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Exploring sexual division of labour at “Nitra Horné Krškany” cemetery using stone tool use-wear analysis, physical activity markers, diet and mobility as proxies.

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Abstract:	This paper aims to explore gender diversity and sexual division of labour at the beginning of farming through the study of one of the earliest Linearbandkeramik cemeteries in central Europe: Nitra (Slovakia). This topic is addressed by bringing out the nuance of the buried individuals’ lifeways and taskways. Use-wear studies have been undertaken on both ground and flaked stone instruments deposited as grave goods, thus generating new data about the activities performed using these tools. The relationships between the artefact function and the buried individuals’ sex, age and health condition have been addressed together with the isotopic and physical activity information related to the inhumated diet and mobility. Our results suggest a schema in which biological sex played a key role in task, lifeways and grave goods differentiation. These differences, however, presented significant overlaps, suggesting that biological sex was not all encompassing and that internal variations within sexes were indeed present, reflecting a complex tapestry of gender and, possibly, status relationships.
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Abstract

This paper aims to explore gender diversity and sexual division of labour at the beginning of farming through the study of one of the earliest *Linearbandkeramik* cemeteries in central Europe: Nitra (Slovakia). This topic is addressed by bringing out the nuance of the buried individuals' lifeways and taskways. Use-wear studies have been undertaken on both ground and flaked stone instruments deposited as grave goods, thus generating new data about the activities performed using these tools. The relationships between the artefact function and the buried individuals' sex, age and health condition have been addressed together with the isotopic and physical activity information related to the inhumated diet and mobility. Our results suggest a schema in which biological sex played a key role in task, lifeways and grave goods differentiation. These differences, however, presented significant overlaps, suggesting that biological sex was not all encompassing and that internal variations within sexes were indeed present, reflecting a complex tapestry of gender and, possibly, status relationships.

Key words: *Linearbandkeramik*, Early Neolithic, use-wear analysis, gender, sex, Funerary Archaeology, Nitra.

1. Introduction

Differences between the biological sexes have been recorded for the *Linearbankeramik* (LBK; Early Neolithic in central Europe ca. 5,500-5000 cal BC) for the last four decades (Jeunesse 1997; Robb and Harris 2018; Augereau 2018; Bickle 2020). Debate has grown about how such dispatiries have played out in experiences of gender and power relationships within kinship systems. Grave goods assemblages signal that at least some of those divergences were recognised in the material cultures of mortuary practices. This data has been interpreted as indicating that biologically female-sexed skeletons, in receiving fewer and a less sex-determined range of grave goods than their male-sexed counterparts at cemeteries, held lower status in LBK communities (Van de Velde 1979; Jeunesse 1997; Hedges et al. 2013; Nordholz 2015; Müller-Scheeßel 2019). Elsewhere, others have argued that these apparent stronger divisions between the sexes were countered by sometimes greater variation within the sex groups than between them, arguing that the LBK does not reveal homogeneous patterns of sex-based differentiation (Bickle 2020).

Grave goods have been considered to be representative of the buried individuals' former belongings, gifts from mourners, or as symbolic representation of the activities related to the identity of the deceased, and, as such, are subject to political or ideological manipulation by mourners (Arnold 2006, Hamlin 2001). Thus, while grave goods may not represent the identity of the deceased in a one-to-one relationship, they provide a powerful insight into a community's response to material culture. Grave goods have also been shown to be active in creating identity through their powerful symbolic role in death rites (Brück 2004), and thus may have shifting meanings over time. We recognise that while in an individual case, the gender of the deceased may not be captured directly by the grave goods, or may have been actively denied by mourners, analysis at a broadscale will reveal which activities were recurrently associated with sex, gender, age, or other hierarchies.

This paper aims to go beyond analysis of the funerary sphere as a straight-forward presentation of the two sexes at death, by considering the relationship between the tasks carried out in life and the ways in which they were represented at death for the LBK.

Skeletal, grave good, and isotopic analyses have shown that men and women were carrying out different habitual activities, presented some differences in their diets and were even subjected

to distinct mobility patterns (Röder 1998; Ruff 2018; Bentley et al. 2012; Bickle and Whittle 2013; Villotte and Knüsel 2013; Sládek et al. 2016; Macintosh et al. 2017; Masclans Latorre et al. in prep). However, those broadly shaped differences are subjected to further variance according to the site's localisation in the central European east-west axis, from Hungary to the Paris Basin. For example, the $^{87}Sr/^{86}Sr$ ratios have already confirmed that females were more likely to be classed as "non-local" than males in eastern sites, particularly at Vedrovice and Nitra (Bentley et al 2012, Bickle and Whittle 2013, Masclans et al 2020, Masclans et al in press), while the situation changes at Schwetzingen (Western Germany), where the isotopic data points towards a major mobility among males (Bentley and Knipper 2005, Knipper 2009). Furthermore, even if recent data on muscular-skeletal stress markers, paleopathologies, and labour-related sexual asymmetry has revealed the presence of sexually differentiated activity patterns (Macintosh et al. 2014a and 2014b, Sládek et al. 2015, Macintosh et al. 2017, Berner et al. 2018), those kinds of studies are still scarce and lacking empirical evidence to address regional diversity.

In view of the above, we consider that finding ways of recording the creation and manifestation of gendered identity is a subject which requires the use of categories adjusted to historicised and local/regional evidence. In the framework of this perspective, we want to examine the extent of diversity within each sex in the case of the cemetery of Nitra Horné Krškany (Slovakia), through a multi-proxy approach. This will include a full use-wear analysis of the flaked and polished and bevelled tools (PBAs) recovered from the site, the osteological evidence of physical activity and the presence of possible gendered differences in diet and mobility patterns.

Nitra is one of the most significant sites of the LBK horizon due to its early chronology (radiocarbon dating suggests it to be one of the first cemeteries in the North Carpathian Basin), and its good level of documentation and preservation. It was published by Pavúk (1972) in a detailed monograph which is the basis on which all further studies have been built on the site. It has a long history of research with publications regarding its anthropological and demographic variability (Tvrdý 2016; Whittle et al. 2013), diet (Jarošová and Tvrdý 2017; Whittle et al. 2013), mobility (Whittle et al. 2013; *LBK Lifeways Project*) and subject to ongoing aDNA analysis (Hofmann et al. 2019) and Strontium and radiocarbon dating (*Gender on the move* project). Nitra, therefore, meets all the requirements for developing an in-depth multi-proxy analysis to provide a better insight into the funerary practices and gender construction of the first Central European farming communities.

2. Objectives, methods, and materials

This paper aims to examine the funerary practices at Nitra to provide insights into the extent of gender diversity by bringing out the nuance of the grave good distribution, use-wear data and health, physical activity, mobility, and diet markers. We do not presume that our data will capture the full diversity of possible lifeways arising in sex and gender for people buried at Nitra, recognising that a grave site may represent community decisions about burial rites, rather than how an individual would have chosen to present themselves.

An attempt will thus be made at finding patterns between sexed human remains and the presence of groups that combine regular distributions of the mentioned variables, in order to distinguish gender from other explanatory factors of the material record, such as age or social hierarchies not related to sex or cultural identities. The following questions will, thus, be addressed: (1) the presence of statistical relationships between sexed human remains (i.e. male/female) and the grave goods distribution (including bone and stone tools, pottery vessels and ornaments) as well as the range of activities represented by the stone tools found in the graves, (2) the presence of sexually distinctive patterns related to osteological stress markers of physical activity and sexual dimorphism, (3) the presence of relationships between age/sex

groups and diet, mobility and care patterns identified through isotopic data ($\delta^{15}N$, $\delta^{13}C$ and $^{87}Sr/^{86}Sr$), metabolic diseases and dental decay.

The main methodological technique used during the artefactual study was the use-wear analysis conducted by surface microscopic techniques: a reliable methodology that provides evidence of people's past activities as well as of their cultural performances (Odell and Odell Vereecken 1980; Vaughan 1985; Gonzalez and Ibáñez 1994; Adams et al. 2009; Lewis et al. 2011). The examination was performed at 10-200x magnifications under a metallographic microscope and a stereomicroscope. Polished bevelled artefacts were analysed in accordance with the methods and techniques suggested in Masclans (2020: 7-70). The flaked tools were studied following the standards and terminology proposed by Clemente (1997), González and Ibáñez (1994), Keeley (1980) and Vaughan (1985).

During the use-wear analysis the PBA and flint experimental reference collection was kindly provided by IMF-CSIC's Laboratory of Prehistoric Technology (Barcelona) (available on request from asd@imf.csic.es). It contains about 1,000 experimental tools on flint from different geological origins. It also includes 34 experimental PBAs made with different kinds of hornfelds and jadeites, which were used on 80 experiments involving bevel polishing, different kinds of woodwork, hide-working, butchering, and ploughing.

All the stone tools confidently interpreted as grave goods at Nitra cemetery were included in this study, with a sample that consists of 19 lithic tools: 8 flaked items and 11 PBAs. 4 PBAs from burials 26, 27, 40 and 41 were missing in the collection, so the studied assemblage was reduced to 7. The results and contextual details can be found in SI 2, Table 1. As a result of the schistose nature of the PBA raw materials, the preservation of the active surface was generally good enough to make an approximation of what materials the tools were used on, though identifying specific activities and particularities of the worked materials presented a greater challenge. The flaked artefacts' surfaces preservation was very good, without significant post-depositional alterations which would have compromised the analysis.

Data from the skeletal remains of 70 individuals already studied by Tvrdý (2016) was reviewed and subjected to new analysis to match the requirements of the present investigation. It includes unpublished measurements of the upper and lower limbs to address sexual dimorphism related to sexual division of labour (SI 2, Table 4). The isotopic raw data have mainly been collected from "Lifeways project" Open Access database (Whittle et al. 2013, available on request from Dr. Penny Bickle: penny.bickle@york.ac.uk) and subjected to further analysis (*vide infra*). In parallel, a database containing all the values of the skeletons sampled by other research teams has been created (SI2, Table 1) and also subjected to new analysis.

3. Nitra: contextual data, funerary patterns and grave good distribution

Nitra was found at western Slovakia on the border of the Carpathian Mountains and the Danube plaint (Figure 1). The site was excavated by Pavúk (1972) during the sixties who dug two parallel trenches covering an area of about 15x50 m where a total of 74 burials were identified (Figure 2).

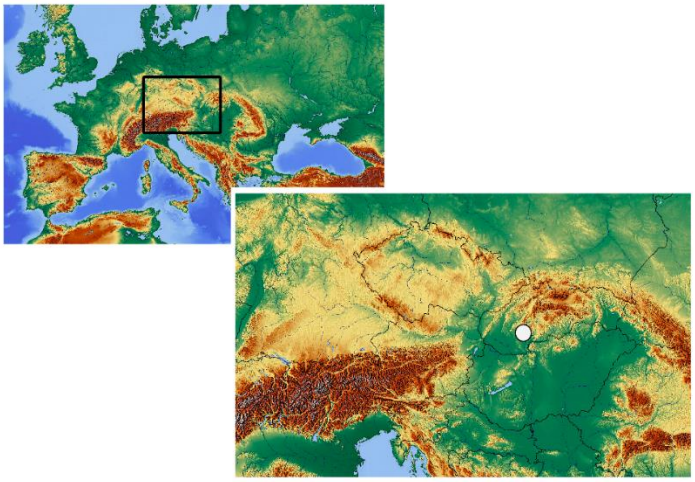

Figure 1. Localization of the site on this regional and European context.

A total of 11 radiocarbon dates were successfully obtained from 11 graves (Griffiths 2013, SI 1). We decided to use the One Contiguous Phase Bayesian Model on the already published dates to determine if there were discontinuities within Nitra occupation, and which was its accurate utilization period. The results (Aoverall index: 98.3 Amodel index: 97.5), indicated that there were no temporal discontinuities and that the site's occupation span was about 10-248 years, beginning between 5367-5219 cal BC and ending between 5221-5029 cal BC (2 σ). However, with only 11 radiocarbon dates of 70 individuals (15.7%), the temporality of the cemetery is not still fully resolved. This means that any differences we may see at the site could be account for by change over time, rather than contemporary varying in burial practice or diet and mobility.

To obtain an accurate overview of the age and sex ranges of the individuals, anthropological data retrieved from Tvrdý (2016) was rearranged according to the age classification criteria proposed by White et al. (2011) and Schaefer et al. (2009) (SI 2, Table 1, Figure 3). 67 burial structures and a total of 70 individuals were included in this study according to Pávuk's database (1972) and after removing the non-reliable graves (SI 2, Table 1). A triple burial (48, 49 and 50/65) of a female skeleton inhumed together with two non-adults 4-6 years in age accounts for the discrepancy between grave numbers and individuals buried. Osteological analysis found 26 adult females (37%), 19 adult males (27%), 7 juvenile/adults of undetermined sex (10%) and 18 non-adults (26%) (Table 1).

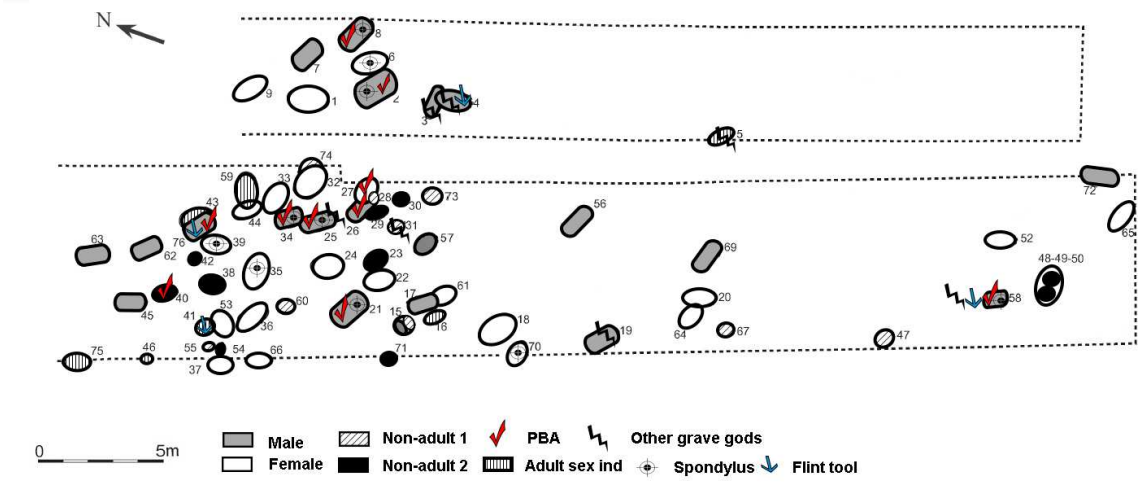

Figure 2. Nitra plant showing the individuals and grave goods spatial organization. Nitra plant made by us based on Pávuk's (1972) grave disposition and Tvrdý's (2016) sexual determination. Those graves not reliably belonging to the LBK horizon have been removed.

	Female	Non-adult/unsexed	Male	Total
Non-adult 1		8		8
Non-adult 2		10		10
Juvenile	2	4	2	8
Young adult	8	1	2	11
Adult	1	2		3
Adult mature	8		10	18
Senile	7		5	12
Total	26	25	19	70

Table 1: Nitra individual age and sex ranges according to White et al (2011) and Schaefer et al (2009) criteria: Perinatal (birth- 3 months), Non-adult 1 (up to 3 years), Non-adult 2 (3-12 years) Juvenile (12-20 years), Young adult (20-35 years), Adult mature (35-50 years), Senile (+50 years).

Two significant observations arise from the age and sex patterns. Considering infant mortality rate in Prehistory is likely to have been about 40-50% (Rinne 2001), non-adults are under-represented. The low number of non-adults is typical for prehistoric cemeteries and it could be caused by either/both: 1) taphonomical processes, as children skeletons are more fragile and easier to disintegrate or could have been buried in shallow graves non-detectable by common archaeological procedures, 2) cultural reasons, as children could have been subjected to completely different burial rites than adults. Significantly, non-adults have a higher representation in settlement burials in contemporaneous sites such as Vedrovice (Podborský 2002).

The second and most striking demographic feature is that female-sexed skeletons outnumber males (42% males to 58% females considering only the adult population). This pattern is also present in other LBK sites of the region. At Nitra, further complexity can be seen by considering the age of individuals at death. Female young adults (8 individuals) outnumber males (2 individuals), perhaps expected due to higher rates of maternal mortality. Young male adults are thus less frequently present at the site than male adult matures (10 individuals) and senile (5 individuals) (Table 1). These numbers could be explained by the fact that only a small proportion of the community's younger males lived a settled life, because they had differential access to certain funerary practices, or because males of that age were less likely to die. Patri-locality and community exogamy has also been considered as a factor explaining the higher proportion of females to males (Whittle et al. 2013), though it would not in itself explain the absence of young male adults.

5. Use-wear and technological analysis results

5.1. Flaked tools

Flaked items are distributed between 4 burials, belonging to three males (graves 58, 4 and 76) and one juvenile of indeterminable sex (grave 41) (Table 2) occurring in 5.7% of graves. The main raw materials are one of Jurassic silicite from the Kraków-Czestochowa highlands, at least two of Radiolarites from the Pieniny Klippen Belt and one Limno silicite from the Middle Slovak neovolcanic mountains. The main technological feature within flaked flint artefacts are blades (6 items), followed by one bladelet and one preparation bladelet (Figure 3.A, Table 2). Only three complete final blades have been preserved, while the rest were in fragmentary state.

Burial	Code	Sex	Age	Description	RM specific	Length	Width	Category	Activity/ WM
4	4.1	M	AM	blade	Limno silicite	77	22	used tool	Hard material
4	4.2	M	AM	blade – mesial part	Flint ind JSKCZh	29	17	not used	
4	4.3	M	AM	blade	Flint ind JSKCZh	36	14	not used	
4	4.4	M	AM	blade – proximal part	Flint ind JSKCZh	30	15	used tool	vegetal hard? (provable)
41		IND	JUV	blade	Radiolarite	54	14	indeterminable	
58		M	AM	blade – mesial part	Radiolarite JSKCZh	35	16	used tool	harvesting
76	76.1	M	JUV	preparation bladelet	Silicite JSKCZh	25	10	not used?	Grave good?
76	76.2	M	JUV	bladelet – mesial part	Radiolarite	10	9	not used	Grave good?

Table 2: Table displaying the flaked tools contextual, technological, metric and functional characteristics. Abbreviations: RM= raw materials. AM= adult mature. JUV = juvenile. WM= Worked material. FG= fragment. M= male. IND = indeterminable. – JSKCZh = Kraków-Czestochowa highlands.

The use-wear analysis indicates the presence of 4 non-used items and 3 used tools while in 1 case it was impossible to determine the artefact function due to the bad preservation of its active surfaces (burial 41). The used tools showed evidence of contact with bone and meat, harvesting and vegetal working (Table 2).

Tools from grave 4 presented both used (blade 4.1 and fragment 4.4) and unused artefacts (4.2 and 4.3), all of them very affected by the presence of pencil graphite. In the first cases, the wear development was significatively low, coherent with an occasional use of the tools. Blade 4.1's displays small spots of flat and shiny micro-polish concentrated at the upper parts of the micro-topography of the distal area of the edge, without any macroscopic evidence of edge alteration (Figure 3.B.1). These features may be related to a sporadic contact of this artefact against a very hard material, even though this interpretation cannot be fully ascertained. Blade 4.4. displayed wear on a single edge possibly resulting from an occasional use to work a hard-vegetal matter, as evidenced by the presence of continuous half-moon scarring as well as isolated spots and semi-opened network of compact, shiny, and undulated micro-polish, crossed by isolated half-moon micro-chipping (Figure 3.B.2). Tools 4.2 and 4.3 did not provide enough evidence to confirm their use as tools.

The flaked tool (bitruncated blade) from grave 58 presents wear evidence consistent with its use as a sickle during cereal harvesting (Figure 3.B.3). The localised patches of wear traces indicate that the blades were diagonally hafted, which is consistent with a curved sickle with a serrated cutting-edge (Figure 3.B.4). One of the active edges displays surfaces intensely used, with a deep rounding, transversal striations and a compact wear network. The opposite edge, however, presents evidence of the first stages of harvesting use, suggesting that, after blunting the first edge, the blade fragment was flipped, reattached to the haft, and used for a small amount of time before its deposition in the burial.

The flaked artefacts from burial 76 consist of non-used fragments presenting technological features that are not common among LBK grave goods. 76.1 is a cortical bladelet with a single potentially usable edge while 76.2 is a very small and irregular fragment presenting an abrupt retouch along one of the edges. These characteristics suggest that they may not be considered grave as goods but as the result of accidental debris falling in the grave. Finally, the blade from

burial 41 presents continual micro-chipping along the dorsal right lateral and isolated, abrupt micro-chipping on the left and ventral zone. Unfortunately, the item's surface was covered by a post-depositional patina that prevented us from identifying microscopic wear features. Given that the macroscopic wear was not diagnostic of any particular activity, we weren't unable to assess if the blade was used.

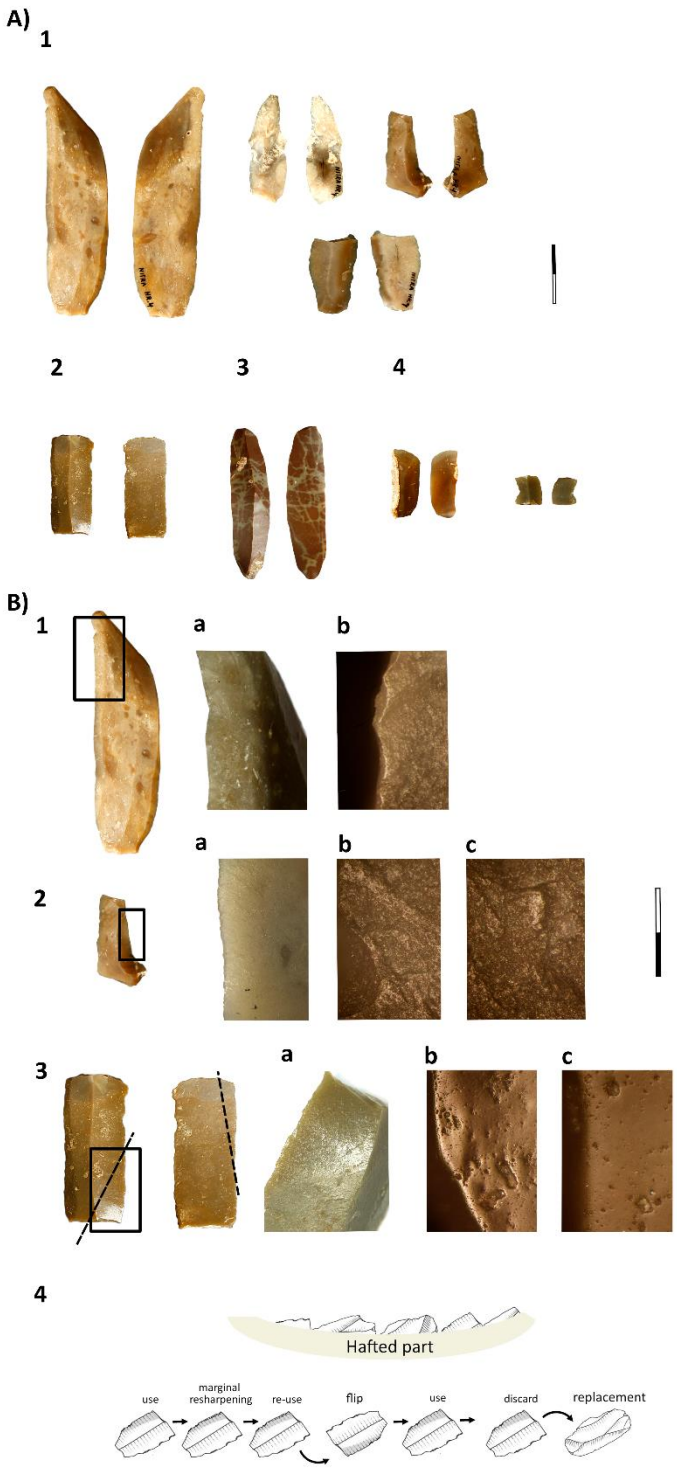

Figure 3: Flaked flint tools from Nitra. A) Macroscopic photos: 1) burial 4, 2) burial 58, 3) burial 41, 4) burial 76. B) Use-wear traces. 1) Blade 4.1 possible sporadic contact with a hard material;

a) absence of edge alteration, b) band of flat and shiny micro-polish concentrated at the upper parts of the edge; 2) Blade 4.4. possible contact with vegetal matter, a) continuous edge damage, 8x, b-c) shiny and undulated micro-topography of semi-open network developed in the upper areas of the topography and crossed by isolated half-moon micro-chipping, 200x; 3) Blade from burial 58 used as a sickle blade, a) diagonal disposition of the sickle gloss, 5x, b-c) deep rounding, micro-pits, and compact undulating micro-polish network, 200x; 4) Hypothetic sickle use cycle (after Mazzucco et al. 2018: 97).

5.2. PBAs

Pavúk (1972) performed an in-depth analysis of the polished and bevelled artefacts (PBAs), including their morphometric and weight characteristics. He found both used and unused PBAs were present in graves, as well as assessing possible hafting systems.

The majority of the adzes were made of high-quality amphibolite (also called hornblende hornfels and amphibolic hornfels at the bibliography) with very uniform fabric, mechanic and granulometric characteristics, deliberate section of high-quality raw materials. The nearest amphibolite sources are the Tribeč and the Male Karpaty Mountains (Méres, Hovorka, Cheben 2001). However, in the absence of petrographic and geochemical studies the specific outcrop used as a supply source remains unknown.

The PBA's morpho-technical features were very standardized (SI 2, Table 2): whole, without proximal fractures, completely polished and displaying technological extraction presence (flaking rough outs) and fine finishes (SI 4). Their sections were mainly flat-cylindrical and triangular, with two exceptions. Furthermore, all them presented very similar hafting traces. Those traces consisted of the development of a dark-coloured band of about 1-2cm width, resulting from a persistent contact against the haft, accompanied by transversal striations in the medial area, and a slight rounding with striation presence between the medial and the proximal area (Figure 4).

Figure 4. Hafting traces. A) Burial 34, B) Burial 76, B1) Microscopic hafting trace, 200x, B2) Microscopic hafting trace 200x, C) Burial 8, C1) hafting traces, 200x, D) Burial 25, D1) Microscopic hafting trace = groove, 100x. D2) Microscopic hafting trace = groove, 100x, E) Burial 2. 5x, F) Burial 21, F1) Microscopic hafting trace, 200x. Arrow = horizontal to the main artefact axis striation presence. Grey square = limits of the dark-coloured band resulting from hafting.

At a microscopic level, those darker and rounded hafting areas evidence the presence of fatty micro-polishes, of closed and semi-closed patterns, irregular to smooth micro-topographies and abundant striations horizontal to the adze vertical axis (Figure 4, SI 4). This indicates the

presence of contact with wooden elements at the proximal part and of animal tissue wraps (pleather or skin) and hard indeterminate materials at the medial areas.

In all cases the PBAs demonstrated evidence of having been used as adzes: the contact face was face A or obverse (convex face). In 2 cases it was not possible to identify the worked material, 2 displayed traces resulting of contact with meat/bone (Figure 6) and 3 more proof of woodwork (Table 3, Figure 5).

In the first two cases the tools displayed an incipient degree of post-depositional alteration in their active surfaces. Burial 76 adze edges were rounded with isolated abrupt micro-chipping resulting from use: fresh in face B (or reverse, flat face) and covered by a homogeneous superficial indeterminate micro-polishing at face A (or obverse, convex face). The adze from burial 2 presented perpendicular to the edge grooves and striations as well as deep micro-chipping.

Wood-working traces consist of isolated, compact, and shiny micro-polishes of undulating micro-topography (Figure 5.A-C). Sporadically there are also abrupt, isolated and fresh chipping (understanding “fresh” as recent damage over which no other wear traces were identified) resulting from use in tools from burials 25 and 8 (Figure 5.E-F). Adze from grave 58 is different from the rest, since its active bevel was re-polished after it was used in a woodworking activity, which could be identified only in the non-affected surfaces at 5mm from the edge (Figure 5.A-B). This final re-polish created a second bevel that disabled the edge (Figure 5.D), which could either indicate the presence of a failed repair activity or a deliberate action resulting in rendering the tool useless. Intentionally breaking the adze grave goods is a practice well recognized in other contemporaneous sites such as Vedrovice (Masclans Latorre et al. 2020) and Kleinhadersdorf (Neugebauer-Maresch and Lenneis 2015), which reinforces the interpretation of this tool disabling as a part of a ritual action.

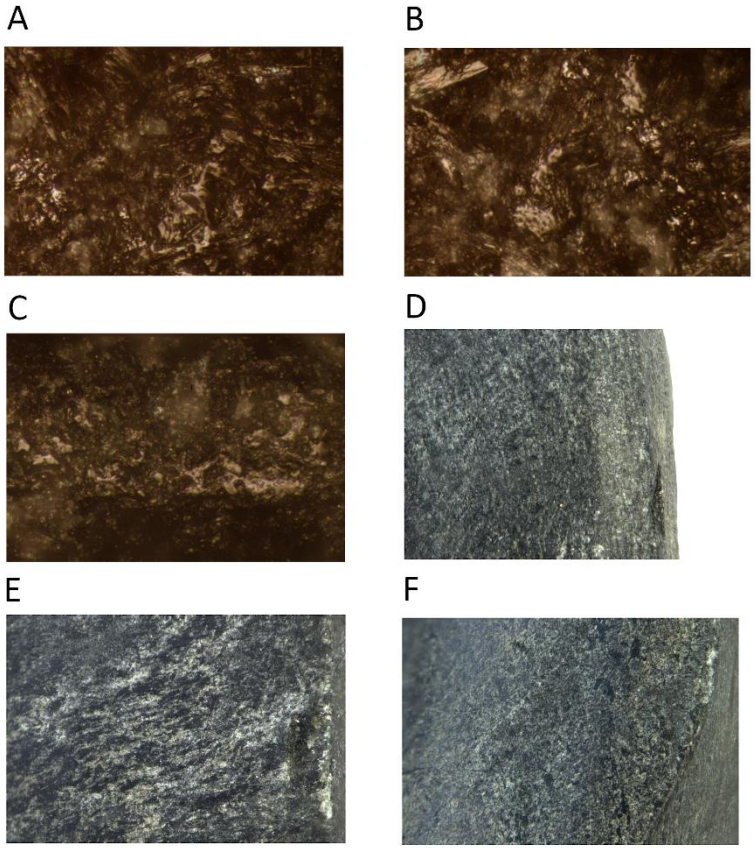

Figure 5. PBA Woodwork use-wear. A-B) Burial 58.A1, 200x, wear consisting in compact-isolated shiny micro-polishes of undulating topography developed at 5mm from the edge; C) Burial 25. B2, 200x, compact-isolated shiny micro-polishes of undulating topography developed; D) Burial 58, 10x, sub-bevel resulting from re-polishing; E) Burial 25, 5x, abrupt, isolated and fresh chipping; F) Burial 8, 5x, abrupt isolated and fresh micro-chipping.

The tools displaying evidence of contact with meat/bone present a slight rounding on their edges, with open/semi-open micro-polishes of irregular microtopography on the matrix (Figure 6.A-C), possibly related to contact with fresh meat. There were isolated fresh chips visible with the binocular (Figure 6.G) as well as contiguous fresh micro-chipping at tool 21 contact face, together with groups of deep striations ended in V (Figure 6.D) and small spots of a shiny compact and flat directional micro-polish (Figure 6.E), possibly indicating contact with a hard and moist material such as bone. The tool from burial 34 displays a slight rounding at the centre of face A (or obverse, convex face) with fresh continuous abrupt chips and perpendicular to the edge loose and deep grooves (Figure 6.F) resulting from the contact with a hard material. It also has superficial directional micro-polish perpendicular to the edge and a mixture of fresh and lightly rounded micro-chipping resulting from use, which may correspond to contact with bone and meat or other soft animal tissues (Figure 6.G).

Those damage patterns can be interpreted either as resulting from animal butchering (symbolic or not) and warfare, of which considerable direct evidence has been found in other LBK settlements (Vencl 1999, Wild et al. 2004, Meyer et al. 2015). However, animal butchering should be considered as a first hypothesis, as this activity seems much more probable in frequency according to the number of animal bone founds, than daily fighting. Nonetheless, the use of PBAs in interpersonal violence has been attested in several contemporaneous sites, suggesting that this kind of tool was certainly used in warfare and possibly symbolically associated to it.

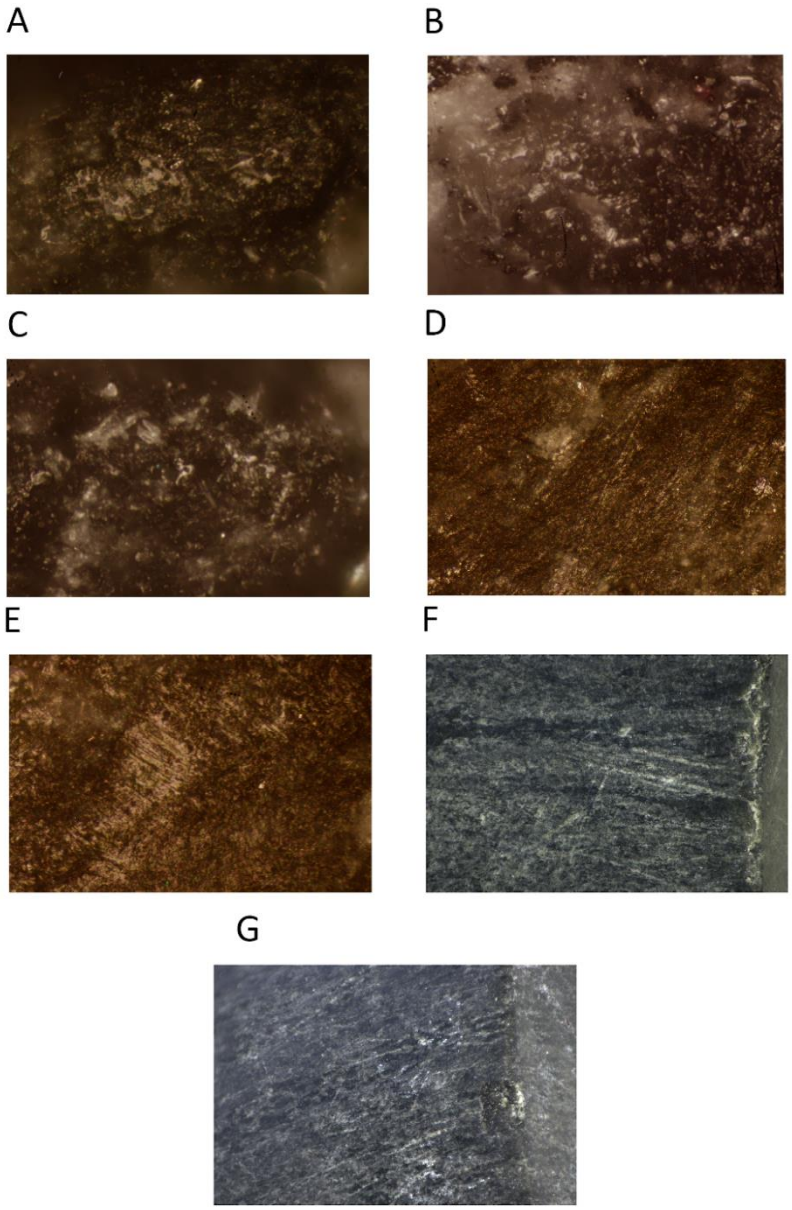

Figure 6. PBA butchering/meat cutting use-wear. A) Burial 25. B2, 200x. B) Burial 8.B2, 200x; C) Burial 8.B2, 200x; A-C) Slight rounding, open micro-polishes of irregular microtopography on the matrix with small, isolated flat/smooth micro-polish spots; D) Burial 21.A2, 200x deep striations ended in V; E) Burial 21.B2, 200x small spots of a shiny compact directional micro-polish; F) Burial 21, 10 fresh continuous chips and perpendicular to the edge loose and deep grooves; G) Burial 34, 5x isolated fresh chips.

A further step was performed to check if the PBAs' shape/measures presented any relation with their uses and the sex and age of the individuals with whom they were buried. To that end we used the stone adze typologies proposed by Ramminger (2007; Ib 2009). This classification is based on combining the PBA's width and thickness values to generate the HBI Index, corresponding HBI to (thickness/width) *100. The three PBA not included in the use-wear analysis due to their unavailability at the time the study was performed (burials 27, 26 and 40) have been incorporated here. Their approximate measurements and morphometry have been recorded using the graphic information available from Pavuk (1972).

All PBAs fall into type 3, with three exceptions belonging to one female (Type 2), one non-adult (Type 4) and one male adult (Type 4). The Type 3 PBAs correspond to medium-high blades with an HBI between 50 and 100 and absolute widths between 35 and 50 mm found with mature adult men and one senile. They mainly present triangular and flat-cylindrical sections, though hexagonal and "U"-shaped are also present (Table 3). Their measurements are very homogeneous, with weigh between 360-278 g, and maximum length between 183 and 150 mm.

Burial	Age/ sex	Section	Weigh (g)	Length (mm)	Thickness (mm)	Width (mm)	HBI Type	HBI	Use
2	MA M	FC	312	182	25.6	38.5	3	66	indeterminable
8	MA M	FC	286	150	27.3	35.5	3	77	wood-work
21	SEN M	T	278	162	29.4	29.6	3	99	butchering
25	MA M	FC	369	179	29	37.7	3	77	wood-work
34	MA M	T	327	165	31	33	3	94	meat cutting?
58	MA M	H	354	182	26.9	37.7	3	71	wood-work + disabling?
76	MA M	U	365	183	29	34.2	3	85	indeterminable
27	SEN F	FCON	-	100	52	20	2	260	
26	MA M	U	-	100	32	30	4	107	
40	Non-adult (4 yr)	U	-	114	30	28	4	107	

Table 3. PBAs contextual, technological, metric, and morphological characteristics. Abbreviations: *Vide* SI 4 for PBA macroscopic images. All the measurements are in mm. Abbreviations: SEN= Senile. AM= Adult Mature. T= triangular, FC= flat-cylindrical, U= "u" section shaped, H= hexagonal, flat-convex= FCON.

It is significant that those tools displaying higher HBI values and lower width values are precisely the triangular sectioned tools that were in contact with meat/bone (tools from burials 21 and 34), while woodworking artefacts provided lower HBI values and higher width values together with flat-cylindrical and hexagonal sections (burials 25, 8 and 58) (Table 3).

Furthermore, the only PBA found associated with a female-sexed skeleton (burial 27) also corresponds to the only tool displaying a flat-convex section. This artefact does not fall into any of the types proposed by Ramminger (2007; 2009). According to its width, it would resemble a Type-2 adze, but its HBI is much higher that all the rest of the items in the assemblage. What is important, however, is that while all those PBAs associated with male-sexed skeletons are characterized by a strong uniformity, that belonging to a female and a non-adult is clearly strongly differentiated. The presence of a gendered PBA morphological characteristic categorisation had been suggested by Ramminger (2009) in the German area of Hesse and by Van de Velde (1979) in the cemetery of Elsloo (Netherlands) and Masclans et al. 2020 at Vedrovice. Nordholz (2015) and Masclans et al. (in press) found that pattern in wider approximations to LBK funerary contexts suggesting that it was well stablished among Early Neolithic symbolic system.

6. Bioarchaeological data analysis and interpretation

6.1. Strontium isotope as mobility indicators

Strontium isotopes ^{87}Sr and ^{86}Sr recorded in human bone and teeth are a widespread method used to determine geographic origin and mobility patterns (Montgomery et al. 2000; Bentley 2002; Bentley 2004). Sr isotopic signatures make their way from local geology into the mineral composition of the human skeleton through the diet and local water sources. Typically, values obtained from the teeth of each individual are compared with a 'local' range. 'Locals' may

include people who moved between similar geochemical provinces, whereas 'non-locals' may include those individuals whose diet catchment extended beyond the local area (Bentley et al. 2003).

The Sr data obtained from Nitra in the framework of another project (Whittle et al. 2013) has been subjected to new statistical analyses in order to distinguish possible correlations between different origins and the different characteristics of the burials, such as sex, age, spatial distribution and grave goods. 13 males (68 % of all male burials), 17 females (65 % of females), 3 juveniles of undeterminable sex (of 4 juveniles) and 11 non-adults (61 % of the non-adults) were sampled in the Lifeways project (Whittle et al. 2013). Considering the data recorded in Table 1, the representativity of the sample is enough to determine statistically robust patterns in the data.

Since strontium isotope data from local animals are not available, nor are baseline models predicting geological strontium variations, a range of values for children and juveniles was used as the "local" indicator, assuming that children were more likely local because they had less time to migrate than adults in their lifetime (Montgomery et al. 2005). The resulting "local" range based on two standard deviations from the non-adult strontium values mean is 0,70932 and 0,70964 (n = 11; mean = 0,7094882, SD = 8,022695E-05), which roughly corresponds to the range of the main cluster as identified by Whittle et al. (2013: Table 4.25) and Hrnčíř et al. (2020).

Figure 7 shows that male strontium values broadly match the "local" cluster, probably indicating that they remained within the same area all their lives. In contrast, 5 out of 17 female individuals' isotopic signature lay out of the local range. On this basis we agree with Whittle et al. (2013) when suggesting a more varied origins for women than for men.

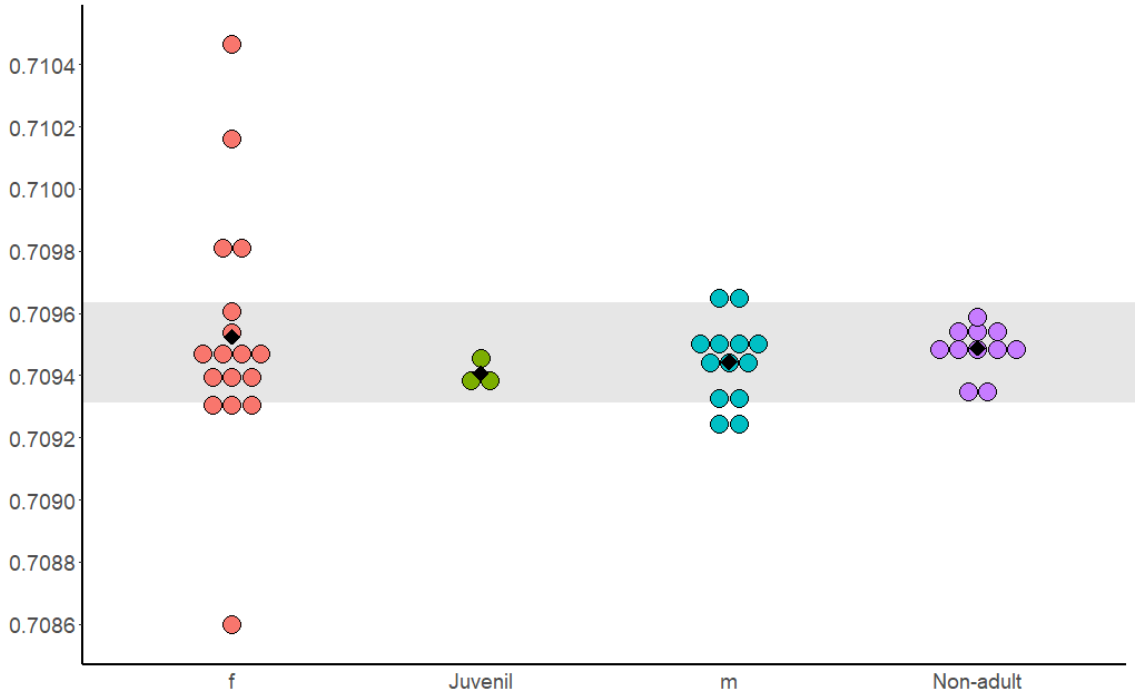

Figure 7. Dot plot including $^{87}Sr/^{86}Sr$ values and $^{87}Sr/^{86}Sr$ concentration according to the sex/age of the buried individuals. Grey shadow= "local" range based on two standard deviations from the non-adult Strontium mean value. F= female. M= male.

We thus argue that evidence supports the practice of female exogamy in a patrilocal community. Given the demographic skew to females, perhaps exogamy was aligned with polygyny, as

suggested by Hrnčíř et al. (2020). Male mobility in young adulthood may also be a possibility, though less likely as it would require *all* incoming men to have died while travelling away from the settlement. Another possibility, raised by Hrnčíř et al (2020), is taking women captive (again, not contradicting exogamy, but rather the agency under which it took place).

To explore those possibilities further, additional strontium analysis comparing different teeth from the same individual would provide insight into the age at which females moved. While this is unlikely to reveal motivation, at the cemetery at Vedrovice (in the neighbouring region of Moravia), female mobility was been shown to coincide with menarche which could support the notion that women were moving as socially recognised adults and potential mothers (Masclans Latorre et al. 2020). Teasing out some of these nuances is the subject of an ongoing project (*Gender on the Move, Gerda Henkel Foundation).*

6.2. Diet indicators: Nitrogen and Carbon isotopes and health conditions

Multiple rib and long bone samples have been studied for dietary isotopes ($\delta^{15}N$ and $\delta^{13}C$) confirming an essentially terrestrial diet based on cereal for Nitra (Whittle et al. 2013). Fourteen males (73.6% of the total male burials), 26 females (100% of the total female burials), 14 non-adult (70% of the total non-adult burials), 3 juveniles (24%) and 1 young adult of indeterminable sex were sampled for $\delta^{15}N$ and $\delta^{13}C$ analysis, concluding that, as a whole, the mean values of men, women and children were very similar (Whittle et al. 2013).

Carbon ($\delta^{13}C$) isotopic values, considered as reliable indicator of marine foods in European Neolithic diet, suggested the absence of marine and lacustrine resources as well as of the absence significant differences between the sexes. Mann-Whitney non-parametric test has been performed confirming that the median $\delta^{15}N$ values of males and females are not statistically different, even if male variance is slightly higher (0.268872) than that found among the female (0.1345656) population.

Non-adult individuals have been excluded from this last analysis because breastfeeding elevates nitrogen values. Infant feeding practices influence the size and demographic structure of a population, with longer weaning periods generally resulting in larger inter-birth intervals and fewer total children born, as well as possibly affecting both infant and mother's morbidity and mortality rates (Waters-Rist et al. 2011). In the case of Nitra, isotope analysis was performed on 14 non-adult individuals between 0 and 7 years, of which 5 (47/65, 67/65, 28/65, 31/65, 15/65) presented Nitrogen values coherent with breastfeeding at death, with $\delta^{15}N$ values between 12 and 13 and Oȝ13 between 19 and 19.83, reaching the expected ≈2–3% trophic level increase (Katzenberg 1999, Kinaston et al. 2008). All the individuals older than 2-3 years old present isotope values consistent with an adult value, suggesting that weaning was performed around 2-3 years old. Average age at onset of enamel hypoplasia was 2.9 years (Ash et al. 2016), corresponding with stable isotope evidence for the age of weaning.

Returning to the adult population, 2 groups have been defined based on $\delta^{15}N$ values by means of a Hierarchical Cluster analysis (Ward's method Algorithm, distance 1,5): NCL 1, composed by 4 males and 14 female-sexed skeletons (between 9.3 and 10.2, lower $\delta^{15}N$ values), and NCL2 including 10 females and 10 males (10.3 and 11.1, (higher $\delta^{15}N$ values) (SI 2, Table 1) (Figure 8). The Mann-Whitney Test indicated that there was indeed a statistical difference between those two groups (=1.2559E-07). This has been here interpreted as evidence that, though some female individuals shared the same protein ingestion rates with males, there were more women consuming fewer proteins than men and thus, presented more variable dietary patterns.

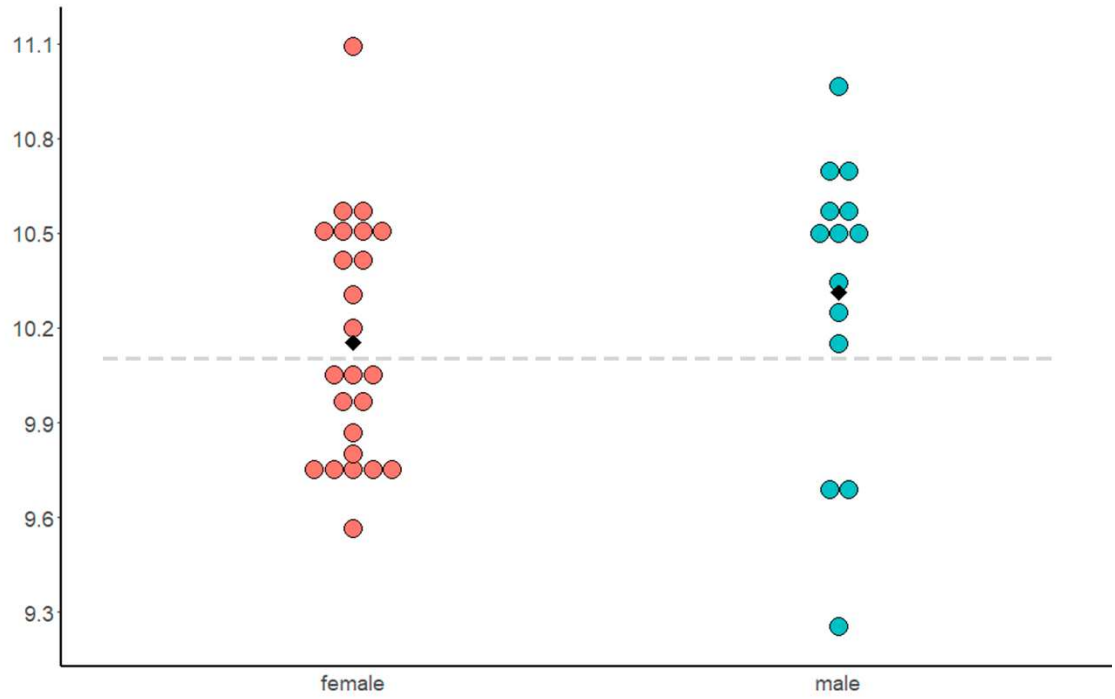

Figure 8. Dot plot including $\delta^{15}N$ values according to sex. Grey discontinuous line = separation between NCL1 (down), NCL2 (up) made by us. Black diamond: mean.

The presence of higher variability in female diet is supported by buccal dental microwear studies. Even if at first sight they indicate an absence of statistically significant differences on diet composition between Nitra's men and women's population (Jarosová and Tvrdý 2017), a closer look to the data shows that all male buccal dental microwear are related to meaty diets, while female's are distributed between meaty (8 individuals), mixed (5 individuals) and vegetarian (2 individuals). This suggests greater variation for females than males, as the largest group of women share the same meaty diet with the men.

Non-specific stress markers were examined through a bibliographic review of the presence of Harris lines, Porotic hyperostosis, *Cribra Orbitalia* and Lineal Enamel Hypoplasia (LEH) in male and female skeletons to explore food deficiency and/or nutritional/immunological stress among the Nitra population (Whittle et al. 2013, Tvrdý 2016, Ash et al. 2016) (SI 2, Table 1). These pathologies mainly form during infancy showing the stressful periods and may also arise from differential access to dietary proteins versus carbohydrates. Data concerning the prevalence of dental health (caries and tooth loss) was also collected (SI 2, Table 1).

After discounting burials with incomplete or absent skeletal remains due to preservation problems (skull and/or postcranial parts), no statistical relationship between the sex of the individual and the presence of non-specific stress/metabolic diseases, nor dental health could be established through $\chi 2$ Test with one exception: *Cribra Orbitalia* ($\chi 2$ 6.3, df 1, p 0,01207). This condition was prevalent among female population and may have been caused by anaemia from nutrition deficiency (iron intake) resulting from some girls being poorly fed during infancy in

opposition to boys. Even though there are other causes that could explain these sex-biased results, such as congenital anaemia, other infections, or susceptibility to parasites (Rivera, Lahr 2017; Rinaldo et al. 2019), this is a plausible hypothesis that fits with the $\delta^{15}N$ data suggesting the presence of a sector of females presenting different dietary patterns from males and the rest of females.

6.3. Physical activity

Physical activity evidence suggests sexually differentiated activity patterns in upper and lower limbs muscular-skeletal stress markers and dental wear. Osteological measurements were taken from both sides of human skeletons according to Braüer (1988) and White et al (2011) (SI 2, Table 4). The measurements were statistically checked for significant differences between laterals (left and right) (Mann-Whitney Test), with negative results. As a result, the used measurements correspond to the mean of left and right long bones (humeri, femurs and tibiae) or one of the two in those cases where only one extremity was preserved.

Attention has been paid to humeri diaphysis cross section index (HDI), Pilastric index (PI, femur), Platymeric index (PYI, femur) and Cnemic index (CI, tibia). Furthermore, two Principal Component Analysis have analysis have been performed involving four main measurements in the case of femurs (M6 anteroposterior midshaft, M7 mediolateral midshaft, M9 mediolateral subtrochanteric, M10 anteroposterior subtrochanteric) and four more in the case of tibiae (M8 anteroposterior midshaft, M8a anteroposterior nutrient foramen, M9 mediolateral midshaft, M9a mediolateral midshaft nutrient foramen).

The main part of skeletons evidence physical load in flattening of the proximal part of the femur and tibia diaphysis, though their distribution among sexes varied greatly. Both indicators have been correlated with the intensity of terrestrial mobility and signal long-term physical activity (Wescott 2006; Ruff 2018).

Statistical results confirmed general differences between males and females on PI (Kruskal-Wallis test p=0,004773, after removing three outliers), with males showing greater bone deformation, and HDI (T student test for normal distributions, Uneq. var. t= -2,233; p=0,031679).

In the cases of PYI and CI, there was an absence of statistically significant differences between sexes. However, their distribution on the graph are very different according to the sex: completely opposed in the case of CI (tibiae), with higher deformation in the case of male values, and in the case of PYI grouping of female values around 78-74 with greater bone deformity while males appear rather scattered (Figure 9).

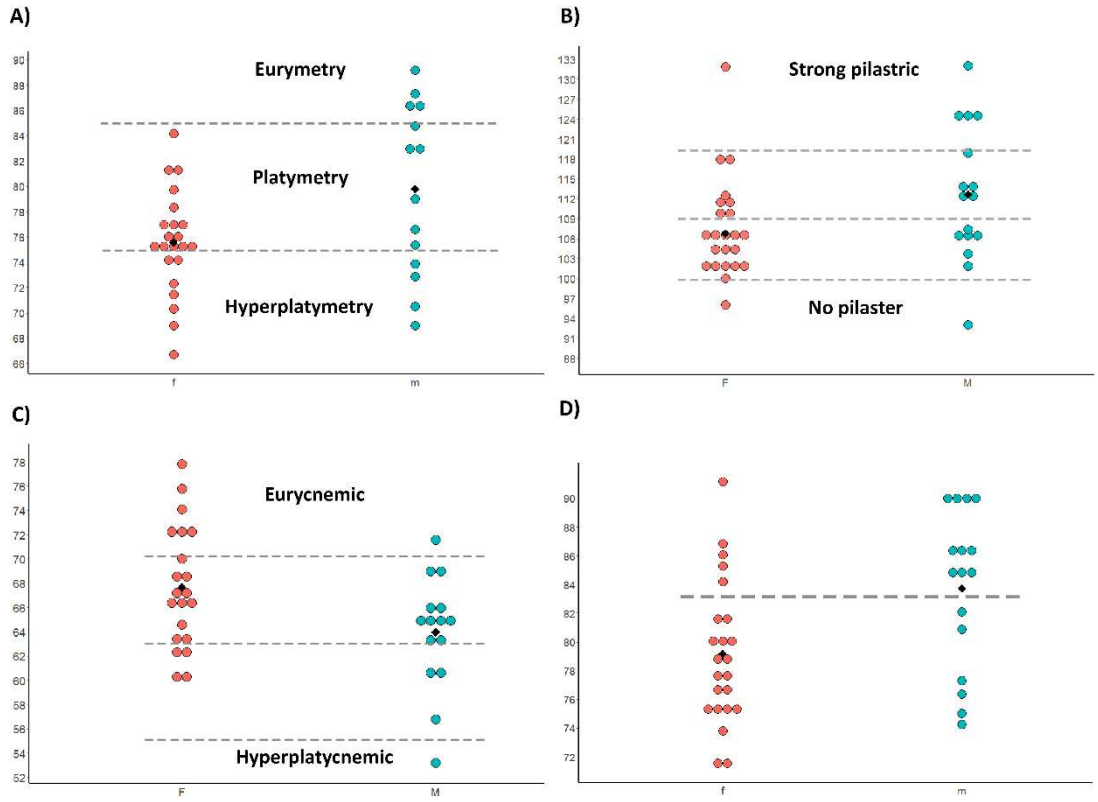

Figure 9. Dot plot including the following biometric indexes according to the sex of the individuals: A) Platymeric index (PYI), B) Pilastric index (PI), C) Cnemic index (CI), and D) humerus diaphysis cross section index (HDI). Black diamond: mean.

The PCAs on femur and tibiae measurements supports these observations, where a clear sexual dimorphism in the bone deformation was identified, as male tibiae and femurs tend to be bigger (quadrants 1-2 versus 3-2) and generally more robust (quadrants 1-3 versus 2-4) than females' (Figure 10, SI 3).

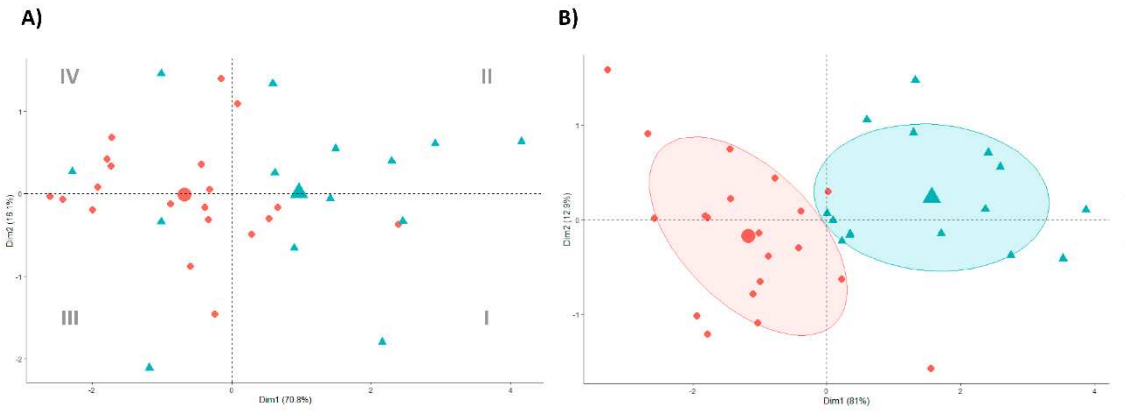

Figure 10. PCA involving femur (M6, M7, M9, M10) and tibiae (M8, M8a, M9, M9a) measurements according to the sex of the individuals. A) femurs B) tibiae. Triangles = males, Circles= females. Roman numerals correspond to the PCA quadrants.

The lower limbs indexes and PCA's indicate a tendency of females to present more grouped and homogeneous values than males, possibly reflecting an inferior variability of movements and tasks, as well as a different degree of bone deformation. This evidence corresponds with Macintosh et al. (2014a) and Berner et al. (2018) results of cross-sectional geometric analysis of lower limb bones in Central European communities including Nitra, confirming sexual dimorphism with males having significantly higher femoral shape ratios and tibial TA (total subperiosteal area, estimating compressional strength) and J (polar second moment of area, indicating bending and torsional rigidity) than females, as well as tibial Imax/Imin.

This evidence suggests either differentiated mobility patterns and/or distinct activities involving lower limb biomechanics, indicating at least a partial sexual division of labour. However, it is not yet possible to attribute those physical activity markers to concrete tasks, so for now it remains unclear to which sex activities such as work with digging sticks, tilling, persisting partial hunting/gathering and/or tending of domesticated livestock, could be related.

Longitudinal lips with pronounced insertion sites for flexors (phalanx flexor hypertrophy) on proximal and middle finger phalanges in the hands of 9 males (64.3 % of males with sufficiently preserved phalanges) and in 12 females (60 % of females with sufficiently preserved phalanges) (Tvrdý's 2016) were caused by extensive activity of the flexors and lumbrical muscles. The rims indicate a long-term working activity with the hands on a wide spectrum of possible crafts, such as weaving or toolmaking. Significant progress has been recently made in the field of hand entheses to distinguish hand use in modern tasks (Karakostis at al. 2017), which opens a wide range of possibilities for future studies on Neolithic phalanges.

Grooves on upper incisors in at least four females (24/65, 33/65, 35/65, 44/65) resulting from the use of teeth in activities other than food consumption were identified, tough in two cases (33/65 and 35/65) the sex of the buried female was not completely certain. These grooves were probably remnants of some type of dental manipulation such as passing of flexible material over anterior the teeth in a repetitive and habitual fashion in processing materials as sinews for bow strings or plant fibres for basketry or weaving, and were more frequently found in females than in males in the area (Larsen 1997; Lorkiewicz 2011; Sperduti et al. 2018; Jarošová-Dočkalová 2007; Frayer 2004; Whittle et al 2013).

Research of humeral morphology in Nitra and other Central-European LBK populations found asymmetry based on sex, with males showing humeri more asymmetric than females', which was interpreted as suggesting more unilateral load (Macintosh et al. 2014b). Pronounced musculoskeletal stress markers were recorded in right humeri (26/65, 34/65, 69/65), both-side calcanei (8/64, 19/64) and patellae (19/64) of five males (Tvrdý 2016) (SI 2, Table 1), confirming heavier physical load of males and their unilateral tasks. Our data on HDI shows opposite trends between males and females (Figure 9.D) suggesting very different nature of movements and workloads according to sex. These results confirm the presence of certain differences between some male and females' activities involving upper limbs as suggested by Sládek et al. (2015) on Central European Neolithic societies.

The presence of postcranial trauma was identified in 3 females (15/65, 44/65, 61/65) and 1 male (26/65). In two cases, they could be the result of a congenital condition (os acromiale 61/65, spondylolysis 26/65) although both traumas could also be caused also by long time strenuous physical load, while probable premortal injury or accident resulted in healed fractures on femur (15/65) and radius (44/65).

Finally, cranial traumas were found in 1 young adult male (72/65), 1 young adult female (1/64) and two non-adults (between 4-5 years; from the triple grave 48–49–50/65, which were buried together with a young female). The more probable cause of cranial trauma is interpersonal violence rather than accidental fall (Fibiger et al. 2013).

7. Grave good distribution

In this section sexed differences in the choice of grave goods is assessed. Grave goods generally consist of pottery vessels (present in 88% of the furnished graves), followed by PBAs (present in 23% of the furnished graves) and ornaments (present in 25% of the furnished graves). Those ornaments were usually made of *Spondylus* (either beads or pendants) while in one case they were made of human and animal teeth. Sporadically, other items were also deposited, such as flint blades/flakes (5 graves), bone tools (3 awls and 2 armbands/wrist guards), ochre remains (3 graves) and 1 grinding stone.

At least 27 burials were unfurnished, or, at least, if there have been grave goods, they were not preserved due to their perishable nature. χ^2 Test indicate the absence of a statistical relationship between sex and the absence of grave goods (χ^2 1.16, df 1, p 0.281), although there is a higher proportion of unfurnished female burials (10 out of 26) than males (4 out of 19). Likewise, there is no statistical relationship between adults and non-adults presence/absence of grave goods (χ^2 2.95, df 1, p 0.085), though the proportion of unfurnished graves is higher among non-adults. With only one exception (burial 40/65) non-adult individuals are only buried with pottery vessels, so the grave good range is quite limited in their case.

Only in the case of PBAs a statistical relationship between grave goods and the sex of the buried individuals was identified (χ^2 8.3299, df 1, p 0.003), as they were practically absent from female's graves. The only exception is a PBA from a female senile individual: burial 27, which displays strongly different morpho-metrical characteristics compared with the male-associated adzes (*vide supra*).

A statistical relationship was found between the different adult age groups (juveniles, young adults, mature adults and seniles) ($\chi^2$12.05, df 3, p 0.00722), showing that older adults (senile and mature adults) were more likely to be buried with grave goods than younger adults (juveniles, young adults), possibly indicating status development related to age.

Older women are more likely to be buried with pottery vessels than young ones, as well as they are the only ones associated with Spondylus ornaments and stone tools. This is a pattern also found in the close-by LBK cemeteries of Vedrovice (Masclans et al 2020). In the case of males, there are only four younger adults at Nitra, which makes it difficult to assess the impact of age in the adult male population, even though only older males were buried with Spondylus items and PBAs. If we consider the grave good distribution at the contemporaneous cemeteries of Vedrovice (Masclans et al 2020) and Kleinhadersdorf (Neugebauer-Maresch and Lenneis (2015), where young male burials are abundant, it can be observed that the differences between them and the mature adults and seniles were not significant. The only exception is the projectile points distribution, that has been observed to be wider among young adults' males in those sites (Masclans et a. in press) and which could explain the absence of this kind of item at Nitra.

Correlation between mobility and diet groups, biological sex and grave goods was explored through Multiple Correspondence Analysis (Figure 11) (a summary of findings is reported in SI 3). The study showed that males were often associated with PBAs related to butchering or

interpersonal violence , and woodwork, and only very sporadically to harvesting (sickle blade) and animal related work. Furthermore, even if the relationship is statistically non-significant, it is important to recall that both flaked tools and Spondylus ornaments were mainly present in male burials. High $\delta^{15}N$ values and local $^{87}Sr/^{86}Sr$ ratios were always related to male individuals. Females do not present consistent relationships with any of the grave good categories used in this study. Contrary to males, a significant number of females were related to low $\delta^{15}N$ values. Significantly, almost all non-local females correspond to the cluster with lower $\delta^{15}N$ values, indicating that women may have received different dietary treatment according to whether or not they were locally born.

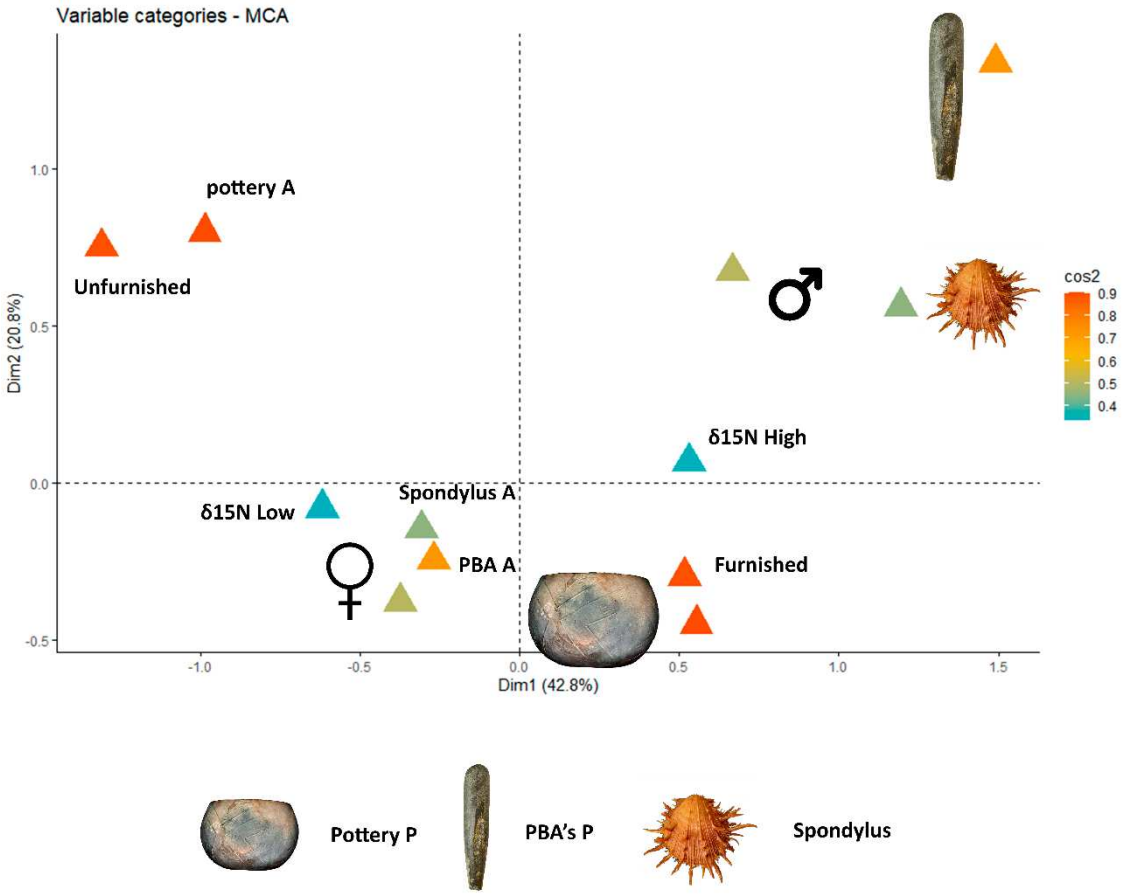

Figure 11: Multiple Correspondence Analysis plot of grave goods presence, sex (male/female) and isotope indicators of diet and mobility. Abbreviations: A= absence. The quality of the representation is represented by the squared cosine (cos2) gradient of colours: red corresponding to the better quality, blue the poorest.

8. Discussion

Our results suggest a schema in which biological sex played a key role in task, lifeways and grave goods differentiation. However, skeletal, use-wear, isotopic and funerary practices evidence is nor exclusive nor homogeneous among each sex, indicating a more complex system possibly build on gender and status relationships.

At least a partial sexual division of labour has been suggested based on the presence of osteological sexual dimorphism, differentiated musculoskeletal stress markers resulting from long-term physical activity involving upper and lower limbs (specially humeri, femurs and tibiae), and the grave goods stone tools distribution and use-wear results.

Sexual dimorphism confirmed males' unilateral tasks on the basis on humeral asymmetry. Furthermore, musculoskeletal stress markers were recorded in right humeri, both-side calcanei and patellae of five males, confirming heavier physical load of males and their unilateral tasks. Those results are broadly consistent with the exclusive presence of PBAs in male burials, as well as with the damage patterns identified in the tools active surfaces, which have been interpreted as resulting from woodworking, animal butchering and/or interpersonal violence. Male Nitra population may thus have been involved, at least, in land clearance activities (including tree felling), carpentry works and wood manipulation, and processing of animal carcasses. Furthermore, they may have been involved in activities related to interpersonal violence (striking, cutting, beating), of which direct evidence has been found in other LBK settlements (Vencl 1999; Wild et al. 2004; Meyer et al. 2015), a phenomenon of which Nitra's was not stranger though no direct use of PBAs in this site has been observed (*vide supra*). Male's physical activity markers indicate heterogeneity in the use of their lower limbs, reflecting a wide variety of possible tasks related to terrestrial mobility and/or activities involving lower limb biomechanics.

Females' lower limbs values were more grouped and homogeneous than males', possibly reflecting an inferior variability of movements and tasks related to terrestrial mobility and/or activities involving lower limb biomechanics. They were loading their upper limbs in a wider variety of ways than males and showed smaller asymmetry, likely participating in a larger range of activities, possibly related to crop planting/harvesting, grain grinding, gardening, and craft activities. This is partly supported by two type of evidence: dental wear and grave goods use-wear analysis. Tools were absent from female-sexed skeletons burials, with two exceptions: a burial with a PBA and another with two bone tools. The PBA corresponds to a senile individual from burial 27, presenting a flat-convex section and metrics resembling a Type-2 adze, which have been found to be related to female-sexed individuals in LBK (Masclans Latorre et al in prep), and interpreted as hide scrapers in the nearest known cemetery of Vedrovice (Masclans Latorre et al 2020). Furthermore, grooves on upper incisors created after processing materials as sinews for bow strings or plant fibres for basketry or weaving in at least four females were identified. The tendency of finding those grooves more frequently in females than in males individuals in the area supports the hypothesis of this activities being related exclusively to certain female individuals.

Insertion sites for flexors on proximal and middle finger phalanges indicate long-term working activity with the hands and have been found in both males and females, though it is not possible now to distinguish to which activities may them correspond. The flaked stone grave goods found on male graves were very sporadically associated to harvesting (sickle blade) and animal related work, but the evidence is too shuffled to find any kind of functional nor technological pattern. A higher bone fracture rate in LBK males was identified by Hedges et al. (2013) among the Lifeways project sample, which may be seen as indicative of sexual division of labour, where males- through the activities they carried out- were at a higher risk of sustaining injuries.

Interestingly, this evidence broadly relates with the data regarding male and female lifeways. Male-sexed individuals were generally characterised by lifeways homogeneity in terms of mobility (they were born, raised, and buried at the same place) and diet, with predominance of meaty diets and high $\delta^{15}N$ intakes, similarly to the close cemetery of Vedrovice (Masclans Latorre et al 2020). However, a small group of males presented both very low $\delta^{15}N$ ratios and distinct funerary treatment. Those few males belonging to $\delta^{15}N$ cluster 1 (low protein values) tend to be furnished only with pottery, while cluster 2 (high protein values) include all the burials

containing PBAs and ornaments. Considering that there is no relationship between male protein ingestion rates and their age nor between the age and the grave good distribution, we can firmly suggest that differences in diet formed meaningful social differences replicated in the presence and amount of grave goods buried with males.

Women showed greater variability of both lifeways and grave good representation. They statistically consumed protein in lower frequencies than men, which could indicate that some women did not share the same meals nor received the same share in the distribution processes than most men. Furthermore, females were significantly more affected by *Cribra Orbitalia*, which may indicate a possible differentiated dietary treatment between certain boys and girls in childhood. However, a part of the female population presented $\delta^{15}N$ intakes equivalent to males, suggesting at least dualistic dietary lifeways. Age, a second factor that determines the grave goods variability, may have also played a strong role, especially among women. Female skeletons associated with grave goods (mostly ornaments) correspond to individuals between 40 and 60 years, as has been identified in other LBK sites such as Aiterhofen (Hofmann 2009) and Vedrovice (Masclans Latorre et al 2020).

Female strontium values indicated that some of them had moved to a different location than their birthplace by the time they reached adulthood. With one exception, all non-local females belonged to the cluster displaying low $\delta^{15}N$ values, were more likely to be unfurnished (or furnished with perishable materials) and presented fewer of *Spondylus* ornaments. This suggests that residential sedentism impacted both on protein consumption, and increased likelihood of burial with grave goods. This makes us consider if non-local women find themselves excluded from the full range of diet, while having less access to personal objects during their lifetimes. Alternative interpretations can also be proposed. Perhaps they brought different dietary preferences with them, and then did not have the primary kin relationships (surviving parents, siblings, etc.) to leave gifts in their grave at death. In either interpretation, it is notable that their different lifeway was marked in death.

The results from Nitra cemetery show distinctive meeting points with the neighbour site of Vedrovice, indicating the presence of regional lifeways, taskways and funerary traditions patterns. Although at the present there is no published data concerning osteological measurements and musculoskeletal stress markers, we know that both sites present similar mobility, diet and grave good distribution patterns between males and females. Especially significant is the fact that the grave goods correlate similarly in relationship with females' age and residence patterns, suggesting that at least some values were shared between the two communities.

Conclusions

Evidence suggests significant differences between Nitra's males and females according to their lifeways and taskways. In amongst this difference we also see overlap and similarity in diet, physical activity and grave goods, as well as different rates of variation, suggesting that biological sex was not all encompassing, but within a schema in which biological sex played an important role in task and lifeways differentiation.

Females' lower limb homogeneity versus upper limb heterogeneity patterns was opposite to males'. Males, in turn, presented more lower limb robusticity and upper limb laterality. This evidence certainly indicates at least a partial sexual division of labour. However, the taskways the osteological data represent were not fully symbolised in the funerary sphere by the presence

of tools and the use-wear analysis results. Certain uniformity was sought to be symbolically exhibited in certain male burials through the presence of very standardised PBAs used on woodwork, butchering or interpersonal violence, but in many more cases labour was not evidenced. There also exists a possibility that funerary codification may have included organic materials that had not been preserved, such as textile decoration and fabrics, wood artefacts or other kinds of items made with vegetal fibres (Neugebauer-Maresch and Lenneis 2015). Furthermore, future research could address the pottery vessels' use through lipid or protein analysis, shading new light into taskways related to food producing and processing activities.

Gendered lifeways were then partially replicated in the presence and amount of grave goods. Male $\delta^{15}N$ intakes and mobility patterns were more homogeneous than female's and their amount of grave goods only consistently varied among those with lower levels of $\delta^{15}N$, which either did not received goods or were made of perishable materials. By contrast, females' grave goods varied according to other variables, fundamentally their mobility ratios and age.

Based on the data available, we suggest two related spheres of identity rooted in sex-based differences with marked internal variations, reflecting a complex tapestry of status relationships. This evidence, however, is not enough to either firmly challenge the male/female gender binarism or refute it as a hypothesis. At this point, we are more inclined to consider those differences as further aspects of identity intersecting with gender. Whether or not those differences may be originated or develop into hierarchical relationships between the sexes and/or genders is the next matter to be faced. This question, however, needs to be addressed together with evidence from domestic contexts and a more detailed knowledge of other labour markers present in grave goods such as pottery pots and bone tools.

It is relevant to acknowledge that PBAs were highly significant in the construction of part of the Neolithic male-related gender expressions. Nitra community certainly symbolized the activities related to PBAs buried with males (woodwork, butchering, interpersonal violence) above the rest of toolkits in funerary contexts. This over-symbolising is a pattern also to be found in European Middle and Late Neolithic burials and figurative representations, which has been associated to the masculine world (Petrequin et al. 2012; Petrequin et al. 2015). Significantly, the only published complete PBA use-wear study of a Neolithic cemetery (Middle Neolithic Pit Burial Horizon, at the Iberian Peninsula) (Mascans Latorre 2017) suggest a similar activity pattern to the LBK. In that case, males were associated mainly big PBA related with woodwork and butchering, while females displayed lighter tools used on hide-processing tasks. PBAs were indeed important symbolic items used to represent gendered relationships during European Neolithic, and at the core of this particular practice was a clear aim to include sexual division of labour in this symbolic representation.

One of the major challenges for the archaeology of gender, is how to move from the differences in biological sex, which is modelled on two sexes defined in opposition to each other, to gender without carrying over the assumptions of a binary system of gender, based on biological sex. Here, we have argued that considering the inter-play of taskways, lifeways and funerary practices can reveal something of how sexed bodies may have shaped identities for the early Neolithic communities that buried their dead at Nitra. Detailed site-specific studies, such as this one, that combine evidence from as many sources of evidence as possible, have the potential to further insight into past formations of gender, as long as we investigate fully the variability in the dataset rather than focusing on male and female gender categories as monolithic and unchanging categories in the past.

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