A common cause? Demographic study of LBK mass grave burial sites inferring community size.

Lambert, Emilie

A common cause? Demographic study of LBK mass grave burial sites inferring community size.

Emilie Lambert

Bachelor Thesis

13/06/2023

A common cause? Demographic study of LBK mass grave burial sites inferring community size.

Emilie Lambert

Supervised by Dr. Q. Bourgeois

Bachelor Thesis

Leiden University, Faculty of Archaeology

Final: 13.06.2023

Cover image: Talheim death pit (Zeeb-Lanz & Haack, 2016, p. 250)

Table of Contents

Abstract 4

1. Introduction 5

1.1 Research problem 6

1.2 Research questions 6

1.3 Procedure 7

2. Overview of the LBK 9

2.1 LBK lifestyle 9

2.2 Mass graves and settlement population 10

3. LBK mass graves 12

3.1 Talheim 12

3.2 Schöneck-Kilianstädten 14

3.3 Asparn-Schletz 15

3.4 Herxheim 17

3.5 Halberstadt 18

3.6 Wiederstedt 20

3.7 Conclusion 21

4. LBK settlement and grave demographics 22

4.1 Houses and inhabitants 22

4.2 Ethnographic comparison 24

4.3 Archaeological demographics 25

4.4 Cemetery populations 27

4.5 Environmental studies 28

4.6 Conclusion 29

5. Relate mass graves to settlement populations 30

5.1 Demographic comparisons and insights 30

5.2 Discussion 35

6. Further Discussion 36

6.1 Missing young women? 36
6.2 Why the violence? 37
6.3 Ritual symbolism? 39
7. Conclusion 40
Bibliography 41

Abstract

Though the Neolithic tends to be viewed as a relatively peaceful time, the appearance of mass graves in the late Linearbandkeramik (LBK) period suggests otherwise. Decades of research have been spent trying to understand the full scope of what happened to these people, often of all ages, with brutal injuries. While so much focus goes into the individuals buried there, counterintuitively, we can also infer much about the people who are not present in the mass grave. We may not only have to look at who has been buried, but also at who has not.

Looking at demographics of the mass graves and corresponding settlements it is possible to investigate the social circumstances around the time of the downfall of the LBK. Certainly in some cases the mass graves show gaps of missing people when comparing the demographic composition of the grave to that of a stable living population. It is possible to argue cases of abduction, or certain people being absent at the time of the massacre. I further argue that the nature of the killings varies widely between sites, and differing levels of ritualism should be accounted for, as summarising LBK mass graves as raids fails to acknowledge multiple factors on the victim's wounds and deposition. A demographic study of who is and who is not present in the graves can contribute to understanding the broader context at these sites of violence in addition to the general population sizes of the time.

1. Introduction

The Linearbankdkeramik (LBK) or Linear Pottery Culture is known for being the homogenous culture that introduced farming to central Europe. Originating in 5500 BCE in Hungary it spread so rapidly throughout Europe that a site from the Netherlands is close to indistinguishable from one in the Balkans (Fontijn, 2021, p. 12). Known for building longhouses (fig 1) and their preference for living on loess soil, the LBK are typically seen as a peaceful farming culture. That is until we see a general trend of a sudden increase of violence in the late LBK. Something happened around 5000 BCE that made fellow LBK people brutally massacre each other. This coincides with the period of the late LBK, as the culture faces its dissimilation, and splits into multiple, more regionally specialised, daughter-cultures (Van de Velde & Amkreutz, 2017, p. 19; Meyer et al., 2014, p. 307). While there are many theories on contributing causes for such violence, here, we will analyse the sites for a more comprehensive view on what could have happened to the victims found in mass graves. I conduct a demographic study of the individuals found in multiple LBK mass graves and assess what the living population size at that settlement would be, based off those demographics and multiple other proxies for population estimations.

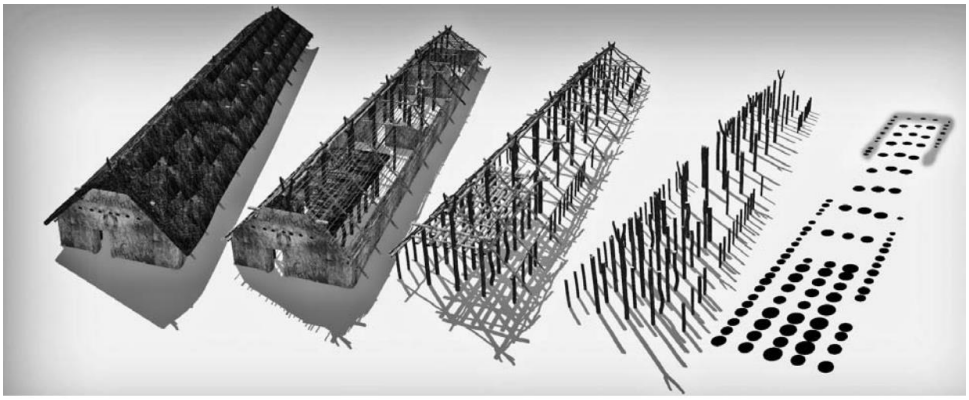


FIGURE 10. Traditional technological reconstruction of the LBK longhouse. Illustration by P. Vavrečka.

Figure 1: Representation of an LBK longhouse. Only the postholes (final image) remain during excavations. (Květina & Hrnčíř, 2013, p.341).

1.1 Research problem

In these mass graves people regardless of age or sex suffered mostly head trauma from fellow LBK tools, inferring it is one LBK community wiping out another (Meyer et al., 2014, p. 313). It is generally believed that the graves are the result of raids on neighbouring settlements, where an entire community is wiped out in one swift battle. "Judging from the cranial trauma patterns, lethal attacks were mostly conducted in largely uncontrolled, chaotic melee clashes" (Meyer et al., 2018 b, p. 35). The narrative seems to be shifting though, to account for a lack of adolescents or young adults (Meyer et al., 2018 b). The goal is then to verify if indeed the entire living population of the time is represented in these graves. This cannot be answered without approximating the local population size, a complex task usually incorporating many proxies. With this information we can deduce details of the people around the site and of the nature of the battles themselves. For instance, a complete annihilation of the settlement implies a sudden unplanned raid rather than an organised fight where the injured would more likely be men while the women and children flee to escape death or capture. These are insights that while revealing what happened at these sites, also shed light on the daily life and social configuration of the LBK people. This is especially relevant as some studies link the mass graves as a key cause or symptom of the societal collapse as they both arise at the end of the LBK (Fontijn, 2021, p. 23; Van de Velde & Amkreutz, 2017, p.19).

1.2 Research questions

- **Do the LBK mass graves represent the killing of an entire community?**
- How can demographics of a mass grave provide population size estimations of the community there, whether buried or not?
- What can be assumed about the fates of missing demographics from a mostly fully representative mass grave?
- Can we infer a cause for the mass graves of the Linearbandkeramik?

1.3 Procedure

We investigate 6 well known mass graves, all located in Germany except one Austrian, in hopes of gaining a closer understanding of the sites (fig 2). Particularly, we are using the demographics of the graves and other measures to infer the population demographics of those that had been living there, along with speculating the fates of those not represented. The first and most famous site is the Talheim death pit, with 34 individuals, as the 'typical' LBK mass grave. Then the grave at Schöneck-Kilianstädten which has been deemed a twin of Talheim for all its similarities, containing 26 individuals. I then investigate Asparn-Schletz, the Austrian grave, not yet fully excavated but containing an estimated 300 individuals. I then analyse Herxheim, a massive site interpreted as a place for ritual murder and cannibalism. A somewhat different site is Halberstadt, an unceremonious burial of 9 adults, because it shows a selection bias. Finally, an outlying mass grave in Wiederstedt, as there are no signs of battle on any of the 10 young individuals. See (table 1) for a brief overview of the sites discussed in this paper.

Site	Location	Period (BCE)	Total n°	Notes
Talheim	SW DE	~5000	34	Near settlement, full demography, LBK tool cranial wounds
Schöneck-Kilianstädten	SW DE	5207–4849	26	Very similar to Talheim, broken legs, missing young females
Asparn-Schletz	NE AT	~5000	67//200	Not fully excavated, missing females
Herxheim	SW DE	5300-4950	500//1000	Half excavated 90 pits, ritual cannibalism(?), disarticulation
Halberstadt	NE DE	5600-4900	9	Executions, planned fight, adult male only
Wiederstedt	NE DE	~5000	10	No battle trauma, adolescent only

Table 1: Table with a basic overview of the 6 main sites. Dates based on radiocarbon dating. x//x = excavated//estimated (made by author).

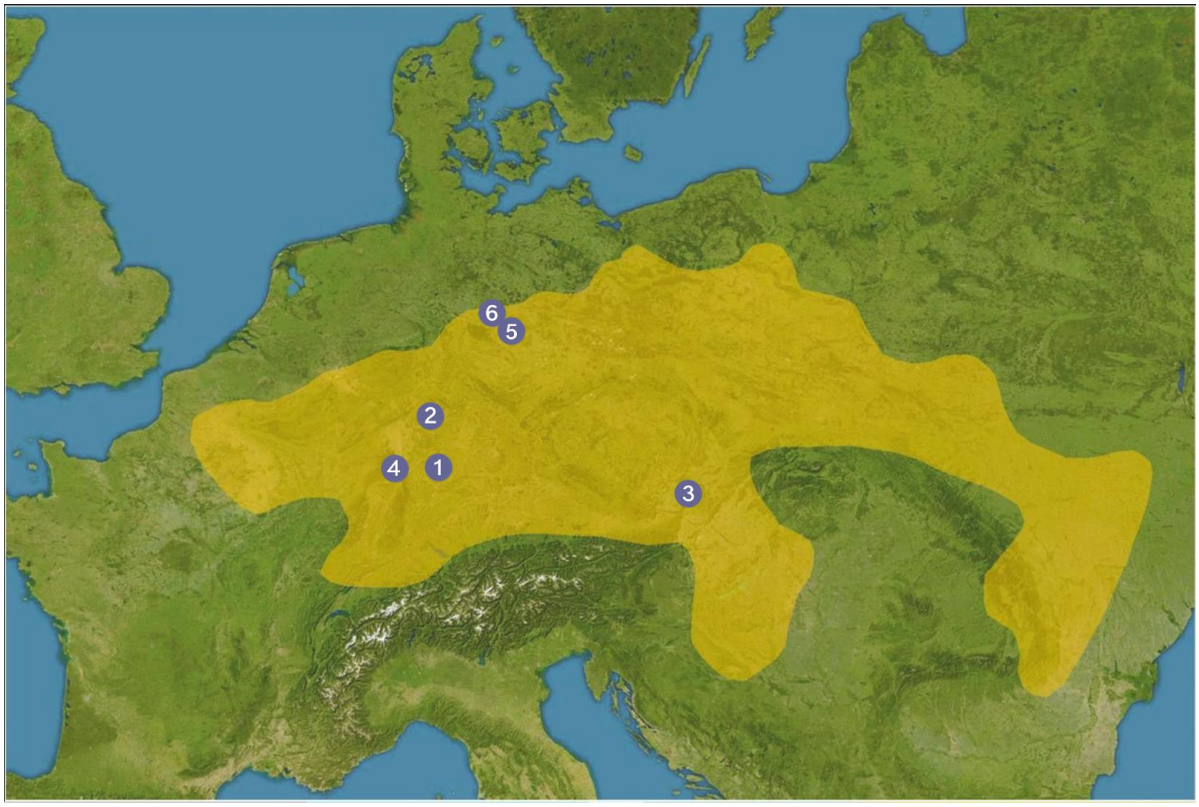


Figure 2: Map of central Europe, highlighting the area of LBK influence (yellow), and each of the key sites' location, numbered in order of discussion (blue). 1: Talheim, 2: Schöneck-Kilianstädten, 3: Asparn/Schletz, 4: Herxheim, 5: Halberstadt, 6: Wiederstedt (Map obtained from Meyer et al., 2015, p. 11218; adapted by author).

2. Overview of the LBK

2.1 LBK lifestyle

Some key background information on the LBK culture itself is of course a crucial addition to our study, in order to paint a picture of the past. While there is not time to delve completely into all the ins and outs of everything we know of these people, a brief overview of some relevant factors will be given here.

People of the LBK culture settled on land previously only inhabited by (semi)-nomadic hunter gatherers. They do however, not seem to have interacted much with each other (Vanmontfort, 2008, p. 159). As the first farmers in central Europe, it made sense that they exclusively built their settlements on the fertile loess soil along riverbanks. Hunting was still a vital part of their subsistence strategy (Hachem 2018), but they lived in clusters of farmsteads, growing pulses and cereals, and rearing farm animals (Saqalli et al., 2014). They cleared forests of mixed oak trees and built massive longhouses that could house the entire family unit, usually 3 generations.

Though incredibly difficult to study, their social organisation seems to still have been rather egalitarian with no central authority even over neighbouring settlements (Van de Velde & Amkreutz, 2017, p. 19). "*It seems evident that one important part of Linear Pottery society was based on exchange, reciprocity and interdependence according to economic and social status*" (Hachem, 2018, p. 920). While houses/settlements are generally self-sufficient, a division of labour and reliance on others is still present. Despite this strong autonomy, there is evidence of long-distance contact and interactions between the LBK and much cultural continuity. "*It seems as if these people considered it very important to stick with the norms and values of the ancestral hamlets and villages from which they once split off, and to persist in 'ancestral habits' for generations. There is not only a strong cultural cohesion, but also a strong social integration between the dispersed Bandkeramik communities.*" (Fontijn, 2021, p. 12).

The LBK were some of the first in the area to separate the areas of the living and the dead, though an overlap is still evident (Meyer at al., 2014, p. 311). Although according to Van de Velde "*at least about 90% of the Bandkeramians have not been buried in regular cemeteries. The large majority has left no archaeological trace at all, possibly having been lain in the field or the forest*" (Van de Velde 1990; Jeunesse 1997; 2011a in Van de Velde & Amkreutz, 2017, p. 22). Nevertheless, the LBK buried a portion of their dead in cemeteries; the inhumations or cremations being carried out carefully and often lavishly decorated. Grave goods include specifically grave-dedicated pots and tools, but also jewellery and animal bone (Van de Velde & Amkreutz, 2017, p. 21). The mass graves then are

primarily identified through the unceremonious burial of bodies as they were tossed carelessly into a pit, with no grave goods.

As there are now multiple mass graves all dating to the fall of the LBK, it certainly leads one to wonder what could have been the underlying cause behind them. It is the most popular belief that the surge in violence was a symptom, if not a partial cause, of the society's demise, blaming the collapse on an unsustainable lifestyle in a changing world (Fontijn, 2021). The LBK people functioned in such a continuous way that to continue expanding, they eventually came into competition over resources with each other for the first time. Having such a strong preference for loess soil riverside settlements meant once that space ran out the settlements were under stress from limited water supply and unspecialised environments (Louwe Kooijmans 2017, in Fontijn, 2021, p. 24). There are also signs of a climatic shift to a drier and colder period, though little adaptive technique is seen within LBK material culture. It must have had an effect on the comfort and crops of the LBK (Louwe Kooijmans 2017, in Fontijn, 2021, p. 25). The likely most relevant factor though is potential social disruption. Perhaps the dynamics of interactions between settlements were changing if, as theorised, intermarriage links need to be abducted instead of agreed upon (Van de Velde & Amkreutz, 2017). In the end, ca. 4900 BCE, LBK societies split into multiple daughter societies which specialised in regional strengths.

2.2 Mass graves and settlement population

We are investigating the link between mass grave demographics and LBK population dynamics, in order to study the demographic representation of those killed. A key application for demographic studies is to "*help repopulate the past with individuals whose presence is suspected yet the material evidence for their existence is lacking*" (Chamberlain, 2006, p. 178). We can apply this in our goal to estimate the settlement size and correlate the data to that of the mass graves.

If indeed an entire settlement was wiped out and buried in one grave, we can take this example to show the exact demographics of the time. Interesting aspects to know are the child/adult ratio, or the ages of the eldest individuals for example. There are many methods to estimate population dynamics in prehistory, but these burials would be an example revealing a slice of what life was like at that exact time. Even if the graves are not fully representative, we could 'auto-complete' them to fill in the gaps. These gaps would indicate inhabitants that did not die in the massacre. This leaves room for us to contemplate their fates and the further context of the massacre itself in understanding the situation and tactics of the killers.

Understanding the demographic composition of the massacres especially in relation to settlements can be useful in inferring a detailed perspective of the lives of people around the site and of the nature of the battles themselves. A narrative of captured young females is becoming a popular hypothesis, creating new implications for the purpose behind the massacres (Meyer et al., 2018 b; Teschler-Nicola, 2012). In order to argue the abduction theory, we will have to study the broader social dynamics within the LBK. Gender roles and mobility systems will be discussed in relation to this. These are insights that while revealing what happened at these sites, also shed light on the daily life and social configuration of the LBK people towards the end of their reign.

3. LBK mass graves

Here I provide all the relevant background on each site, as an introductory overview. See (fig 8) for a refresher of the site's locations. The demographic study and further insights will be discussed per site in 5.1.1.

3.1 Talheim

The Talheim death pit is perhaps the most famous LBK mass grave site that first raised all the questions of extreme LBK violence since its excavation in 1983 (fig 3). A total of 34 individuals were unceremoniously thrown and partly lain in a shallow pit after having received fatal blunt force trauma, mostly aimed at the head (Meyer et al., 2014, p. 314). The demographics assumedly represent a full settlement, of children of all ages, adults, and matured people, of all sexes (table 2). The site is unanimously described as deadly raid killing (close to?) all inhabitants of the village (Meyer et al., 2018 b, p. 25; Zeeb-Lanz & Haack, 2016, p. 251).

Though still under investigation, it is suggested that 4 family units are represented here (Zeeb-Lanz & Haack, 2016, p. 250). The grave is located near a likely contemporary village, though it is impossible to directly link these individuals to that specific place, as dating cannot be that precise.

Some pottery sherds and animal bones were also present among the individuals. It seems we can "*assume that the pit, which was excavated to dispose of the victims, cut into a former refuse pit and was later filled in again with the same debris to cover the bodies*" (Wahl & Trautmann, 2012, p. 88) The complete lack of any kind of personal items on the bodies indicates they were "*likely plundered before burial*" (Wahl & Trautmann, 2012, p. 88).

It has been suggested that Talheim shows a minor underrepresentation in women. Though some have argued the lack to be a 'secondary deficit' as women were simply more likely to naturally die younger (i.e., at childbirth) (Wahl & König, 1987 in Teschler-Nicola, 2012, p. 117), this belief is being replaced by the abduction theory, especially at the sites where the difference is much more evident (Teschler-Nicola, 2012).

Fig. 10.2 Skeletal remains of the 34 individuals in the mass grave of Talheim near Heilbronn (Baden-Württemberg, Germany) Photo: E. Strauß, LAD Baden-Württemberg, RP Stuttgart.

Figure 3: Image of the Talheim death pit at the time of excavaiton (Zeeb-Lanz & Haack, 2016, p. 250).

Age	N° (total)	N° (M)	N° (F)	N° (?)
Infans I (0-7yrs)	7	-	-	7
Infans II (7-14yrs)	7	-	-	7
Juvenile (14-20yrs)	2	-	1	1
Adult (20-40yrs)	11	7	4	-
Mature (40-60yrs)	7	2	3	2
Total	34	9	8	17

Table 2: demographic table of the individuals of the Talheim death pit. Table by author adapted from (Wahl & Trautmann, 2012, p. 91).

3.2 Schöneck-Kilianstädten

The grave at Schöneck-Kilianstädten, discovered in 2006, holds very similar information to Talheim. 26 individuals of all ages and sex are represented and buried shortly after death in a pre-existing ditch that was part of the enclosure system of an 18-house settlement (Meyer et al., 2015, p. 11218) (fig 4). Unfortunately, the preservation at the site is rather poor (Meyer et al., 2018 b, p. 27), making a detailed analysis of the stratigraphy, finds and bones more difficult.

Figure 4: The mass grave at Schöneck Kilianstädten, containing the 26 victims (Meyer et al., 2015, p. 11218)

Something that differs is the breaking of the lower legs during the fight, though cranial trauma is still the most common fatality. Interestingly though, despite the brutal nature of their deaths, they do not seem to have defended themselves, as parry fractures (wounds obtained while in a position of defence) are not found (Zeeb-Lanz & Haack, 2016, p. 252). Whether this was due to the speed of the attack or a ritualistic acceptance of their deaths is unclear and discussed below.

There is a strong case of missing young adult females, particularly at this site, so although 13 of the murdered were children (table 3), the women seem to have been spared, absent, or taken (Meyer et al., 2015, p. 11221).

It is suggested that the LBK aggressors took over the settlement as it remained inhabited long after the grave had been dug, though it is also possible that it could have remained inhabited by the survivors (Fontijn, 2021, p. 21).

Table S3. Approximate subadult demography of the Kilianstädten mass grave, based primarily on evaluation of preserved cranial fragments and cross-checked with postcranial elements

Age range	<0.5 y	0.5–2 y	2–3 y	3–5 y	5–7 y	7–9 y	16–21 y*	Total
No. of individuals	1	1	2	4	3	1	1	13

*Probably a social adult (56) but counted here as a biological subadult.

Table S4. Approximate adult demography of the Kilianstädten mass grave, based primarily on evaluation of preserved cranial fragments and cross-checked with postcranial elements

Age range, y	Male	Male?	Female	Female?	Indeterminate	Total
20–30	3	3	—	—	1	7
25–40	2	1	—	—	—	3
40+	—	—	1	1	—	2
Indeterminate	—	—	—	—	1	1
Total	5	4	1	1	2	13

Table 3: Demographics from Schöneck-Kilianstädten. Above: age groups for the subadults. Below: age and sex groups for the adults. (Meyer et al., 2015, p.11219)

3.3 Asparn-Schletz

Another similar site in Austria contains 67 excavated bodies left to rot in a defensive ditch. Animal gnawing marks lead to the assumption the bodies were left uncovered after the fight, merely cleaned up by throwing them into the pre-existing ditch and left the site uninhabited (Teschler-Nicola, 2012, p 102). This ditch was one of the defensive ditches around the entrance to the village, of which many houses, wells and ovens remain traceable (Zeeb-Lanz & Haack, 2016, p. 251). A whole population is estimated, having lots of blunt force trauma, in an assumed tactical attack at the entrance ditches. But if they died defending themselves the lack of parry-fractures is especially intriguing -were they already lying defenceless on the ground? Interestingly though, some isolated skull caps provide even more reason to question the nature of the attack, as to having a more symbolic meaning (Zeeb-Lanz & Haack, 2016, p. 252).

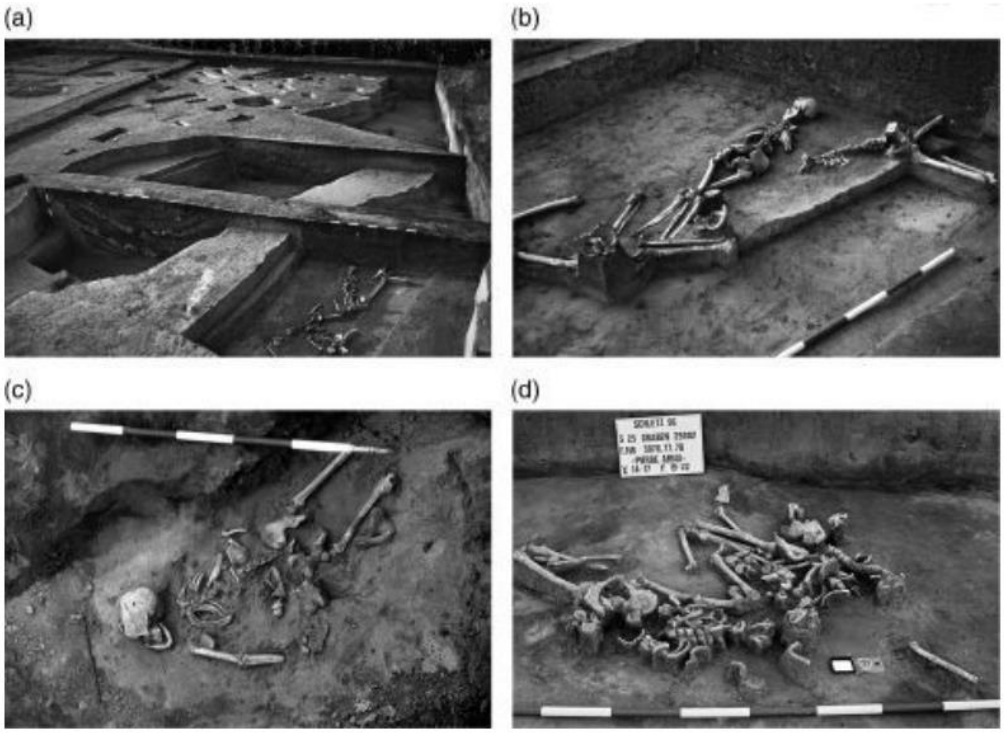
Asparn-Schletz also has a theorised missing portion of young females, though as the site is not fully excavated demographic studies cannot be absolute. Only 20% of the site has been excavated (Teschler-Nicola, 2012, p. 105), making detailed analyses difficult. With the unexcavated, the body count could be as high as 200 individuals (Zeeb-Lanz & Haack, 2016, p. 251). Given the proportions of young to old individuals however, there are notably fewer adult women than men (fig 5). Teschler-Nicola (2012) argues that "*according to our view, young males are not overrepresented, but rather young females are underrepresented.*" (Teschler-Nicola, 2012, p. 105) and is in favour of the

theory of abduction. In the demographic table below (table 4), it is clear that a 40% male, 22% female ratio, is worthy of analysis. While it would well be that they have simply not been excavated yet, it seems unlikely to drastically change the statistics as there is no sign of clearly separating people of different ages and sexes.

Table 6.1. Age at death and sex distribution at the late Linear Pottery site of Asparn/Schletz (*n* = 67)

	N(tot)	%	N(m)	%	N(f)	%	N(?)	%
Infans I	12.5	17.2	–	–	–	–	–	–
Infans II	8.5	12.7	–	–	–	–	–	–
Juvenil	5.5	8.2	2	2.9	1.5	2.2	2	2.9
Adult	22.5	33.6	16.5	24.6	5	7.5	1	1.5
Matur	18	26.9	9.5	14.2	8.5	12.7	–	–
Total	67	100	28	41.8	15	22.4	3	4.5

Table 4: Demographic table of the individuals excavated in Asparn/Schletz (Teschler-Nicola, 2012, p, 105)



(a) Asparn/Schletz, ditch system: overview of the oval double ditch system with human relics *in situ*. (b) Asparn/Schletz, ditch system: detail of the skeletal assemblage (*in situ*, close to the south gate). (c) Asparn/Schletz, ditch system: *in situ* example of an incomplete preserved human skeleton. (d) Asparn/Schletz, ditch system: *in situ* example of two incomplete preserved human skeletons.

Figure 5: Images from Asparn/Schletz showing multiple articulated and disarticulated burials in the ditch system (Teschler-Nicola, 2012, p. 104)

3.4 Herxheim

Straying from the typical, we now investigate Herxheim, a massive anomaly, yet to be truly understood. Masses of disarticulated human bones are placed in commingled and sorted arrangement in ditches around a large site (fig 6). Some bone was crushed into powder and skull nests again show a certain ritual aspect to the scalping and butchering of the deceased (Zeeb-Lanz & Haack, 2016, p. 256), while other bones show various degrees of burning (Orscheidt & Haidle, 2012, p. 135). Cannibalism is a theorised practice due to the butchering of the bone but is still an uncertainty. Believed to be heavily ceremonial the area is not seen as a raided settlement but a place of ritual ceremony. Among the great lengths gone to destroying the human remains, valuable pots, grindstones and adzes received the same treatment (Zeeb-Lanz & Haack, 2016, p. 257). Though the 10-house ditch-enclosed settlement was inhabited between 5300-4949 BC, the deposited bones only date to the final period i.e., 5000-4050 BCE (Zeeb-Lanz & Haack, 2016, p. 255).

Fig. 10.3 A typical concentration (K 9) of human bone fragments, pottery sherds, and other material at Herxheim near Landau (Rhineland-Palatinate, Germany). Note the clusters of skull calottes in the centre. Photo: F. Haack, GDKE Rheinland-Pfalz.

Figure 6: One of the ditches at Herxheim. (Zeeb-Lanz & Haack, 2016, p. 256)

As yet not fully excavated, the demographics are more difficult to analyse, but there is an estimated MNI of 324 individuals excavated (table 5) (Orscheidt & Haidle, 2012, p. 124), although it could easily be up to 500 out of a total 1000 estimated to be present. This is a huge number

compared to the rest, reinforcing the idea of travel to the site and Herxheim representing a long-term ritual rather than a single event.

Interestingly, 90% of 100 sampled individuals were of non-local strontium isotope origin (Turck in press; Turck et al. 2012, in Zeeb-Lanz & Haack, 2016, p. 259). The haplogroups of the same individuals however were commonly known among the LBK. This huge discrepancy still needs further investigation, but provides an interesting view into the LBK social networks. Much of the pottery was also non-local, further suggesting travel to the site (Orscheidt & Haidle, 2012, p. 133).

Furthermore, there seem to be few cases of cranial trauma among the masses of cranial remains. There are hardly any signs that the deceased were brutally wounded as a cause of death as is the case for Talheim, Schöneck and Asparn (Orschiedt & Haidle, 2012, p. 129). Many however, showed signs of healed trauma. This is a huge distinction to make as, the bodies were not killed similarly to the previously discussed mass graves, nor were they buried in the same manner.

Table 7.1. MNI calculations based on cranial remains, burials, and partial burials

	Fetus	Neonate	Infans I 1–6	Infans II 6–14	Infans 1–14	Adolescence 14–20	Subadult 1–20	Adult 20–30	30–40	40–50	50–60	>60	Adult 20–>60	Indet.	M	F	Indet
Calottes			16	63	39	15	14	3	50	11			211				
Burials				1		1		4	1				1		5	2	1
Partial burials								1	1		1				3		
Crania				2		1		6	2	1	2		2		4	10	2
Refits			1														1
Combinations														80			80
Fetus/neonate	6																6
Age/sex total	6		1	3		2	16	74	43	17	17	3	53	91	12	12	301

Indet., indetermined.

Table 5: Demographic table of aged and sexed body parts in the Herxheim mass burial (Orschiedt & Haidle, 2012, p. 125).

3.5 Halberstadt

The ceremoniless burial of 9 young individuals in Halberstadt is another outlier both in demographics and in circumstance. Here, it was 9 nonlocal adult males found in the grave (Meyer et al., 2018 a, p. 3) (table 6). Their injuries consist of near identical targeted blows to the head, along with the breaking of a few limbs (fig 7). What archaeologists theorise happened here is a systematic execution, clearly a different situation to the other raids on villages. Another option presented is a failed raid where only a handful of people were captured and disposed of (Meyer et al., 2018 a, p. 8), though a random accumulation of people is unlikely, as, unlike the other sites, there are no infants, juveniles, mature, or senile individuals. A very distinctly young adult selection had been made. Furthermore, the "*Sr and the C and N isotope data characterise the individuals in the mass grave as clearly distinct from the settlement burial population*" (Meyer et al., 2018 a, p. 6), which enforces the execution of foreigners theory.

The burial itself was not done with care or even soon after death. The bodies were erratically placed, falling as if tossed into the grave. Animals had disturbed the site, resulting in a handful of missing bones and traces of rodent gnawing (Meyer et al., 2018 a, p. 8).

Fig. 1 The mass grave feature in situ. Individual skeletons have been coloured and numbered for better visual differentiation

Figure 7: Image of the Halberstadt mass grave, with individuals outlined (Meyer et al., 2018 a, p.3)

Table 1 Osteological characteristics of the individuals found in the mass grave

Ind.	Sex	Age (years)	Height (cm)	ICT	IPT	ICD
1	M	25–35	166	(no skull preserved)	—	Possible
2	M	30–40	171	Occipital R	—	Yes
3	F?	21–26	152	(no skull preserved)	—	Yes
4	M	25–35	162	Frontal R, Parietal RL, Occipital RL	—	No
5	M	16–20	—	Parietal RL	—	Yes
6	M	30–40	161	Parietal R	Humerus R	Yes
7	M	25–35	163	Occipital L	Femur R	Possible
8	M?	25–40	—	Parietal L, Occipital L	Humerus L, Ribs L	Possible
9	M	25–40	—	Parietal L, Occipital R	—	No

ICT identified cranial trauma, *IPT* identified postcranial trauma, *ICD* identified carnivore damage, *y* years, *M* male, *F* female, *R* right, *L* left

NATURE COMMUNICATIONS | (2018)9:2472 | DOI: 10.1038/s41467-018-04773-w | www.nature.com/naturecommunications 3

Table 6: Demographic table with age, sex and damage dealt to each individual in the Halberstadt mass grave (Meyer et al., 2018 a, p.3)

3.6 Wiederstedt

The mass grave of Wiederstedt excavated in 1998 is also worthy of a brief mention. Despite their similarly unceremonious burial, these 10 predominantly young individuals of mixed ages (table 7) revealed no traces of trauma injuries (Meyer et al., 2018 b, p. 26). It is suspected to be a situation where these people had to be buried very quickly and had no time for the right traditions. A serious disease perhaps, poison or natural disaster are plausible theories, though without evidence only lets us speculate over who did the burying. This is not to say that they could not also have seen violent deaths at the hands of others, though the manner would have had to be different as it left no trace on their bones (Meyer et al., 2018 b, p. 26). The bodies were placed in a pre-existing refuse pit (fig 8), as the few pot fragments and animal bones found with the bodies were deemed unintentional (Meyer et al., 2014, p. 314).

This site is useful for understanding a meaning behind ceremoniless burials such as the mass graves mentioned above. The manner of burial is clearly indicative of a refusal or impossibility to treat the dead with the typical tradition.

Figure 8: "B: Wiederstedt (Sachsen-Anhalt), during excavation in 1998. Photo: O. Kürbis; Landesamt für Archäologie und Denkmalpflege Sachsen-Anhalt; after Meyer et al. 2004, 32." (Meyer et al., 2014, p. 313).

Age group	3-6	7-12	18-25	35-45
Number of individuals	3	5	1	1
Sex	Unidentifiable		Male	Female

Table 7: Demographics of those of the Wiederstedt mass grave. (Table by author after Meyer et al., 2014, p. 314)

3.7 Conclusion

These six mass graves are all dated to the late LBK, at the turn of the 5th millennium BCE. They are all an attack on LBK people by one another. Generally uniform is the preference of killing by heavy blows to the back of the head with LBK associated tools, while sometimes also going to the trouble of breaking some limbs. While some are small and select, some contain the bodies of hundreds.

The burial of the victims was never respectfully done in the typical LBK tradition, bodies are left tossed erratically instead of positioned with care, and any kind of grave good is lacking. This strips the bodies of any individuality and personhood making it difficult to know how they would have been buried if not by these circumstances based on social status (Meyer et al., 2014, p. 319). In these instances, it was clearly more important to dispose of the bodies quickly than to provide the appropriate funerary customs (Meyer et al., 2014, p.317).

4. LBK settlement and grave demographics

In the following section I will briefly elaborate on the results of multiple approaches on estimating population size and demographics for the LBK society, which can potentially be applied to the mass graves studied. As mentioned, there are many proxies and different angles to interpreting the demographics, using various data points.

4.1 Houses and inhabitants

An evident starting point is to consider correlating the grave demographics to households of a settlement. Understanding if or how many family units could be present would be a key insight to understanding the demographic representation.

While there are so many LBK sites with houses we know of, there are some controversies that hinder our understanding of settlement composition and size. In short, they are the lifespan of a house and inhabitants per house. LBK sites are excavated as huge clusters of where houses once stood, but to understand which ones existed contemporaneously depends on the lifespan of a house: a hugely debated topic with opinions varying from 20 to 100 years (Hamon & Gomart, 2021, p. 692; Meadows et al., 2019, p. 1654). A case study at Versend-Gilencsa, Hungary, found that all 21 houses had a relatively short lifespan – only 10-20 years (Jakucs et al., 2018, p. 113), despite the potential for the houses to stand much longer given regular upkeep. They assume they are abandoned for cultural reasons rather than practical ones, an opinion that has ethnographic plausibility. Still, the authors stress that this model gave results for only one settlement, and a short lived one at that, and the 20-year maximum should not be assumed throughout the LBK (Jakucs et al., 2018, p. 114). As for the number of inhabitants per household, it could be anything from a family of 6, to a complex agglomeration of 40 related people (Hamon & Gomart, 2021, p. 695). Dubouloz (2008) refines his estimations to having an average hamlet size of 5-7 houses (range of 2-10+ possible), with between 8 and 13 occupants per house, based on 3 different ethnographic studies (Narrol 1962; Casselberry 1974; Cook 1972) of occupant/surface area (Dubouloz, 2008, pp. 210-212). The Dubouloz estimates are most often cited, and we will thus work with an average house size of 10 people during this study.

The settlement at Vráble is one of the largest LBK sites known and contains around 50 contemporaneous houses at any given time, and 70 houses at its peak, assuming a lifespan of 40 years per building (Furholt et al., 2020, p. 472). The settlement is clearly divided in three distinct neighbourhoods (fig 9). Superimposing the average household size of 10 people per house, our settlement population is 500 as a maximum. There are other opinions, as Meadows et al. (2019) only believe a maximum population of 300 to be plausible with a maximum of 30

contemporaneous houses, assuming a lifespan of 25 years per house and only 8.5 inhabitants per house (Meadows et al., 2019, p. 1668). This correlates more closely to the study above (Jakucs et al., 2018) wherein a 25-year house lifespan is generous. The village at Vráble is divided into neighbourhoods as clusters are clearly separated, but the neighbourhoods are also further divided into wards, or hamlets; a close grouping of 4-7 farmsteads that are believed to have closer kinship and economic ties to each other than the rest of the neighbourhood (Hamon & Gomart, 2021, p. 696). This application is further discussed in part 5.1 for the sites at Talheim, Schöneck-Kilianstädten and Asparn-Schletz.

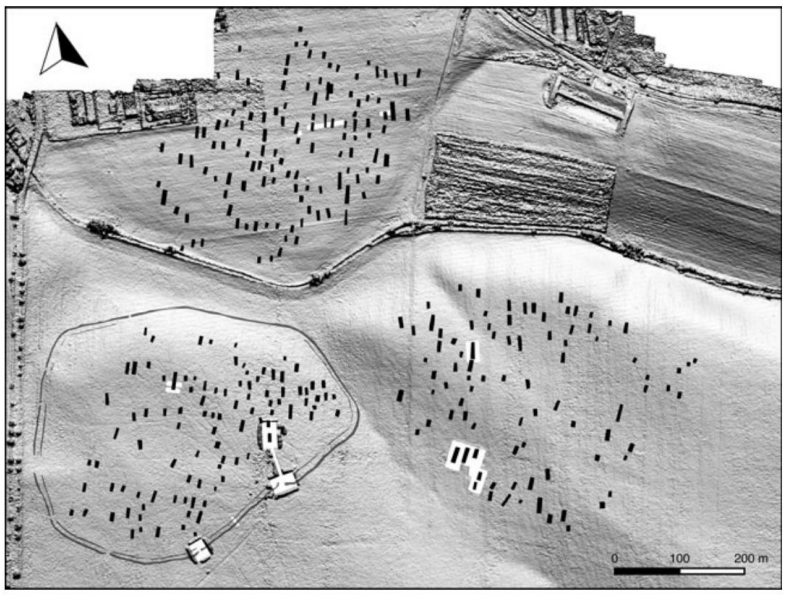


Figure 1. *Reconstruction of the early Neolithic settlement site of Vráble, showing houses and the enclosure system, based on the magnetic plan, projected onto the modern landscape. The figure also shows the position of excavations in the years 2012–17 (in white).*

Figure 9: Map of the 3 neighbourhoods at the settlement at Vráble, Slovakia (Furholt et al., 2020, p. 470). The house plans were not all contemporaneous, but estimations say there were between 30-70 active houses at a time. (Meadows et al., 2019, p. 1668.; Furholt et al., 2020, p. 472).

Though most publications avoid concrete settlement size estimations, it seems most LBK settlements consist of only up to 20 houses at any given time. The vast clusters of house plans had accumulated over settlement lifespans of up to centuries (Hamon & Gomart, 2021, p. 692). Although the LBK are known for their uniformity there is still variability in the size and structure of their settlements (Hamon & Gomart, 2021, p. 700), which allows for large sites like Vráble, and small sites of just one hamlet. This leaves us to deduce a vague population average of 100-200 individuals. It seems then that the majority of the mass graves contain but a fraction of the local population.

It is relevant to remember that the LBK landscape was very well populated. Most settlements were tightly packed and not far from other neighbourhoods. This was by no means an isolated grouping of a few people scattered around. Given the settlement patterns found, it seems the LBK landscape was as densely populated as rural Europe was in the 1800s (Q.P.J. Bourgeois, personal communication, 2021).

Because of the number of constraints and contradictions in data, LBK population reconstructions are almost solely based off modern mathematical demographic models (Hamon & Gomart, 2021, p. 695). Unfortunately, these models often rely on huge datasets or are very much only intended for modern populations. As such, applying these models within archaeology is often very problematic and unreliable, as the number of assumptions and lack of contextual nuance are so high.

Modelling comes in useful in many instances, such as in the change of house surface area over time in Dubouloz (2008) (fig 10). Here a model is made showing clearly how average house size is dependant on the age of the settlement. There are however, also stark differences in contemporaneous house size (the vertical lines) (Dubouloz, 2008, p.219).

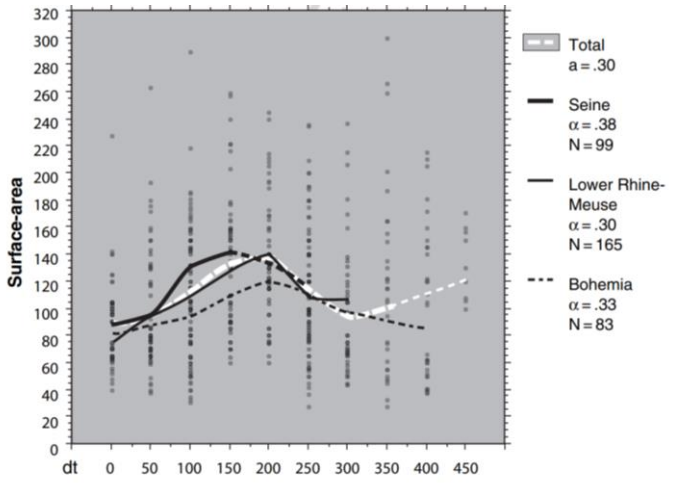


Fig. 4 Surface-area of 433 LBK houses on dt with Lowess smoothing for three principal selections

Figure 10: graph showing the change of settlement size in different areas of the LBK over time. dt=years after original settling (Dubouloz, 2008, p.219)

4.2 Ethnographic comparison

Population size can also be evaluated using the carrying capacity of the area. Often comparisons are made with ethnographic information available from various cultures with similar aspects of living to what we know of prehistoric life.

Chamberlain (2006) strongly supports the use of ethnographic comparison and elaborates on how site by site evaluations can be made based on the environmental factors and lived-in space. Examples would be by assessing the space used per person in a house dictating how many people

fit in a house of certain size, or how many houses of certain size a local environment would support given the used subsistence strategy (Chamberlain, 2006, p. 12).

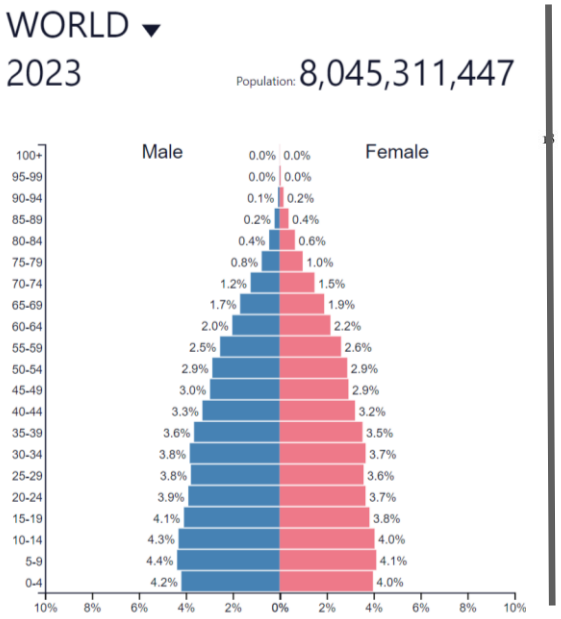
One aspect outside of house structure ethnography can help with is understanding gender roles in the LBK. As it seems young women are underrepresented in the mass graves, it would be beneficial to understand their roles in society at that time. Many studies have been conducted, showing that societies have very different ways of expressing wealth, individuality, and social ties even within patrilineal compositions, which the LBK appears to have been (Bickle & Hofmann, 2022, p. 110). While activities seem sex-determined, females seem to have more freedom in burial tradition and expression. It seems the LBK was less strictly binary than previously believed (Bickle, 2020, p. 212). Views on the gendering of burial goods are also changing, as goods are now believed to not represent the individual's prized possessions, but those of the mourners. As such there is much less gendered association to what goods are appropriate as had been expected in Neolithic cultures (Van Wijk et al., 2021, p.209-210).

These results are typically achieved by taking indirect archaeological data, such as grave goods or mobility patterns given by strontium isotope study and correlating the data with what we know of modern variations of societies to associate the most logical reasoning.

4.3 Archaeological demographics

An added challenge when studying demographics in prehistory is the difficulty in confidently estimating an individual's sex, as well as precisely placing the individual in low-range age groups. Depending on the preservation or taphonomic processes, often one can only differentiate between infants, adolescents, and adults (Chamberlain, 2006). This is not optimal for societal studies as often there are many more age groups with societal distinctions than those three basic ones.

Demographics are often visualised as population pyramids (fig 11), showing the percentage of males and females of a population in 5-year age ranges. While these are very easy to study, they are not suitable in prehistoric archaeological contexts. When age groups cannot be determined so distinctly the bars would cover a very unproportional amount of space. A different model is proposed by Chamberlain (2006) to ease use in archaeological contexts. The 'triangular graph of mortality' (fig 12) only divides the populations into juvenile, prime, and old sections. It can be used to better understand the population dynamics of a local area, which can be applied to study periods of growth, decline, or stability (Chamberlain, 2006, p. 18).



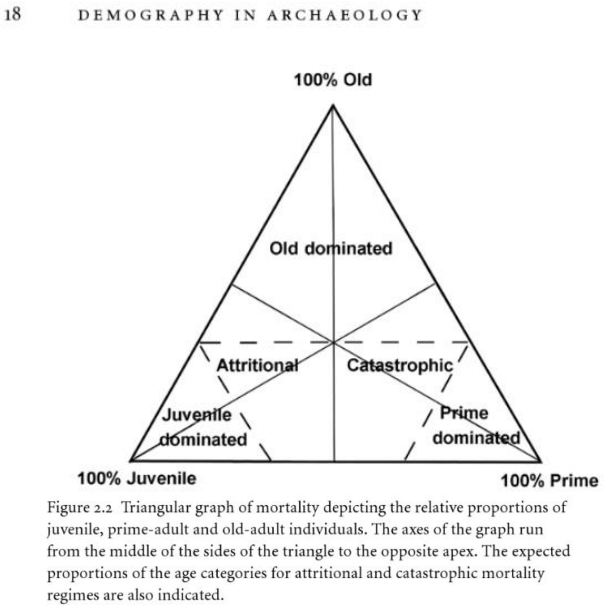


Figure 11: Population pyramid of the world in 2023. https://www.populationpyramid.net/world/2023/

Figure 12: The demographic triangle proposed to demonstrate age demographics in a more archaeologically feasible way (Chamberlain, 2006, p. 18).

With this in mind there are ways of differentiating adult skeletons into smaller age categories, if preservation allows it. Aging is determined by various signs of growth or decay. In youth there are many stages of development, for example in skull sutures or tooth eruption (White & Folkens, 2005, p. 365; p. 369). After puberty it becomes more difficult to assess age, as the rate and degree of decay is dependent on the health and occupation of the individual and thus imprecise (White & Folkens, 2005, p. 361). In the case studies below, often 10-year ranges are made, as accurately as possible. It is important to note that the estimations are exactly that; an educated guess where the majority of traits indicate the likelihood of a certain age group.

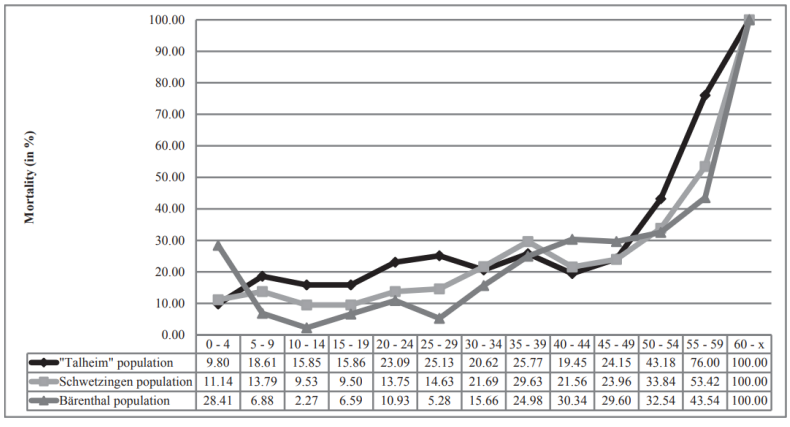
There may not be as many possible answers when estimating sex, but this also relies on the presence of bones with the specific features to analyse, usually the skull and pelvis (White & Folkens, 2005, p. 386). While estimating sex of children is too unreliable, adults show more reliable differences, often in size, weight, or structure of certain features (White & Folkens, 2005, p. 386). Unless DNA analysis is involved it is impossible to determine without a doubt that a skeleton is of a certain sex. And this does not even begin to cover the estimation of a skeleton's gender, a completely societal aspect, not a biological one.

It is with this information that I show the age and sex estimations on which the basic data for comparison is composed is imprecise when it comes to estimating age and can be inaccurate when

it comes to estimating sex. Usually, sex can be estimated with 80% accuracy (White & Folkens, 2005, p. 386) but this includes studies that have lots of comparative samples from the same context or population. The LBK mass graves are often commingled as they were lain erratically over each other, which further adds a layer of difficulty.

4.4 Cemetery populations

We are not limited to studying the areas of the living to study population size. Cemeteries are frequently used to judge how populated an area was. One method models estimates of stable living population dynamics with the 'population and cemetery simulator'. The principles are greatly detailed in (Düring & Wahl, 2014), but in short it models a network of generations being born, aging, and dying, counting the number of alive (living population size) to dead (dead population size) people. This pattern was predicted using life tables, which "explore the effects on survivorship of age specific probabilities of death" (Chamberlain, 2006, p. 27). When analysing the Talheim death pit, they found an incredibly strong match and say that while there can of course be a few individuals of a family unit missing, it would be a great coincidence considering how well the data fits (fig 13) (Düring & Wahl, 2014, p. 463). Unfortunately, due to the many parameter constraints only Talheim and Schöneck-Kilianstädten are feasible mass grave sites for study through this method. Schöneck-Kilianstädten is predicted to have an incredibly similar match to a full representation of nuclear households as well, though an underrepresentation in adult women is acknowledged (Düring & Wahl, 2014, p. 461).



	0 - 4	5 - 9	10 - 14	15 - 19	20 - 24	25 - 29	30 - 34	35 - 39	40 - 44	45 - 49	50 - 54	55 - 59	60 - x
"Talheim" population	9.80	18.61	15.85	15.86	23.09	25.13	20.62	25.77	19.45	24.15	43.18	76.00	100.00
Schwetzingen population	11.14	13.79	9.53	9.50	13.75	14.63	21.69	29.63	21.56	23.96	33.84	53.42	100.00
Bärenthal population	28.41	6.88	2.27	6.59	10.93	5.28	15.66	24.98	30.34	29.60	32.54	43.54	100.00

Fig. 6. Mortality structures based on life-table calculations of all three skeletal samples.

Figure 13: Graph comparing the mortality rates of Talheim, Schwetzingen, and Bärental. The Talheim population is noted to closely match the living population sample of Bärental, and less so the cemetery population at Schwetzingen, further affirming a single event killing the Talheim population (Düring & Wahl, 2014, p. 456).

4.5 Environmental studies

Multiple environmental proxies indirectly provide insight to the population size as they look at anthropogenic influence on the environment and relate environmental shifts to a change in subsistence strategy, technology, or population size. Often a stronger effect on the landscape means a higher population size. These environmental studies are clearly useful in establishing a base idea or further validating or supporting the pre-established hypotheses.

An example of application is the paper by Feeser et al. (2019), who used palynology and soil erosion to establish population 'boom and bust' phases in the northern European Neolithic. While subject to localised variation they found clear overall periods of growth or decline, though this is not synonymous with a maximum or minimum population. Unfortunately, their studies do not quite overlap with the time period of the mass graves. While these methods are no doubt valuable, they remain too large scale for the very local focus of the few mass graves with their local environments.

Population density is relevant in our analysis, especially as population pressures are suggested to be the precursor to the eruption of violent scenes in the late LBK. The LBK was fairly densely populated, though only on their preferred grounds. With their strong adherence to loess soils, LBK settlements are almost guaranteed to be found on the fertile land (Fontijn, 2021, p. 16), with many neighbourhoods. A comparison of settlement layout and density can be seen at Elsoo (fig 14), where the LBK settlements -houses not farmland, are mapped out over the modern towns and neighbourhoods (Van Wijk, 2022, p. 26).

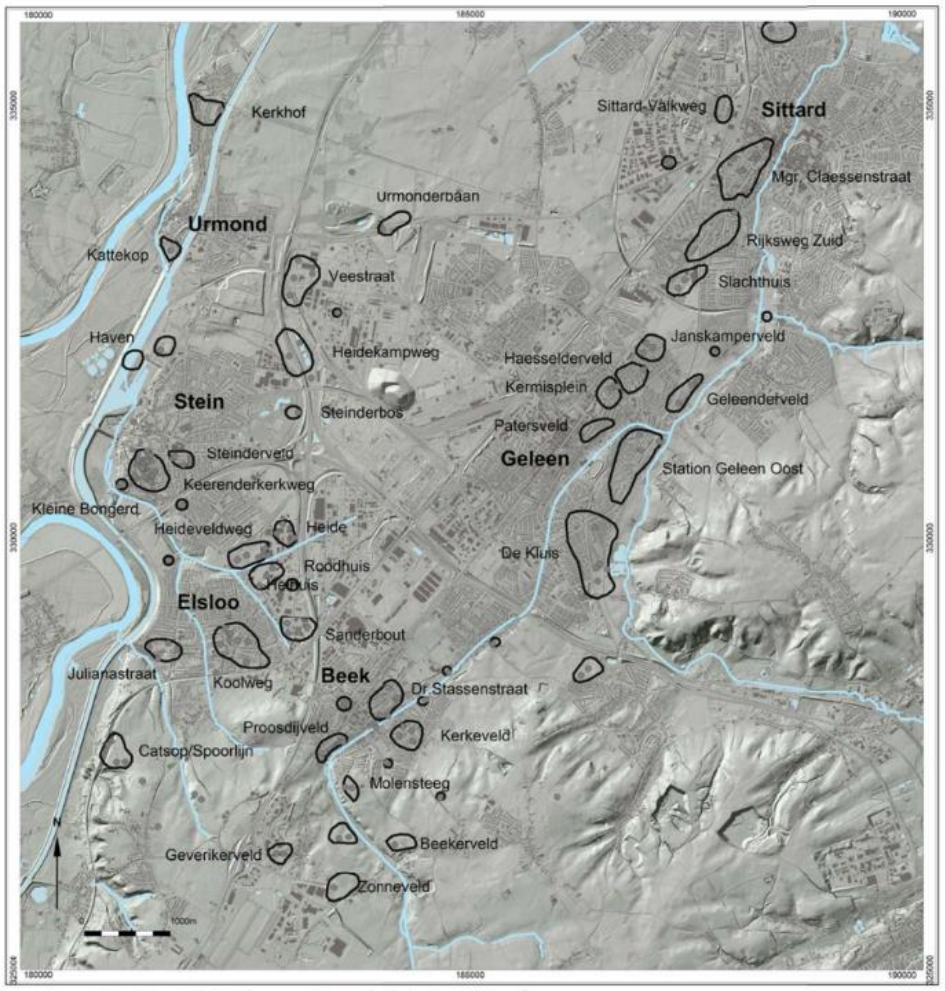


Fig. 2.3 Known LBK settlements with their presumed dimensions in the Graetheide region.

Figure 14: Example of settlement density in the Netherlands (Van Wijk, 2022, p. 26).

4.6 Conclusion

Through various methods we can correlate the demographics of those in the mass grave to those of a reconstructed settlement population. Though variable, the average LBK settlement through various means of examination seem to sustain roughly 20 households with family units of around 10 people (Dubouloz, 2008, pp. 210-212). The whole unit acts as one community, though closer clusters of wards of 4-7 houses are more socially close and dependent on each other (Hamon & Gomart, 2021, p. 696). These insights are all relevant in assessing the demographics in the LBK mass graves.

5. Relate mass graves to settlement populations

5.1 Demographic comparisons and insights

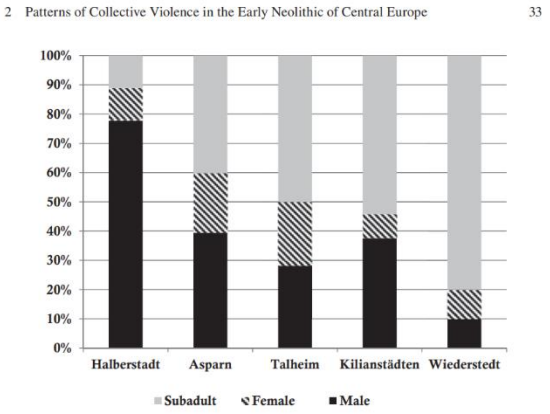


Fig. 2.4 Relative demographic structure of the mass fatality sites discussed in the text; only precisely age- and sex-determined individuals have been included in the graph. The category "subadult" is used in the biological sense and includes all individuals below the age of *c*.20 years. This is not necessarily consistent with social understandings of this age group in LBK society (Image: Christian Meyer)

Figure 15: Overview of the sex estimations represented in each of the mass graves discussed, excluding Herxheim (Meyer et al., 2018 b, p. 33).

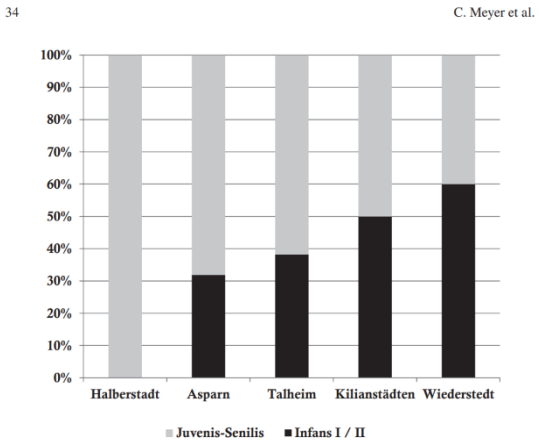


Fig. 2.5 Percentages of younger children (age classes *infans* I and II) in relation to older individuals from the mass fatality sites discussed in the chapter. Only precisely age-determined individuals have been included in the graph (Image: Christian Meyer)

Figure 16: Overview of the percentage of juvenile and older to children at all the mass graves discussed, excluding Herxheim (Meyer et al., 2018 b, p. 34).

To draw some clear comparisons between the sites studied I will discuss what we can and cannot interpret when it comes to the settlement representation and the likelihood of ritual violence. The graphs above (fig 15 & 16) demonstrate the variation in demographics of all the mass graves discussed – excluding Herxheim. The table below (table 8) recaps the demographic information for each site – excluding Herxheim.

Table 2.1 Demography of the mass fatality sites discussed in the chapter. Age and sex data have been compiled from the literature cited herein (the few individuals lacking reliable age and sex determinations are not included in the table)

Site	Inf. I	Inf. II	Juv.	Ad. Male	Ad. Female	Mat. Male	Mat. Female	Sen. Male	Sen. Female
TH	7	6	3	7	4	2	3	1	–
AS	12.5	8.5	5.5	16.5	5	9.5	8.5	–	–
KS	10	2	1	9	–	–	2	–	–
WS	1	5	2	1	1	–	–	–	–
HS	–	–	1	7	1	–	–	–	–

TH Talheim, *AS* Asparn/Schletz, *KS* Schöneck-Kilianstädten, *WS* Wiederstedt, *HS* Halberstadt. Age classes are those commonly utilised in continental Europe (e.g. Herrmann et al. 1990). *Inf.* infans, *Juv.* juvenis, *Ad.* adultus, *Mat.* maturus, *Sen.* senilis

Table 8: Overview of age classes in all aforementioned mass graves, excluding Herxheim (Meyer et al., 2018 b, p. 31).

Talheim

Seeing as the Düring population simulation (see 3.3.2) strongly suggests that the people buried here reflect "*two to four farmsteads of a functioning living community*" (Düring & Wahl 2014, p. 463) due to the practically perfect match to a living population demographic, this would mean the Talheim 'hamlet' consisted of 4 family units – 34 people in total. This coincides with surveys of the area allowing space for 4-5 houses, with the assumption of 6-8 inhabitants per house (Wahl & Trautmann, 2012, p. 93). Furthermore, our assumption of 10 people per house still shows 3-4 households. The individual's relations to one another are further supported by ongoing genetic research (Zeeb-Lanz & Haack, 2016, p. 250). We can suppose this was a locally distinct separation of around 4 longhouses in tight knit ward, that acted self-sufficiently to neighbouring people (Hamon & Gomart, 2021, p. 696). Interactions between these neighbourhoods are known, as traditions and trade showed commonality and persistence over long geographical distance. Given the universal nature of the killing of those in the Talheim death pit, we can assume these 34 people were seen as one unit, though we can only speculate the reasons why particularly this unit was targeted.

As mentioned, there are not as many underrepresented women as in other mass graves, in female to male ratio (fig 15). This is still a notable difference, and we must assume these women were a part of the population composition but were not buried with them. The details hypothesising their abduction rather than absence is detailed in section 6.1. We see a 60/40 representation of adult to subadult (fig 16), which ties in with the stable population size interpretations seen (Düring & Wahl 2014).

The Talheim massacre appears to closely resemble the actions of a raid. A manageable population is targeted and killed by blows to the head, with few other injuries. Blunt weapons and arrows surprise the victims from behind, before they can act in defence (Zeeb-Lanz & Haack, 2016, p. 251). Their bodies, and perhaps hamlet, were plundered and the dead buried shortly after death (Wahl & Trautmann, 2012, p. 88). The most likely cause seems to be result of a feud or competition, though that alone does not account for all the circumstances.

Schöneck-Kilianstädten

Given the demographic information and literature provided so far, the results at Schöneck-Kilianstädten will be incredibly similar to that of Talheim (Meyer et al., 2015, p. 11220). The demographics in the grave should thus represent a full living population size, probably consisting of 3 or 4 family units. There is a notion of missing- likely abducted, young/teenage women (Meyer et al., 2015, p. 11221).

Indeed, when comparing Talheim – which we can believe to represent full households, with Schöneck-Kilianstädten, the similarities in youth to adult ratio are clear. While the male to female ratio is near 50/50 for Talheim, Kilianstädten clearly has far fewer women at around 1/5 of the number of men (see also fig 15). This has led archaeologists to believe they were abducted rather than killed, likely for marriage, as environmental and social stresses were leading to a crisis in expansion and diversification (Meyer et al., 2018 b). There are of course other explanations, such as escape or different means of burial, though these are less well-rounded arguments.

There is a settlement of up to 18 houses by the pre-existing ditch which became home to the 26 victims (Meyer et al., 2015, p. 11218). This of course is more than the 3/4 longhouses expected to correspond to the 3/4 family units. Although we must acknowledge that the 18 houses likely did not stand contemporaneously, and the studies are lacking to suggest how many would have been inhabited at the same time. Here, we have to ask ourselves again if only a dedicated portion of a village would have found themselves in fatal trouble, or by which means they may have been separated from the rest of the community. There is little information on the village structure, it could provide some insights if perhaps these 4 longhouses were geographically or socially separated from the 17 as a larger whole. A cemetery is also found at Kilianstädten (Schwitalla and Schmitt 2006, in Meyer at al., 2014, p. 316), though it is believed to have no direct association to the mass grave.

The settlement remained inhabited after the attack (Fontijn, 2021, p. 21) but whether it was lived in by the same community or if foreign attackers moved in is unclear. Given the additional wounds to the face and in breaking legs, it seems the individuals were more caught up in a fight rather than a swift attack (Meyer et al., 2015, p. 11221). On the other hand, the lack of parry fractures might suggest a different story of sacrifice. It seems unclear whether to describe this killing as part of a raid or a sacrifice. Zeeb-Lanz & Haack (2016) argue for a tendency of sacrifice over feud, especially at Schöneck-Kilianstädten, as there is clear mutilation. The act is not simply about killing the victims, but in mutilating them, shows more malicious intent.

Asparn-Schletz

Though not fully excavated, if we take the assumption of 10 people per household, we see a clear representation of at least 7 households worth of people at Asparn-Schletz. On its own, these hypothetical 7 houses would represent a large hamlet, according to estimations made by Dubouloz (Dubouloz, 2008). Given that there are more bodies to excavate though, this site could possibly reveal a full settlement demographic. Going with the data that Asparn-Schletz is 20% excavated (Teschler-Nicola, 2012, p. 105), and a total estimation of 200 individuals at the site (Zeeb-Lanz & Haack, 2016, p. 251), we may end up with 30 households, if the demographics remain at a similar representation. While it is also unclear exactly how many houses typically make an LBK settlement, our population estimations average around 100-200 people. While it is too soon to say for certain, this site has the potential to truly represent the massacre of an entire large settlement.

Asparn-Schletz again has similar demographics to Talheim and Schöneck, and while the male to female ratio is not as drastically stark as in Schöneck-Kilianstädten, there are half as many women as men (fig 15). We can likely assume the same happenstance of selective abduction here, as was discussed for Schöneck-Kilianstädten. There are fewer children at Asparn than the Talheim or Schöneck graves (fig 16), but it remains unclear if this would be because of further abduction or a decline in population size at the time, leading to fewer childbirths (Teschler-Nicola, 2012, p. 117). Preservation could also play a role here.

This site could represent another fatal raid, this one more widespread and brutal, as it could be the entire settlement, a population of 300, that was slaughtered for yet unclear reasons. The lack of self-defence is an aspect that makes the whole thing more difficult to understand. Is there a ritual aspect to the skull nests, beside bodies that have lain unburied in the ditch they died in? Why did the victims not defend themselves – surely they would have had the chance to? It is yet unclear if this act of violence was under war-like or ritual circumstances, over resources or ideals. In any case, an otherness within the LBK is becoming clear.

Halberstadt & Wiederstedt:

Due to likely very different circumstances, Halberstadt and Wiederstedt are heavily distinguished from the Talheim-Schöneck-Asparn semblance of consistency. Halberstadt consists almost entirely of adult males, while Wiederstedt is near solely subadult. While different, these sites both represent a clear choice in who is targeted. This indicates a change in intent and purpose of the situations. It is more difficult in these cases to argue the violence is caused by environmental

pressures. Social challenges and inter-personal conflict would arguably play a much larger role here. Neither of these cases have enough bodies to be able to reconstruct the size of their communities, but it is evident that they do not represent households as the other mass graves did. Potentially, if we assume the 9 young men at Halberstadt originate from the same community, we could match that with the 7 young men from Talheim and superimpose that their community may be more or less of the same size – 34+ individuals in 4-5 households. This is certainly not substantial evidence, and we will likely never know who these victims at Halberstadt represent. It is then the burial manner that links these two sites to the rest of the mass graves. The victims at Wiederstedt may not even have died a violent death, yet their fast burial was the important factor, lacking in all traces of material funerary customs (Meyer et al., 2014, p.317).

Herxheim

It is clear from the basic context that Herxheim does not represent the killing of a full community, and it is hardly described as such. There are far too many bodies of many different origins (Zeeb-Lanz & Haack, 2016, p. 259). The fact that they do not bear the same signs of trauma (Orschiedt & Haidle, 2012, p. 129), these bodies are further set apart from the rest. The people who wound up in these graves must have died and been buried under very different circumstances to those of all the other mass graves.

Using the demographic table seen earlier (table 5) it appears that while children and adolescents were by no means excluded from these graves, they are very few compared to the number of adults identified. This further breaks the pattern of family units being targeted. A different selection process must have taken place. As the bones are so commingled very few were able to be adequately sexed, leaving us with 12 males and 12 females, but 300 indeterminate individuals (table 5). We cannot with this information add any insight to the possibility of differential treatment based on sex.

Though there is a settlement associated within the ditches lined with bodies, they are not believed to be the lived-in farmsteads all other houses discussed were. Rather, the entire site complex is referred to as a ceremonial centre. The ten houses within would not have held more than 100 people at any given time (Zeeb-Lanz & Haack, 2016, p. 259). It is this ritual aspect, and number of individuals deposited as if they were waste among broken pots and tools (Zeeb-Lanz & Haack, 2016, p. 258) that truly sets the Herxheim mass grave apart from the rest.

5.2 Discussion

It seems then that all but one of the LBK mass graves cannot represent an entire community as they all wildly underrepresent the number of people per settlement. What is likely however, when looking at the more demographically fully representative sites (Talheim, Schöneck and Asparn), is that the killing was aimed towards one ward of a settlement, as 4-7 complete households are murdered in various ways. Something would have separated that tight-knit group from the rest that justified the killing of all infants, adults, and elderly members of those family units.

But if it is not a full settlement being wiped out, why were only specific households or people targeted, and what happened to the rest of the inhabitants of the neighbourhood? Could the murder of the wards in Talheim and Schöneck-Kilianstädten have been an interpersonal conflict between those few families and the rest of the settlement, not outsiders looking for easy plunder? This may give an explanation to the sites closer resembling ritual executions in their lack of defence, controlled killing, and odd deposition. Zeeb-Lanz & Haack (2016) are certainly in favour of this, entertaining the likelihood of the bodies being "used as props" in ritualised violence, rather than a spiteful violent crime (Zeeb-Lanz & Haack, 2016, p.265-268).

While at Asparn-Schletz the deposition and violence maintain the same ritualistic semblance, the scale implies different circumstances. If it could not be the majority of the community turning against a specific group, it appears to be a large-scale raid by one or more communities outside of this site.

The other sites are too unique to group within this same explanation. Here the selection of individuals is more targeted to one age group, and it is the burial manner that is the common link between the sites.

6. Further Discussion

Though the demographic information has now been discussed, the other elements of the LBK mass graves will be summed up for a more complete understanding of the study.

6.1 Missing young women?

The underrepresentation of women in many of these mass graves is something I want to come back to and finalise my thoughts on. The investigation of potentially abducted women during these raids is clearly an intriguing theory that gained traction recently. It would allow archaeologists to build a fuller story, as the implications, causes, and intentions behind the massacres can be adjusted more clearly if factoring in female abduction. There is however, little way of verifying which theory explaining the underrepresentation is correct. The best we can do at this time is entertain a few ideas and acknowledge their absence.

Teschler-Nicola particularly, is in favour of the abduction theory, as it best explains the underrepresentation, especially in the context of the failing societal structure and difficulty during the late LBK expanding and forming new relations (Teschler-Nicola, 2012).

"*This was probably followed by forced inclusion into the attacker's own communities, although the further fate and status of these women remains unknown. The selective capture of women is currently the most likely explanation for the imbalanced adult sex ratios encountered at Talheim, Asparn-Schletz, and Schöneck-Kilianstädten, which also contain numerous subadult individuals who were violently killed just like the adults.*" (Meyer et al., 2018 b, p. 32).

Being in a likely patrilocal society where women were the ones who moved around far more than men this would match the abduction of women for marriage. However, it is also important to note that just because isotopes say women moved about (Knipper et al., 2017; Haak et al., 2008) does not mean strict marriage and kinship configurations. There are many ethnographic examples that demonstrate various roles and rights of individuals in patrilocal and matrilocal social organisations (Bickle & Hofmann 2022, p. 110).

There are of course other possible explanations for the missing demographic. It is entirely plausible that a certain group of people was absent from the site at the time of the massacres. As we can believe that different everyday activities in the LBK were conducted by certain members of society (Bickle & Hofmann, 2022, p. 210), whether differentiated by age or sex, it could be that the ward's young women were occupied outside the bounds of the farmstead and managed to escape. This becomes more difficult to substantiate though when at all three cases in the Talheim-Scöneck-Asparn massacres, it is always young women who are missing. If it came down to the location of

group activities one would expect a variety of demographic groups to have gone missing per site.

The underrepresentation of women of reproductive age is an evident factor in the overall similar mass graves of Talheim, Schöneck-Kilianstädten, and Asparn-Schletz. There seems to be a lot of merit in believing they were abducted by the attackers in the events that ended in the massacre of multiple full households of people. It is not applicable to the remaining 'outlier' sites of Halberstadt and Wiederstedt as a particular demographic is targeted over a household. The case for missing women is yet unclear at Herxheim, considering the amount of commingled bones and difficulty determining their sex.

6.2 Why the violence?

Given the multiple societal and ecological reasons contributing to the collapse during the end of the LBK (Fontijn 2021) it must follow that a strong societal shift changed the ways of life. It seems distinct change in behaviour instigated the normalisation of violence towards others. Competition over resources certainly would have played a role, as fewer natural sources become available. However, a certain ritual aspect of the killings, clear in the manner of murder and deposition, cannot be overlooked. As aforementioned; it is unsurprising for end of era revolutions to cause massive shift/intensification of symbolism and ritual (Zeeb-Lanz & Haack, 2016, p. 268), which would explain how a certain behaviour became a part of everyday life. The people who lived in the late LBK were acutely aware of their stresses and cultural changes.

It is often assumed that continuity is the default stable state of society, and that change is only a response to crisis. According to Hofmann (2016) we ought to consider both continuity and change with all their nuances on varying scales of analysis to gain full understanding. They say diversity does not only occur when forced, and that we need to use caution when equating material culture uniformity with social cohesion (Hofmann et al., 2016, p 13). With this in mind it becomes clear that the collapse of the uniform LBK into separate regionalised cultures, may have begun much longer before the material culture had shifted, by identifying themselves differently to their neighbours.

A degree of othering neighbours and increased symbolism then seem to have allowed these people – who were very aware of the crisis surrounding them, to change their perspectives and on some occasions justify a raid, massacre, and/or ritual sacrifice on their 'fellow people'.

It would be worthwhile to note here that in the 600 years of continuing expansion throughout Europe there is little evidence to say that the settling farmers had any large dispute with the already present hunter-gatherers. All the mass graves provide evidence for LBK-LBK conflict, and

very little LBK-hunter-gatherer conflict (Vanmontfort, 2008, p. 159). This reveals that something in the mindset of these people had also changed over time, where one would expect the spread of the LBK to be considered an invasion involving attacks on the indigenous, this was not the case. As the LBK moved in they seemed to stay out of each other's way, and out of conflict for the most part. Once faced with many obstacles triggering a collapse of their way of life, they take it out amongst themselves.

Otherness is also shown late LBK in settlement structures as enclosures and ditches around neighbourhoods becomes common, and more variety in burial type is known (Furholt et al., 2020). This is a general trend among the LBK, not only associated with mass grave massacre sites. An example in Vráble, Slovakia describes three large yet distinct neighbourhoods of 70 contemporaneous farmsteads at its peak, where one of them clearly sectioned itself off from the others in the late LBK. The southwestern neighbourhood built a palisade and ditch system around itself with entrances far from the other neighbourhoods, indicating a deliberate othering (return to fig 9). Also, different burial forms are found in this area, as bodies of differing status (some headless and meaningfully arranged) are buried in and around the ditches (Furholt et al., 2020). It is also notable that there is no evidence of violent killing of these buried individuals as in the mass graves discussed above.

A further aspect to consider is how these sites are (almost) all located in modern Germany. The LBK reached so much further, yet mass graves are yet to be found outside this central area. While it surely is possible some simply have not been discovered yet, it seems plausible to argue a regional distinction with in the LBK where this rise of violence took place. It could be possible that the increased, symbolic violence was a regional adaptation that other areas didn't have to go through.

On a similar note, the violence did not end with the fall of the LBK, as there are many further examples in later periods. Multiple Tripolye mass graves (5500-2750 BCE) show similar tendencies, as well as Corded ware mass graves such as Eulau (Germany) and Koszyce (Poland) (3000-2350 BCE) (McClure et al, 2020). Both of these observations further substantiate the idea that the appearance of mass graves and mass violence are not to be strictly associated with the downfall of a society. They can be a consequence of societal stresses leading up to a culture's collapse but should not be treated as a causal factor. It must be said however, that this violence was "*not integral to the functioning of that society*" (Fontijn, 2021, p. 26) as neither the early LBK, nor the succeeding cultures show similar levels of defence structure or mass intra-personal violence are known (Fontijn, 2021, p. 26).

6.3 Ritual symbolism?

As mentioned, a certain ritual aspect to the massacres cannot be overlooked. Multiple sites discussed suggest more meaning behind the killings than a mere raid to eliminate competition as previously presumed. The inhabitants of the Talheim, Schöneck-Kilianstädten and Asparn-Schletz settlements did not show signs of defence when their time came. The lack of parry- fractures (blows to a body in a position of defence) is incredibly suspicious and "*supports the notion of a surprise attack, or one by a far superior force, which could have encouraged the victims to flee rather than fight back* (Wahl and König 1987, Wahl and Trautmann 2012)" (Meyer et al., 2014, p. 313). With this in mind, other explanations to the graves have been offered. For example, it has also been suggested that the Talheim massacre could be an execution of a group of prisoners by those living at Talheim (Narr 1993 in Zeeb-Lanz & Haack, 2016, p. 266). Such theories can of course not easily be proven. The example of Halberstadt proves that there were also instances of clear controlled killings. This raises different contextual nuances to consider when investigating the causes, intentions and procedures of these events.

Either way, a certain regionalisation and otherness across LBK is evident, especially towards the end of the 5th century. The implication of the dead being used as 'others' in ritual further strengthens this idea (Zeeb-Lanz & Haack, 2016). Similar aspects are suggested for Herxheim: "*the human bodies were also treated as objects and not as persons, as like the other artefacts they were broken into fragments and then deposited as "ritual refuse". Herxheim must have been the location of a special ritual which concentrated on the destruction and discard of precious objects*." (Zeeb-Lanz & Haack, 2016, p. 258).

Skull nests are a common feature in Herxheim and Asparn-Schletz yet lacking in the others. With Asparn being so closely related to the Talheim and Schöneck burials though, it is still unclear where the overlap is. The meaning of the variation in burial manner is still not fully understood here. By definition all the mass graves see ceremoniless burial, but not all are necessarily careless. A point is being made of not adding appropriate grave goods or of laying the bodies in the appropriate positions. Yet on the other hand care is being taken in some cases to place skull caps together for example.

7. Conclusion

It is important to remember that these mass grave sites are only found in one region of the LBK, and that the increase in violence may only have been regional and not a universal factor in the collapse of the LBK culture. That being said, LBK mass graves remain the first instances of extreme violence toward others at such scale. These types of massacres do not end with the LBK, as there are many examples within the European Neolithic that show similar treatment (ex. Eulau or Koszyce). Thus, the link between mass violence and the fall of societies should not be as strong a correlation as previously made.

Under the rise of othering others and ritual in a changing world, several explanations for the circumstances and intent of the late LBK mass graves have been given. Talheim appears as a swift murder of around 4 complete family units in raid-like circumstances. Schöneck-Kilianstädten again represents 3 or 4 family units killed by broken limbs and head trauma. They did not seem to have defended themselves and many young women were removed from the site. Asparn-Schletz shows the potential for representing a full settlement, as it is yet not fully excavated. The occupants of at least 8 households were massacred and tossed into the ditches at the entrance of the settlement. Again, there are few signs of self-defence and young women are underrepresented. Herxheim is an extreme case for ritual deposition as hundreds of bodies lie in commingled arrangements. People of various origins and post-death treatments are broken and discarded among other items like pottery and animal bones. Halberstadt shows variety in the targeting of violent behaviour, as here, 9 young men were selectively murdered in similar style to the other mass burials. Wiederstedt allows speculation to the symbolism behind being unceremoniously buried in a mass grave, though the cause of death is unknown for these 10 young individuals.

In sum, we need to reframe our beliefs on the implications of the LBK mass graves. While they might be the first representations of mass violence we have found, even mass graves within the LBK cannot be seen as uniform. They have different causes and compositions and are not as related as previous archaeologists have claimed. They also do not fully represent the slaughter of entire settlements as previously thought, rather occasionally represent the killing of a few full households. These houses are not the full composition of the settlement, as indications of population size and typical house numbers for the LBK do not match.

Bibliography

Amkreutz, L., & van der Velde, P. (2017). A world ends: the demise of the northwestern Bandkeramik. In H. Kamermans, C. Bakels (Eds.), *Analecta Praehistorica Leidensia 47* (pp. 19-36). Leiden University.

Bickle, P. (2020). Thinking gender differently: new approaches to identity difference in the central European Neolithic. *Cambridge Archaeological Journal*, *30*(2), 201-218. doi:10.1017/S0959774319000453

Bickle, P., & Hofmann, D. (2022). Female Mobility Patterns in prehistory: Patrilocality, descent and kinship of the Linearbandkeramik (LBK). In *D'Oberlarg à Wesaluri, itinéraire d'un préhistorien.: Mélanges offerts à Christian Jeunesse* (pp. 105-122). AVAGE.

Bocquet-Appel, J. P., Moussa, R., & Dubouloz, J. (2014). Multi-agent modelling of the Neolithic LBK. *Computers Applications & Quantitative Methods in Archaeology*, *42*, 611-622.

Chamberlain, A. (2006). *Demography in archaeology*. Cambridge University Press.

Dubouloz, J. (2008). Impacts of the Neolithic demographic transition on Linear Pottery Culture settlement. In J. P. Bocquet-Appel & O. Bar-Yosef (Eds.), *The Neolithic demographic transition and its consequences* (pp. 207-235). Springer.

Duering, A., & Wahl, J. (2014). A massacred village community? Agent-based modelling sheds new light on the demography of the Neolithic mass grave of Talheim. *Anthropologischer Anzeiger*, *71*(4), 447-468. DOI: 10.1127/anthranz/2014/0450

Feeser, I., Dörfler, W., Kneisel, J., Hinz, M., & Dreibrodt, S. (2019). Human impact and population dynamics in the Neolithic and Bronze Age: Multi-proxy evidence from north-western Central Europe. *The Holocene*, *29*(10), 1596-1606. https://doi.org/10.1177/0959683619857223

Fontijn, D. R. (2021). Give peace a chance: on violence and warfare in prehistory and why it matters. Huizen: J. Bout & Zn. https://hdl.handle.net/1887/3256989

Furholt, M., Müller-Scheeßel, N., Wunderlich, M., Cheben, I., & Müller, J. (2020). Communality and discord in an Early Neolithic settlement agglomeration: The LBK site of Vráble, Southwest Slovakia. *Cambridge Archaeological Journal*, *30*(3), 469-489. doi:10.1017/S0959774320000049

Hachem, L. (2018). Animals in LBK society: Identity and gender markers. *Journal of Archaeological Science: Reports*, *20*, 910-921. https://doi.org/10.1016/j.jasrep.2017.09.020

Hamon, C., & Gomart, L. (2021). Social Rules and Household Interactions Within the LBK: Long-Standing Debates, New Perspectives. *Open Archaeology*, *7*(1), 690-704. https://doi.org/10.1515/opar-2020-0158

Hofmann, D., Amkreutz, L., Haack, F., & van Wijk, I. (2016). Introduction: Diversity and Uniformity in LBK studies. In L. Amkreutz, F. Haack, D. Hofmann, & I. van Wijk (Eds.), *Something Out of the Ordinary? Interpreting Diversity in the Early Neolithic Linearbandkeramik and Beyond* (pp. 3-33). Cambridge Scholars Publishing.

Jakucs, J., Oross, K., Bánffy, E., Voicsek, V., Dunbar, E., Reimer, P., ... & Whittle, A. (2018). Rows with the neighbours: the short lives of longhouses at the Neolithic site of Versend-Gilencsa. *Antiquity*, *92*(361), 91-117. https://doi.org/10.15184/aqy.2017.218

Knipper, C., Mittnik, A., Massy, K., Kociumaka, C., Kucukkalipci, I., Maus, M., Wittenborn, F., Metz, S. E., Staskiewicz, A., Krause, J., & Stockhammer, P. W. (2017). Female exogamy and gene pool diversification at the transition from the Final Neolithic to the Early Bronze Age in central Europe. *Proceedings of the National Academy of Sciences*, *114*(38), 10083-10088. https://doi.org/10.1073/pnas.1706355114

Meadows, J., Müller-Scheeßel, N., Cheben, I., Agerskov Rose, H., & Furholt, M. (2019). Temporal dynamics of Linearbandkeramik houses and settlements, and their implications for detecting the environmental impact of early farming. *The Holocene*, *29*(10), 1653-1670. DOI: 10.1177/0959683619857239

Meyer, C., Knipper, C., Nicklisch, N., Münster, A., Kürbis, O., Dresely, V., ... & Alt, K. W. (2018). Early Neolithic executions indicated by clustered cranial trauma in the mass grave of Halberstadt. *Nature Communications*, *9*(1), 2472. https://doi.org/10.1038/s41467-018-04773-w

Meyer, C., Kürbis, O., Dresely, V., & Alt, K. W. (2018). Patterns of collective violence in the Early Neolithic of Central Europe. In A. Dolfini, R. J. Crellin, C. Horn, & M. Uckelmann (Eds.), *Prehistoric warfare and violence, Quantitative and Qualitative Approaches* (pp. 21-38). Springer International Publishing. https://doi.org/10.1007/978-3-319-78828-9_2

Meyer, C., Lohr, C., Gronenborn, D., & Alt, K. W. (2015). The massacre mass grave of Schöneck-Kilianstädten reveals new insights into collective violence in Early Neolithic Central Europe. *Proceedings of the National Academy of Sciences*, *112*(36), 11217-11222. https://doi.org/10.1073/pnas.1504365112

Meyer, C., Lohr, C., Kürbis, O., Dresely, V., Haak, W., Adler, C., ... & Alt, K. W. (2014). Mass Graves of the LBK. In A. Whittle & P. Bickle, (Eds.), *Early Farmers: The View from Archaeology and Science* (pp. 307-325). Oxford University Press.

Orschiedt, J., & Haidle, M. N. (2012). Violence against the living, violence against the dead on the human remains from Herxheim, Germany. Evidence of a crisis and mass cannibalism. In R. Schulting, & L. Fibiger (Eds.), *Sticks, stones, and broken bones: Neolithic violence in a European perspective* (pp. 121-137). Oxford University Press.

Price, T. D., Wahl, J., & Bentley, R. A. (2006). Isotopic evidence for mobility and group organization among Neolithic farmers at Talheim, Germany, 5000 BC. *European Journal of Archaeology*, 9(2-3), 259-284. DOI:10.1177/1461957107086126

Saqalli, M., Salavert, A., Bréhard, S., Bendrey, R., Vigne, J. D., & Tresset, A. (2014). Revisiting and modelling the woodland farming system of the early Neolithic Linear Pottery Culture (LBK), 5600–4900 BC. *Vegetation history and archaeobotany*, *23*, 37-50. DOI 10.1007/s00334-014-0436-4

Teschler-Nicola, M. (2012). The early neolithic site Asparn/Schletz (Lower Austria): anthropological evidence of interpersonal violence. In R. J. Schulting, & L. Fibiger (Eds.), *Sticks, stones, and broken bones: Neolithic violence in a European perspective* (pp. 101-120). Oxford University Press. https://doi.org/10.1093/acprof:osobl/9780199573066.003.0006

Van Wijk, I. M., van Amerongen, Y. F., Baetsen, S., van Gijn, A., van der Laan, J., Maule, C., Rofet-Salque, M., Verbaas, A., & Amkreutz L. W. S. W. (2021). LBK burial practices in the Netherlands and the Rhineland. In I. M. van Wijk and L. W. S. W. Amkreutz (Eds.), *Elsloo-Koolweg Revisited: Science-based perspectives on the burials and grave goods of the Linear Bandkeramik burial ground of Elsloo-Koolweg*. Nederlandse Archeologische Rapporten 076.

Vanmontfort, B. (2008). Forager–farmer connections in an 'unoccupied' land: First contact on the western edge of LBK territory. *Journal of Anthropological Archaeology*, *27*(2), 149-160. doi:10.1016/j.jaa.2008.03.002

Wahl, J., & Trautmann, I. (2012). The Neolithic massacre at Talheim: a pivotal find in conflict archaeology. In R. J. Schulting, & L. Fibiger (Eds.), *Sticks, stones, and broken bones: Neolithic violence in a European perspective* (pp. 77-100). Oxford University Press.

White, T. D., & Folkens, P. A. (2005). *The human bone manual*. Elsevier.

Zeeb-Lanz A. & Haack F. (2016). Diversity in Ritual Practice at the End of the LBK. In L. Amkreutz, F. Haack, D. Hofmann, & I. van Wijk (Eds.), *Something Out of the Ordinary? Interpreting Diversity in the Early Neolithic Linearbandkeramik and Beyond* (pp. 247-282). Cambridge Scholars Publishing.