrs	0-6 yrs	subAd	taphonomic postmortem defects on macroscopic level		N/A										rib	-20.3	9.5	2	
Nit. C	49/65	1513	child	4-5 yrs	0-6 yrs	subAd	m1UR	3	607	28	141.68	65	124.15	142	131.05	0.1972	0.4577	meaty diet	cranium	-20.3	11.0	2	
Nit. C	50/65	1514	child	4-5 yrs	0-6 yrs	subAd	no teeth for mcrw												cranium	-20.2	10.6	2	
Nit. C	52/65	1515	f	45-55 yrs	50+ yrs	Ad	postmortem defects; no other tooth suitable for microwear	3	608										rib	-20.2	9.8	2	
Nit. C	53/65	1516	f	24-30 yrs	20-35 yrs	Ad	M1LR	3	609	35	204.98	19	158.98	77	190.46	0.4545	0.2468	vegetarian	rib	-20.1	10.6	2	
Nit. C	54/65	1517	child	7 yrs	7-14 yrs	subAd	m2LL	3	610	24	199.39	56	195.85	112	174.23	0.2143	0.5000	meaty diet	rib	-20.3	10.7	2	
Nit. C	55/65	1518	child	0 - 6 months	0-6 yrs	subAd	no teeth for mcrw																
Nit. C	56/65	1519	male	50 + yrs	50+ yrs	Ad	dental pathology (caries)		N/A										rib	-19.9	9.7	2	
Nit. C	57/65	1520	f	20-30 yrs	20-35 yrs	Ad	taphonomic postmortem defects on macroscopic level		N/A										rib	-20.1	11.1	2	
Nit. C	58/65	1521	male	40-50 yrs	35-50 yrs	Ad	M1UL	3	611	7	182.37	24	324.98	59	264.74	0.1186	0.4068	meaty diet	rib	-19.8	10.6	2	x
Nit. C	59/65	1522	?	14-15 yrs	15-19 yrs	Ad	M2UR	3	612	17	150.94	22	125.77	92	131.47	0.1848	0.2391						
Nit. C	60/65	1523	child	1 y	0-6 yrs	subAd	no teeth for mcrw																
Nit. C	61/65	1524	f	45-55 yrs	35-50 yrs	Ad	M2LL	3	613	27	255.73	17	214.17	64	202.89	0.4219	0.2656	vegetarian	rib	-19.9	10.2	2	
Nit. C	62/65	1525	male?	30-35 yrs	20-35 yrs	Ad	M2UR	3	614	20	132.71	35	225.15	94	181.59	0.2128	0.3723	mixed	rib	-20.2	10.2	2	
Nit. C	63/65	1526	male?	35-40 yrs	35-50 yrs	Ad	M1UL	3	615	20	159.16	50	247.07	96	203.69	0.2083	0.5208	meaty diet					