doi:10.17746/1563-0110.2022.50.4.067-075

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Seasonality of Sintashta Funerary Rites (Based on the Kamennyi Ambar-5 Bronze Age Cemetery)

Based on archaeological materials from the Kamennyi Ambar-5 cemetery, we test the hypothesis about the connection between the seasonality of pastoral practices and funerary rites during the Late Bronze Age (early 2nd millennium BC). We studied growth layers in the teeth of 24 cows, 19 sheep/goats, 14 horses, a dog, and ten humans from 17 graves. We combined samples from various species from the same contexts into eight assemblages. With regard to animals, differences in seasons of death were revealed only once. 70 % of graves were arranged in spring and 30 % in autumn. Therefore, the hypothesis about the seasonal use of the cemetery can be supported at least partially. The contemporaneous settlement of Kamennyi Ambar demonstrates a similar tendency in the seasonality of animal slaughtering. However, the reasons for slaughtering at the settlement differed from those in the cemetery. At the settlement site, it was motivated by practical needs, and in themortuary site, only by the seasonality of human deaths, specifically by a higher frequency of deaths in late winter and spring. Also, postmortem selection is possible, whereby kurgan burials were arranged only for some individuals. In practice, several of the above factors overlapped, resulting in an anomalous composition of the buried cohort (disproportion of sexes and a higher proportion of individuals who died at the peak of vital activity).

Keywords: *Bronze Age, Trans-Urals, Sintashta culture, funerary rites, burial season, animal sacrifices.*

Introduction

In recent decades, kurgan cemeteries, fortified and unfortified settlements and mine-workings of the Sintashta culture have been comprehensively studied in the southern Urals. Fortified settlements are found only in the Trans-Urals, in the basins of the tributaries of the Tobol and Ural rivers. Often, they form contemporaneous complexes with kurgan cemeteries. In the Cis-Urals and the adjacent part of Kazakhstan, only cemeteries areknown to date. A necropolis usually includes a relatively small number of kurgans, each of them up to 1 meter high. The space under the mound may contain from 1 to 40 grave-pits. Inhumation is a prevailing burial practice, but excarnate and intramural burials also occur (Gening V.F., Zdanovich, Gening V.V., 1992: 207–219; Vinogradov, Berseneva, 2013).

Archaeology, Ethnology & Anthropology of Eurasia 50/4 (2022) 67–75 E-mail: Eurasia@archaeology.nsc.ru

The composition of the buried population usually includes all age cohorts, and a disproportion of sexes is often recorded. A comparatively small number of buried people is obvious at the Kamennyi Ambar-5 cemetery, as the number of buried individuals (at least 125 persons) sharply contrasts with the size of the contemporaneous settlement. The site comprises 1.8 ha, consists of 40–50 houses of 150–220 m^2 each. During the period of ca 100 years (Chechushkov, Epimakhov, 2021), with at least 500–600 people living at the same time, the number of deceased should be clearly higher. One way to explain this is to assume the seasonal use of the settlement and the cemetery.

The work program included selecting biological samples (teeth) for identification of the season of death of people and animals; analysis of annual layers of teeth; contextual analysis; and comparison of data on the season of death with previously obtained evidence of the seasonality of Sintashta burials.

Materials

The Bronze Age archaeological complex of Kamennyi Ambar is located in the Kartalinsky District of the Chelyabinsk Region (Fig. 1). The territory is characterized by a predominantly steppe landscape, with patches of forests. The fortified settlement is located on the first terrace of the left bank of the Karagaily-Ayat River. It was archaeologically studied in 1992 and from 2004 to 2013 (Multidisciplinary Investigations…, 2013; The Bronze Age…, 2021). According to stratigraphy and radiocarbon dating, four phases are distinguished at the settlement

Fig. 1. Location of the site.

(Koryakova, Kuzmina, 2017). The first three correspond to the early stage, with a closed layout and densely arranged buildings. Phase 4 is represented by separate buildings containing Alakul-Timber-Grave materials. At all stages of the settlement's use, the subsistence strategy was based on animal husbandry, supplemented by a foraging economy.

The Kamennyi Ambar-5 cemetery is located on the opposite bank of the river. Four kurgans (No. 2–4 and 8) are attributed to the Sintashta culture (Epimakhov, 2005). They contained from 1 to 17 grave-pits, which dimensions depended on the number of individuals buried (from one to nine). There are no reliable traces of the repeated use of the same grave-pit. The inner space of each grave was most often equipped with a wooden chamber with a ceiling 30–40 cm above the bottom level. More than half of the burials are disturbed or looted. Children's burials account for more than 60 %, age groups of 35–50 and 50+ years old are represented in a few burials. Sex was determined for 55 individuals; among them, 64 % are males. The total number of buried is 125 persons (Judd et al., 2018). The chronology of the Sintashta part of the cemetery is based on 17 radiocarbon dates corresponding to a duration of 70–80 years (Chechushkov, Epimakhov, 2021).

Animal sacrifices (complete skeletons, skulls, and limb bones) were found in 31 graves out of 38. The articulated state of the bones indicates a short time from killing the animals to placing them into the graves, i.e., the sacrifices were usually conducted during funerals.

To test the hypothesis about the seasonal use of the cemetery, an analysis of the dental cementum (from humans and animals originating from the same context) was carried out. The maximum possible number of samples was taken. The analysis was limited due to a small number of teeth with well-preserved cementum and the predominance of children's burials. All the teeth were removed from the jaws and found in an articulated state.

Methods and results

Methods for determining seasonality vary considerably and depend on the materials available. In particular, seasonality is studied using the data on the uneven growth of an organism during the year. The teeth of mammals are most commonly used.

Studies of seasons of burials for the Bronze Age of Northern Eurasia are scarce. The scholars who studied the burials of the northern Caspian region in the 5th–3rd millennium BC combined the results of the analysis of human dental cementum and the pollen data obtained from materials from closed one-time burial grounds (Klevezal et al., 2006; Shishlina, 2007: 395–397). The

reliability of the determination of the season of death by the layers of dental cementum was confirmed by pollen analysis.

In this study, the season of death was determined using a technique based on the study of growth layers in the teeth (cementum and secondary dentin). The growth layers consist of two elements: a wide element, which reflects the active growth of the organism in spring–summer, and a narrow one, which reflects a slowdown in growth in autumn–winter (Klevezal, 1988: 53). Determining the time of death is possible with an accuracy of the season because there is individual variability in layer formation.

The degree of development of the last layer of cementum was assessed in relation to the previous one. In controversial cases, layers in the dentin were studied additionally. The time interval when cattle and sheep/goats were slaughtered was determined to the season: spring, summer, autumn, or winter. The season of death of a horse, owing to the great variability in the formation of zones of active growth or growth slowing, can be identified within autumn–winter, early spring, or late spring–summer (Burke, 1995). However, in cases when narrow (autumn–winter) or wide (spring–summer) layers began to form, the time of death was determined within narrower limits (winter/spring). This conclusion was verified by comparing the findings on other animal species from the same context (if they were available).

In assessing the season of human death, we followed the same approach as for mammals (Klevezal et al., 2006). If along the edge of the cementum was an indistinct narrow layer, the formation of which falls on the winter period, the season of death of the individual was considered to be winter. A very clear winter layer is usually observed when the next wide (growth) layer has already begun to form behind it, but is not visible yet. This happens at the very beginning of spring. In such cases, the season of death of the individual was identified as late winter–early spring. If the very beginning of the growth of a wide layer was observed along the edge of the cementum, the season of death was interpreted as spring, and if this layer was formed by 70–80 % relative to the previous one, it was late summer–autumn.

Samples with an intact root system were selected to analyze the teeth of sacrificial animals. When selecting the teeth of cattle and horses, preference was given to the first upper/lower molars (M1/m1). In a cow, these erupt at the age of 5–6 months (Beasley, Brown, Legge, 1992), in small ruminants at 3–5 months, and in a horse at 9–12 months (Silver, 1969). This makes the first molars ideal for the identification of the season of death for animals from 1–2 years of age. However, other cheek teeth were also used for analysis in cases where molars were missing. The season of death of a human could be determined by this method only if the deceased was not older than 35 years of age (Klevezal et al., 2006). Therefore, the permanent teeth of individuals of this category were studied.

Teeth from 58 individuals older than one year were studied to determine season of death for animals. In some cases, the unsatisfactory state of preservation of the roots forced the selection of several samples from one individual. Therefore, the sample consisted of 72 specimens. However, owing to the poor preservation of the dental cementum, only 61 specimens (out of 58 individuals) turned out to be identifiable: 27 – sheep/goat, 19 – cattle, 14 – horse, 1 – dog (Table 1). Additionally, the state of the dental system of young individuals was taken into account. If teeth are present in the jaws at the eruption stage, it is possible to estimate the probability of animal slaughter in a certain season (Silver, 1969). Thus, the sample is based on materials from 17 grave-pits of three kurgans. Among the anthropological samples, permanent teeth were selected from 10 individuals, one from each (Table 2). In this work, we limited ourselves to determining only the season of death since this approach has shown almost 100 % effectiveness (Wedel, 2007).

The sample preparation procedure included the following steps. Each tooth was filled with epoxy resin. After that, polished transverse sections were made along the entire length of the tooth root (Fig. 2). Each of them was studied visually under a binocular in reflected light.

The sacrifices were localized in two variants: at the bottom of the grave-pit (8 samples from 4 graves) and on the wooden ceiling of the burial chamber (25 from 7). Animal bones were also found in the filling of grave-pits (25 from 9). A significant part of them was probably originally located on the ceiling.

In the final determination of the time of burial, priority was given to the season of animal slaughter. It cannot be ruled out that a human corpse could have been kept for some time, and sacrificial animals were immediately used in the funerary rite. We should also consider the technology of grave digging (the absence of traces of heating, and minimum use of metal tools) and the timing of the soil thawing (late April to early May).

The analysis of the remains of animals has shown that for 60 % of them the season of death was spring, and for 40 % of them the slaughter occurred during autumn. The predominance of the former was ensured by two types—the horse and the small ruminants. When grouped by grave-pits, the dominance of spring sacrifices is even more pronounced: only a quarter of the graves refer to the autumn period. In kurgan 4, there are burials of only one season (spring), while in kurgan 2 and kurgan 8 various seasons are present.

A discrepancy in the season of sacrifice within the same grave-pit was found only once (see Table 1,

Table 1. **Data on sacrificial animals**

No.	Kurgan/ pit	Localization	Type	Tooth	Season	Age, years	Context*
1	2	3	4	5	6	7	8
1 2 3 4 5	2/1	Filling " " " "	Cattle " " " "	m1 m1 M1 m1 M1	Spring " " " "	4 6 6 5 2–4	Highly disturbed, composition of buried unknown
6	2/3	"	Horse	m1	"	2	Highly disturbed, one individual (M 49–55)
7 8 9	2/5	Ceiling " "	" " "	m1 m1 m1	" " Spring?	5 7 4	Disturbed, eight individuals (M 15–18, M 9,5–12, M(?) 25–30, M 10–12, M 14–18, F 10–12, U 1,5–3, F Neonate)
10 11	2/6	" "	" "	i M1	Spring "	15–20 2	Highly disturbed, seven individuals (M 40–50, M 15–18, F 6–10, U 14–16, U 1–5, U <1, M Adult)
12	2/7	Filling	"	I	"	23–25	Highly disturbed, five individuals (F 45+, U 6–8,5, M 4,5–8,5, M 12–18, U 5–12)
13 14 15	2/8	Bottom " "	" " Cattle	m1 M1 m1	" " "	4.5 5 5.5	*In situ*, four individuals (M 30–44, F 7–11, F 2–4, U Neonate)
16 17 18	2/10	Ceiling " "	Sheep/goats " "	m1 m1 m1	Autumn " "	1.5 1.5 1.5	*In situ*, three individuals (M 7,5–12,5, U 1–2, U Adult)
19 20	2/12	Filling "	Cattle "	p2 p4	" "	5 10–11	*In situ*, four individuals (M 5–9, U 2–4, F 38–49, F 20–24)
21 22 23 24 25 26 27 28 29	2/15	Ceiling " " " " " " Bottom "	Sheep/goats " " " Cattle " " Horse "	m1 m1 m1 m1 M1 m1 m1 i3 i1	" " " " " " " " "	2 2 3 2 4 2 5 8 10	*In situ*, one individual at the bottom (M 16–18) and one at the ceiling (U 1–3)
30 31	2/17	Filling "	Cattle Horse	m1 i	" "	4 9–10	Disturbed, two individuals (F Adult, M 6–10)
32	4/1	Bottom	Sheep/goats	m1	Spring	2	*In situ*, one individual (F 12–18)
33 34 35 36 37 38 39 40	4/2	Filling " " " " " Bottom "	" " " " Cattle " Sheep/goats "	m1, M1 M3, p4 m1 p4 m1 m1 m1 Erupting m1	" " " " " " " "	1 7 3 3 7–8 7–8 2 3–5 months	*In situ*, eight individuals (F 7,5–12,5, U 7–11, M 3–5, M 3–5, M <1, M 3–5, U 7–9, U 1–2)
41 42 43	4/5	Filling " Ceiling	" " Horse	Erupting m1 " "	Spring? " Spring	3–5 months 3–5 months 4	Highly disturbed, six individuals (M Adult, M 12,5–17,5, U >5 , U infant, M 5–6, U 3–5)
44 45	4/8	Filling "	" Cattle	m1 M1	" "	5? 5	Highly disturbed, four (?) individuals (M? Adult, U 6–14, U 5–9, U 0,5–3)
46 47 48	4/15	Ceiling " "	Sheep/goats " "	m1 P2 m1, P4	" " "	1 4 4	*In situ*, one individual (U 2–4)

Table 1 (end)

1	2	3	4	5	6	7	8
49	8/2	Filling	Sheep/goats	m1	Spring	5	Highly disturbed, at least one adult, three children
50		"	Cattle	m1	Autumn	?	
51		"	"	M1	"	4	
52		"	"	P2	"	7	
53		Ceiling	Sheep/goats	p2	Spring	5	
54		"	"	m1	"	2	
55	8/3	"	Cattle	m2	Autumn	8	Highly disturbed, four individuals (M 25–30, F Adult, U 5–12, U <1)
56		"	Dog	C	"	4	
57		"	Sheep/goats	m1	"	2	
58		"	"	m1	Autumn?	4	

*Designations of the biological sex: M – male, F – female, U – unidentified.

Table 2. **Season of death of the individuals**

Item	Kurgan/pit, skeleton	Sex and age, years	Tooth	Season of death
1	2/5, 1	M 15–18	i1	Late winter – early spring
2	2/5, 3	M 20–25	p2	"
3	2/12, 1	M 5–9	i1	Late summer – autumn
4	2/12, 4	F 20–24	i1	"
5	2/15	M 16–18	c1	"
6	2/17, 1	F 20–25	m1	Late summer – autumn?
7	4/1	F 12–18	i1, i2	Spring
8	4/2, 2	F 7–12	i1	"
9	4/5, 1	M 20–30	m2	Winter
10	4/5, 2	M 12–18	i2	Late winter – early spring

No. 49–54). The altar in grave 8/2* could have been formed during two seasons. All sheep/goat individuals slaughtered in spring and cattle slaughtered in autumn lay at the same level. Almost all the skulls were connected to mandibles, and most limb bones were articulated. This clearly indicates a short time interval between the slaughter of animals and the placement of the parts of carcasses on the ceiling (Fig. 3). It can be assumed that there was access to the grave-pit both in spring and autumn (at least to the ceiling level). In other cases, there were no discrepancies in the season of sacrifice, even if the samples were taken from mandibles, which were found *in situ* at the bottom and on the ceiling of the same grave (pit 2/15).

The analysis of the human teeth sample showed that most of the ten individuals died in late winter–early spring, or late summer–autumn. We interpreted all deaths during the warm period (spring–summer) as deaths in spring, based on the context (data on the death of animals in closed complexes). A discrepancy in the season of death within one grave was observed once (see Table 2, No. 9, 10): one individual died in winter, and the other in late winter–early spring. Probably, the burial of the first one was delayed until the beginning of the warm season. Judging by the analysis of animal teeth, this burial was made in spring.

Thus, a comparison of zoological and anthropological materials did not reveal any discrepancies, and in two cases, it was possible to clarify the time of burials; the season of death of the individuals from graves 2/5 and 4/5 was determined as late winter–early spring, and the sacrificial animals from these graves died in the spring; consequently, the burials belong to the spring period (Table 3). The observed consistency suggests the relative simultaneity of the repose of people and the sacrifice of animals. An additional argument in favor of this conclusion is the results of the analysis of the internal structure of the grave-pits. Of the seven graves with data on the season of death of people and animals, simultaneity has been stratigraphically confirmed for four. In pits 2/12, 2/15, 4/1, and 4/2, there are no traces of disturbance of the original filling. In three of these graves, the remains of the buried individuals were found *in situ*, and in one of them, the bones had been partially displaced by burrowing animals (pit 4/2). In the latter case, the single-phased burial process is confirmed by the great depth of the pit (–220 from the subsoil) and the location of sacrificial animals on the ceiling 20–40 cm above the bottom.

*Hereinafter, the designation is in accordance with Table 1.

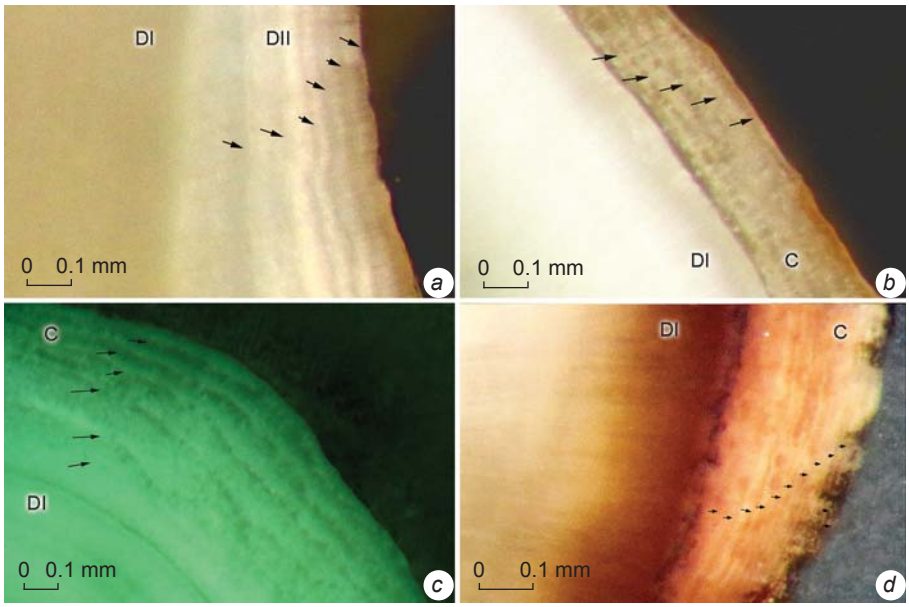

Fig. 2. Areas of transverse polished sections of animal and human teeth.
a – cattle, 6 years old, m1, the animal died in spring (Table 1, No. 2); *b* – small ruminants, 7+ years old, p4, the animal died in spring (Table 1, No. 34); *c* – cattle, 8 years old, P2, the animal died in autumn (Table 1, No. 52); *d* – human, died at the end of winter or in spring (Table 2, No. 1). Arrows indicate winter layers. C – cementum, DI – primary dentin, DII – secondary dentin.

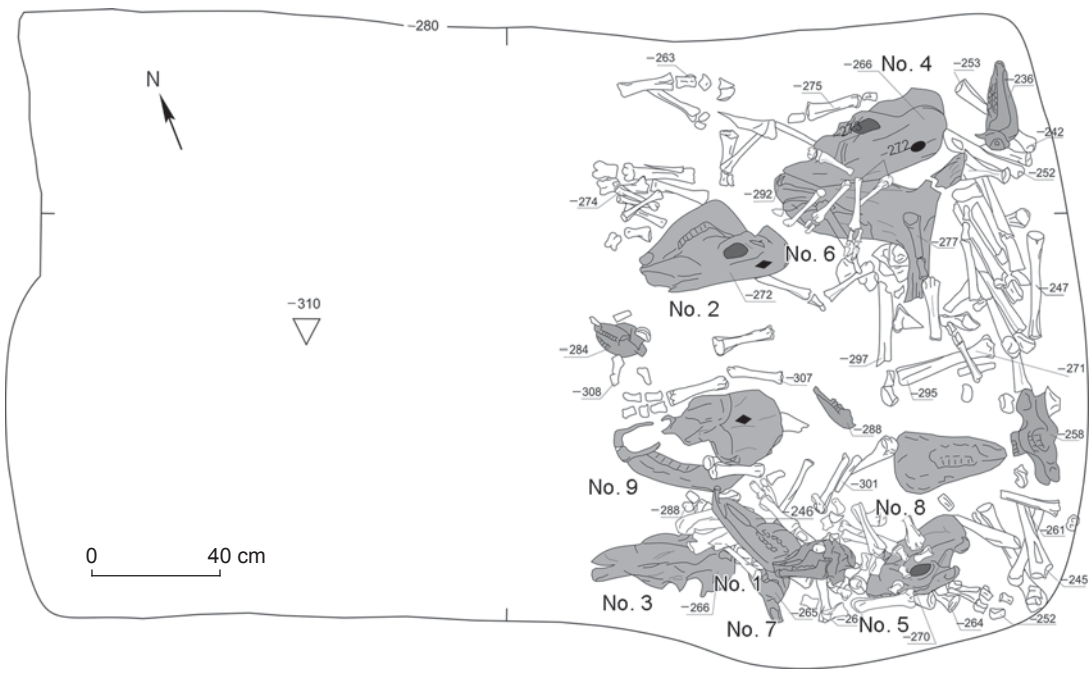

Fig. 3. The altar on the ceiling of grave 2, kurgan 8.

Sandy-loam soil rules out the possibility of any long-term leaving of the pit in the open state*. No differences in the season between the finds at the bottom and in the filling were revealed.

The situation in disturbed graves 2/5, 2/17, and 4/5 looks more ambiguous. Nevertheless, some of the bones at the bottom and ceilings were also found *in situ*. Considering the consistency of death seasons of

*During the excavation of the deep pits of this cemetery, which took up to two weeks in summer, one of the main problems was preventing the soil walls from sliding.

Table 3. **Results of the synthesis of information on the season of death of people and animals from closed complexes (grave-pits)**

Kurgan/pit	Animals		People				Season of burial*
	Spring	Autumn	Late winter – early spring	Late summer – autumn	Spring	Winter	
2/1	5	–	–	–	–	–	Spring
2/3	1	–	–	–	–	–	"
2/5	3	–	2	–	–	–	Early spring
2/6	2	–	–	–	–	–	Spring
2/7	1	–	–	–	–	–	"
2/8	3	–	–	–	–	–	"
2/10	–	3	–	–	–	–	Autumn
2/12	–	2	–	2	–	–	"
2/15	–	9	–	1	–	–	"
2/17	–	2	–	1	–	–	"
4/1	1	–	–	–	1	–	Spring
4/2	8	–	–	–	1	–	"
4/5	3	–	1	–	–	1	Early spring
4/8	2	–	–	–	–	–	Spring
4/15	3	–	–	–	–	–	"
8/2	3	3	–	–	–	–	Spring, autumn
8/3	–	4	–	–	–	–	Autumn

*The final conclusion was made taking into account the greatest possible narrowing of the interval.

individuals and animals, we can assume a funerary rite similar to that recorded in undisturbed burials.

Of the ten graves for which only the animal teeth analyses were carried out, the context of finds is reliably documented in five: three had not been disturbed (pits 2/8, 2/10, 4/15), and in two cases (pits 2/6 and 8/3) the finds were discovered on a partially preserved ceiling.

Discussion

Our results suggest the seasonal nature of the formation of the cemetery. More than 70 % of the burials were made in the spring, a little less than 30 % in the autumn, and no summer burials. The most obvious reason for the predominance of spring burials is the increased mortality during this harsh period of the year. Inadequate nutrition and decreased immunity weaken the body's natural defenses; therefore, the possibility of a rapid spread of infectious diseases arises. Infectious agents could have been especially contagious in the crowded living conditions of people in the settlement. A small number of diseases recorded from skeletal remains should not be misleading, since owing to the rapid course of the disease it may not leave characteristic markers in bone morphology but is detected upon the in-depth study (Mühlemann et al., 2018).

The absence of summer burials can be explained in different ways. The first version is based on the assumption that animal slaughtering was tabooed during the summer, in order to increase livestock number and the overall meat weight. The taboo could have also extended to the ritual sphere, which may explain the absence of altars in some burials*. The second version (which does not contradict the first) suggests the transhumance of livestock. Perhaps, most of the settlement's inhabitants lived there only during the cold period and moved to some remote pastures in summers. Accordingly, part of the community may have been buried near these hypothetical summer camps. However, to date, reliable evidence of such sites has not been found.

There are no traces of summer slaughter of animals among the kitchen remains at the settlement either. In addition, spring slaughter clearly predominates over autumn slaughter (Bachura, 2014). Most likely, the slaughter of livestock in the spring was a forced measure associated with the depletion of the fodder supply and the desire to maintain a viable part of the livestock. Autumn slaughter was focused on the procurement of the maximum amount of meat. The rapid degradation of

*Unfortunately, such complexes were not included in the analyzed sample.

pastures during their daily exploitation may have limited the possibilities of summer grazing near the settlement (Frikke, Chechushkov, Bachura, 2021). According to an alternative opinion, people of the settlement lived and kept cattle in dwellings or separate buildings all year round (Rassadnikov, 2020). Additional arguments in favor of nearby grazing are calculations of the ecological capacity of the surroundings (4–5 km) (Stobbe et al., 2016) and traces of animals living in buildings (Multidisciplinary Investigations…, 2013: 305–326; Chechushkov, Kalinin, Yakimov, 2021). Thus, the economic factor could have influenced seasonal fluctuations in the use of the cemetery.

One of the reasons for the seasonality of burials could have been the sharply continental climate of the southern Urals. Currently, the steppe and forest-steppe of the region are characterized by a significant difference (more than 30 °C) in the average temperatures of January and July. It was found that in the Late Bronze Age the climate was close to the modern one (Stobbe et al., 2016; Chechushkov, Valiakhmetov, Fitzhugh, 2021). Severe conditions in winter inevitably created serious difficulties in burying the deceased and could have influenced the cemetery composition.

The analyzed versions, however, do not clarify the causes of anomalies in the burial sample: sex disparities, a significant proportion of children aged 5–12 years, and adolescents (12–18 years old), for whom an increased risk of death is an unusual phenomenon. Thus, there is no reason to exclude the influence of socially and ideologically determined postmortem selection, which implies the inhumation in kurgans of only a part of the dead.

Conclusions

As part of the research, the odontological material from the Kamennyi Ambar-5 cemetery was studied. The analysis of the dental cementum of people and animals has allowed to ascertain the seasonal use of the burial ground. Most of the burials were associated with the spring period, and about one-third of the burials with the remains of sacrificial animals were made in the autumn. At first glance, this ratio is close to the pattern of the seasonal slaughter of animals at the settlement. But this correlation cannot be interpreted as a causal relationship in view of the obvious difference in the history of each sample formation and, most importantly, the motives for the activity.

It is difficult to assess the "contribution" of different factors to the overall distortion in the mortality structure, but it is clear that seasonality was one of them. Indirectly, the predominance of spring (including late winter deaths) burials, in the absence of summer ones in our sample, could have resulted from natural processes and transhumance. But for a rigorous argumentation for the latter, there is a lack of summer camps and burial grounds associated with them. Furthermore, seasonality was clearly not the cause of the disproportion of sexes of the buried and the significant share of those who died at the peak of vital activity. Most likely, we are dealing with a sum of various factors that influenced the composition of the buried cohort.

Acknowledgements

The study was performed under R&D projects of the Institute of History and Archaeology, Ural Branch, Russian Academy of Sciences, No. 121102500121-8, and the Institute of Plant and Animal Ecology, Ural Branch, Russian Academy of Sciences, No. 122021000095-0.

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Received October 22, 2021.
Received in revised form May 17, 2022.