

AKADÉMIAI KIADÓ

Acta Archaeologica
Academiae Scientiarum
Hungaricae

73 (2022) 1, 81–92

DOI:

[10.1556/072.2022.00007](https://doi.org/10.1556/072.2022.00007)

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ORIGINAL RESEARCH PAPER



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High-status Avar warriors identified. Differences in the prevalence of the horse riding syndrome in “high-status” vs. “low-status” adult male burials in the Avar cemetery of Wien 11-Csokorgasse (seventh–eighth century AD)

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Received: December 2, 2021 • Accepted: February 1, 2022

ABSTRACT

Bioarchaeology can contribute to interdisciplinary research on the social organization of the Avar Empire (568 AD to around 800 AD) by providing information on the health, lifestyle and habitual activity patterns of Avar populations, thus offering an important, additional perspective to traditional archaeological methods focusing on material culture. The so-called horse riding syndrome refers to a combination of changes on the human skeleton, which may indicate that the individual in question practised horse riding as a habitual activity during his or her lifetime. The aim of this paper is to identify potential differences in habitual horse riding activity between different socioeconomic groups within the adult male population of the Avar cemetery of Wien 11-Csokorgasse, using a major criterion of the horse riding syndrome (namely the ovalization or vertical elongation of the acetabulum) and an indicator of social status in burials of Avar men (namely the depth of burial). The sample included only males (age group adult or older) with at least one completely preserved acetabulum ($n = 38$ for the left acetabulum, $n = 40$ for the right acetabulum). The ovalization of the acetabulum was determined using a basic measurement method, the Index of Ovalization of Acetabulum (IOA). The sample was divided into two groups according to depth of burial: The “high-status” group included the skeletal material of adult male individuals with a depth of burial of 1.00 m or more. The “low-status” group included the skeletal material of adult male individuals with a depth of burial less than 1.00 m. We observed highly significant differences regarding the ovalization of the acetabulum between “high-status” and “low-status” adult males. This may reflect considerable variation in lifestyle and/or habitual activity patterns between these two groups, which could suggest differences regarding the prevalence of habitual horse riding between “high-status” and “low-status” adult males. Hence, using a major criterion of the “horse riding syndrome” – the “ovalization” of the acetabulum – we may have identified a group of “high-status” Avar warriors, whose way of life appears to have differed from that of the “lower-status” male population buried in the Avar-period cemetery of Wien 11-Csokorgasse.

KEYWORDS

Avar archaeology, horse riding syndrome, human osteology, mortuary archaeology

INTRODUCTION

The Avars,¹ a nomadic tribal confederation of Central Asian origin, were present in East-Central Europe from the year 568 to around 800 AD. According to the historical sources, the

¹For a summary of Avar history and archaeology, see, for example, [Daim \(2003\)](#).

Avars were accomplished mounted warriors: Their outstanding skills in mounted archery, but also in fighting with a range of different weapons on horseback, appear to have been a major factor in their military success, especially when they first arrived in Europe in the late sixth–early seventh century AD. The archaeological record (currently over 60,000 graves of the Avar period in the Carpathian Basin) complements this picture: A considerable proportion of men's burials in Avar cemeteries is furnished with weapons (bow and arrow, lance-heads, sabres/swords, axes) and multi-part belt sets, which were also part of the Avar warrior's equipment. Some graves also include horse-riding equipment, as well as partial or even complete horse-burials.²

Due to a lack of written sources from within the Avar Empire, we have no information about many aspects of life in the Avar period. Historical records concerning the Avar Empire are all external, written by historiographers of neighbouring cultures, such as Byzantium, China or the Frankish Empire. The scarcity of relevant historical sources can make it difficult for archaeologists to decipher the “cultural code” inherent in Avar burials. This aspect is particularly relevant for issues such as identity, socioeconomic status and gender roles. Burial customs and rituals were an opportunity for the family of the deceased to consciously present and reinforce their status within their community. Hence, protohistoric burial customs and rituals may reflect the position of the deceased, or at least his or her family, in society.

Archaeologists specialising in the Avar period have identified several indicators of “high socioeconomic status”, such as the presence of multi-part belt sets and precious metal objects in Avar graves, as well as an above-average depth of the burial in question.³ However, we have no historical sources describing the social organization of the Avar Empire. Hence, the exact implications of wearing a multi-part belt set in the Avar period remain unclear. Nevertheless, multi-part belt sets are clearly an indicator of male high status because they occur in above-average-depth burials and in association with other high-status grave goods such as precious-metal artefacts.

Bioarchaeology can contribute to interdisciplinary research on Avar identities by providing information on the health, lifestyle and activity patterns of Avar populations, thus offering an important, additional perspective to traditional archaeological methods focusing on material culture. Hence, osteological research on the horse riding syndrome in Avar populations may serve as a control for the results of archaeological research, thus adding an additional dimension to historical interpretations. In particular, this could be extremely relevant for the issue of identities of the different segments of the population in the Avar period, in particular the Avar warrior elite.

The aim of this paper is to identify potential differences in habitual horse-riding activity between different socio-economic groups within the adult male population of the Avar cemetery of Wien 11-Csokorgasse, by combining a major criterion of the horse riding syndrome (the ovalization of the acetabulum⁴) with an indicator of social status in Avar male burials (depth of burial).

BACKGROUND INFORMATION

Avar horsemanship: historical and archaeological background

Horses were an important aspect of life in the Avar Empire both from a practical and from a symbolic point of view. The phenomenon of human-horse burials and other rituals involving horses and riding equipment as part of the burial customs in the Avar period is diverse, with considerable regional and chronological differences, which appears to reflect a range of cultural traditions. Throughout the Avar period, human-horse burials constitute only a small proportion of all Avar-period graves (10% on average⁵). Moreover, the abundance of valuable grave goods in such burials may indicate that, generally speaking, only high-ranking burials included horses and/or horse-riding equipment. It should be noted that in the Late Avar Period, especially during its final phase in the late eighth century AD, there is an increased prevalence of human-horse burials in the border regions of the Avar Empire and that – unlike the majority of human-horse burials in earlier periods – in some cases, women⁶ and children were also buried with horses. This phenomenon occurs in the Late Avar (eighth century AD) cemeteries at Komárno (Slovakia),⁷ but also in some Avar cemeteries during the same period in the Vienna region,⁸ such as Wien 11-Csokorgasse, Vösendorf and Wien 23-Liesing.

The most detailed information on Avar mounted warriors can be found in the so-called *Strategikon*,⁹ a Byzantine military handbook attributed to the Byzantine Emperor Maurice, who ruled the Byzantine Empire from 582 to 602. However, a high-ranking Byzantine commander may in fact have been the author of the *Strategikon*. The *Strategikon* gives the following description of Avar mounted warriors in the late sixth century: “They are armed with mail, swords, bows, and lances. In combat most of them attack doubly armed; lances slung over their shoulders and holding bows in their hands, they make use of both as need requires. Not only do they wear armor themselves, but in addition the horses of their illustrious men are covered in front with iron or felt.

⁴Berthon et al. (2018).

⁵See, Bede (2012).

⁶Čilinská (1990).

⁷Trugly (1987).

⁸Tarcsay (2013).

⁹Dennis (1984).

²Bede (2012).

³See, for example, Daim (1987).



They give special attention to training in archery on horseback.¹⁰ The Avars' preference for mounted archery is also apparent from their military strategies: *"They prefer battles fought at long range, ambushes, encircling their adversaries, simulated retreats and sudden returns, and wedge-shaped formations, that is, in scattered groups"*.¹¹ The *Strategikon* also emphasizes the Avars' preference for mounted combat and attributes the latter to their training and lifestyle: *"Also in the event of battle, when opposed by an infantry force in close formation, they stay on their horses and do not dismount, for they do not last long fighting on foot. They have been brought up on horseback and owing to their lack of exercise they simply cannot walk about on their own feet"*.¹²

Despite the fact that the above-cited passage of the *Strategikon* includes a well-known *topos* of classical historiography regarding equestrian nomads of Central Asia, it may contain an element of truth with respect to their traditions and way of life, for instance in that they would have avoided having to fight on foot. In order to reach the level of proficiency ascribed to Avar mounted warriors by the historical sources, we can assume that they must have begun their training at an early age and from then on had devoted a considerable amount of time every day on perfecting their skills. Mounted archery, in particular, requires an extraordinary amount of training because the technique of taking aim is instinctive, which can only be effective if the archer acquires sufficient routine in shooting from horseback. For Avar mounted warriors, hunting from horseback was presumably one way of staying in training during long periods of peace. Hence, it is likely that hunting was an important part of the lifestyle of the Avar elite, also because it allowed the mounted warriors to hone their fighting skills during times of peace. The *Strategikon* also discusses hunting as an additional way of training for battle during times of peace.¹³

Certainly, warriors of all period and cultures, whether infantry or cavalry, must have invested a considerable amount of time in perfecting their fighting skills because, in the event of battle, excellent combat skills were a matter of life and death. Furthermore, it is an advantage to begin this training as early as possible. According to the Chinese historiographer Meng Hung children in the medieval Mongolian Empire were given small bows and arrows at age four to five, expected to ride and hunt as frequently as possible and could be conscripted for battle at the age of fifteen.¹⁴ It is quite likely that in other pre- and protohistoric steppe cultures such as the Avar Empire, a mounted archer's career followed a similar pattern. In the case of the Hiung-nu, a protohistoric Central Asian steppe culture, a Chinese source reports that the children of the Hiung-nu rode sheep.¹⁵ This

is interesting in the context of early medieval Turkish burials from Central Asia, where young children were buried together with sheep in a similar way that adult warriors were buried with horses.¹⁶

Obviously, the exact details of the horse-riding techniques of the Avar period are no longer accessible to us. However, some basic principles of the communication between rider and horse remain the same throughout the history of equestrianism, whether past or present. Similarly, much can be inferred about Avar horse-riding techniques due to the necessities of horseback archery: For instance, we can safely assume that Avar horse-riding techniques must have focused on controlling the horse effectively without reins, using only the rider's seat and legs, because this is crucial for horseback archery and other types of mounted combat. Other important aspects must have been efficiency and comfort while covering long distances at moderate to high speed. Hence, generally speaking, we can assume that Avar horse-riding techniques are comparable to those of present-day mounted herdsman and hunters, particularly in Central Asia.

Bioarchaeological background: the horse riding syndrome

From a bioarchaeological point of view, any physical activity performed on a day-to-day basis since early childhood is likely to have had an effect on the skeleton of the individual in question. According to Wolff's Law, bone tissue can respond to mechanical stress by growth and remodelling and the capacity for bone tissue to adapt to mechanical stress is greatest in non-adults.¹⁷ The so-called horse riding syndrome¹⁸ refers to a combination of changes on the human skeleton which, if found in association, may indicate that the individual in question practiced horse riding as a habitual activity during his or her lifetime. The characteristic traits of the horse riding syndrome occur predominantly on the bones of the lower limb, the pelvis and the spine. Surprisingly, the number of systematic, bioarchaeological studies on the horse riding syndrome is less extensive than expected and detailed studies on the horse riding syndrome in Avar populations are still lacking. However, the characteristic traits of this syndrome frequently appear in bioarchaeological literature as an argument that a particular individual was a "horse rider".

The trait most frequently cited in the bioarchaeological literature as an indicator of habitual horse riding activity is the so-called "*Reiterfacette*" ("rider's facet"; see Fig. 1), indicating characteristic changes in the area of transition between the *caput femoris* and the *collum femoris*. For example, Andelinović et al. list Poirier's facet as one of the characteristic traits of the horse riding syndrome.¹⁹

¹⁰Dennis (1984) 116.

¹¹Dennis (1984) 117.

¹²Dennis (1984) 117–118.

¹³Dennis (1984) 165–169.

¹⁴Hyland (1996) 130.

¹⁵Bálint (1989) 261.

¹⁶Bálint (1989) 261, Abb. 128.

¹⁷Pearson and Liebermann (2004).

¹⁸See, for example, Andelinović et al. (2015); Berthon et al. (2018); Belcastro et al. (2001).

¹⁹Andelinović et al. (2015) 714, Table 3.





Fig. 1. Wien 11-Csokorgasse, Grave 348 (male, 40–60 years), right proximal femur, ventral view: Poirier's facet (photo: Birgit Bühler)

However, there appear to be some inconsistencies regarding the terminology and its usage in bioarchaeological literature. As the issue of the aetiology of this non-metric trait is not yet resolved, it is certainly preferable to use the term Poirier's facet because it is more neutral than “rider's facet”. Hence, the term Poirier's facet is used throughout this paper. However, it is interesting that Poirier's facet was extremely rare in the modern population (Certosa cemetery, Bologna, Italy, first half of the 20th century) studied by N. Radi and colleagues.²⁰

Another osteological change frequently associated with habitual horse riding in the bioarchaeological literature is a change in the shape of the acetabulum (“ovalization” or “vertical elongation”).²¹ In this context, the Index of Ovalization (IOA) introduced by Berthon et al.²² is a useful, simple tool for quantifying what may be one of the major characteristics of the horse riding syndrome, namely the vertical elongation (ovalization) of the acetabulum (see Fig. 2).

The aim of this paper is to identify possible differences in the Index of Ovalization of Acetabulum (IOA) between different socioeconomic groups within the adult male population of the Avar cemetery of Wien 11-Csokorgasse.

We tested the following hypothesis:

The mean IOA of adult male individuals with “high socioeconomic status” (proxy: burial in “deep” graves = grave depth of 1.00 m or more) is significantly higher than the mean IOA of adult male individuals with “low socioeconomic status” (proxy: burial in “shallow” graves = grave depth less than 1.00 m).

²⁰Radi et al. (2013).

²¹Erickson et al. (2000).

²²Berthon et al. (2018).

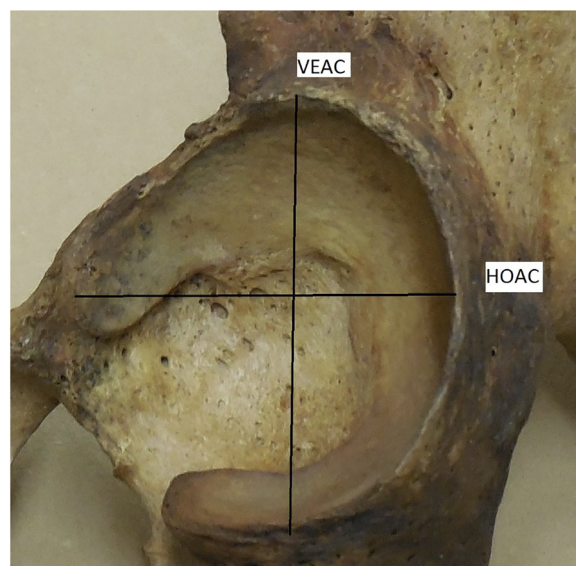


Fig. 2. Wien 11-Csokorgasse, Grave 21 (male, 20–40 years), left acetabulum with noticeable “ovalization” (vertical elongation); showing the measurements of the maximum vertical diameter of the acetabulum (VEAC) and the maximum horizontal diameter of the acetabulum (HOAC); Photo: Birgit Bühler

Furthermore, additional data on the prevalence of Poirier's facet in the adult male population of Wien 11-Csokorgasse as well as archaeological data (the relative proportion of deep/shallow male burials and the presence of specific grave goods relevant for status (such as arrowheads, multi-part belt sets, weapons) are also included in the results section because they are relevant for discussing issues of socioeconomic status within the male population of this Avar cemetery.

MATERIAL AND METHODS

The sample for the research presented in this paper was taken from the adult population of the Avar cemetery of Wien 11-Csokorgasse.²³ This was advantageous because the osteological material is easily accessible at the Department of Evolutionary Anthropology of the University of Vienna and the age and sex determination, as well as valuable palaeopathological observations have already been published.²⁴ The archaeological data (presence of weapons and multi-part belt sets as grave goods; the depth of graves) used in this paper are derived from the preliminary catalogue,²⁵ the preliminary, chronological evaluation²⁶ and from a recent zooarchaeological study of this cemetery.²⁷

Wien 11-Csokorgasse is one of the largest cemeteries of the Avar period in present-day Austria, comprising 755

²³Streinz (1977); Großschmidt (1990).

²⁴Großschmidt (1990).

²⁵Streinz (1977).

²⁶Streinz and Daim (2018).

²⁷Baron (2018).

burials (in 705 graves), including adults and non-adults of both sexes and all age groups. The archaeological finds are still unpublished. However, a preliminary catalogue²⁸ and a preliminary, chronological evaluation²⁹ are available and constitute the basis for the archaeological criteria relating to socioeconomic status used in this paper. Some chronological information based on archaeological data is also available in a recent, detailed archaeozoological study of this cemetery.³⁰ At present, the archaeological data suggest that the Avar cemetery of Wien 11-Csokorgasse was in use over a considerable period,³¹ from the second quarter of the seventh century AD (Early Avar Period 2) to the final third of the eighth century (Late Avar Period 3). The latest phase of the cemetery includes four human-horse burials (Grave 650, 690, 692 and 693),³² in which the deceased were buried with a horse (including equipment for riding), as well as with other animals, such as dogs, and rich grave goods, including weapons (bow and arrow, sword, sabre) and multi-part belt sets. Although the human-horse burials, like many other rich burials in this cemetery, had been robbed of their most valuable grave goods in antiquity, enough evidence remains of the originally deposited grave goods in order to verify that high-status individuals were buried in these graves. Similarly, all human-horse burials are characterised by the large size of the grave and by an above-average depth, which, in Avar burials, is also an indicator of the high socioeconomic status of the deceased.³³

For the research presented here, the sample size for investigating differences in IOA between “high status” and “low status” adult males was $n = 38$ for the left acetabulum and $n = 40$ for the right acetabulum: Only males (age group adult or older) with at least one completely preserved acetabulum were included in this research.

We chose a combination of two archaeological criteria – the presence of multi-part belt sets and the above-average depth of burials – as a proxy for “high socioeconomic status” in male burials within the Avar cemetery of Wien 11-Csokorgasse: The average depth for burials with multi-part belt sets is 0.96 m in this cemetery.³⁴ Hence, we chose a burial depth of 1.00 m as the limit between the two groups with “shallow” (= “low status”) and “deep” (= “high status”) burials, respectively. For the purposes of our research, “shallow” graves are all burials with a depth of less than 1.00 m, while “deep” graves are defined as all burials with a depth of 1.00 m or more.

The research presented in this paper was part of a larger study, focusing on different osteological traits of the pelvis and the lower limb which are potentially associated with the so-called horse riding syndrome: Due to insufficient state of preservation and to lack of relevant archaeological data for some individuals, sample sizes vary for the different traits of

the horse riding syndrome and for the left/right side. Hence, a total of 77 male individuals of the age groups adult and older³⁵ with either at least one acetabulum or at least one proximal femur sufficiently well preserved for scoring these traits were included in this larger study. For scoring Poirier’s facet, only individuals with at least one well-preserved anterior proximal femur region were included: In this case, sample size was $n = 57$ for the left side and $n = 46$ for the right side.

The Index of Ovalization (IOA) of the acetabulum is a basic measurement method developed by Berthon et al.³⁶ in order to facilitate a quantification of the vertical elongation of the acetabulum (“ovalization”), a characteristic trait of the horse riding syndrome, without having to resort to more complex morphometric methods such as the Fourier analysis used by Erickson et al.³⁷

The IOA is defined as $VEAC/HOAC$, where VEAC is the maximum vertical diameter of the acetabulum and HOAC is the maximum horizontal diameter of the acetabulum, measured on the rim of the acetabulum in each case (see Fig. 2). The measurements were carried out with a digital caliper, in mm, to 1 decimal. For each VEAC or HOAC, 2 measurements were carried out on the same day and the arithmetic mean was used for calculating the IOA.

Intra-observer reliability (see Appendix) was measured by carrying out a third round of measurements in a separate session after several months, on a random sample of 10 individuals with 20 femora. The correlation coefficients (non-parametric, Spearman-Rho) for these measurements are shown in Table 1 (Appendix).

All statistics were carried out with SPSS 25. After verifying normal distribution using the Kolmogorov-Smirnov test, we tested the hypothesis with the help of the independent-sample *T*-test. Results were considered significant when $P = 0.05$ and highly significant when $P = 0.001$. Box-plots were constructed in order to illustrate variations in IOA within the adult male population of the Avar cemetery of Wien 11-Csokorgasse. Pie charts were constructed to show the prevalence of Poirier’s facet in the adult male population, as well as the relative proportion of deep/shallow male burials and with/without specific grave goods relevant for status (arrowheads, multi-part belt-sets, weapons).

RESULTS

Differences in IOA between socioeconomic groups: “high-status” (= burial depth of 1.00 m or more) vs. “low status” (= burial depth below 1.00 m) male burials (age group adult or older) in the Avar cemetery of Wien 11-Csokorgasse

For the left acetabulum (Fig. 3), the IOA was higher in “high-status” males buried at a depth of 1.00 m or more

²⁸Streinz (1977).

²⁹Streinz and Daim (2018).

³⁰Baron (2018).

³¹Streinz and Daim (2018).

³²Streinz (1977); Baron (2018).

³³Daim (1987) 171.

³⁴Baron (2018) 302.

³⁵Großschmidt (1990).

³⁶Berthon et al. (2018).

³⁷Erickson et al. (2000).



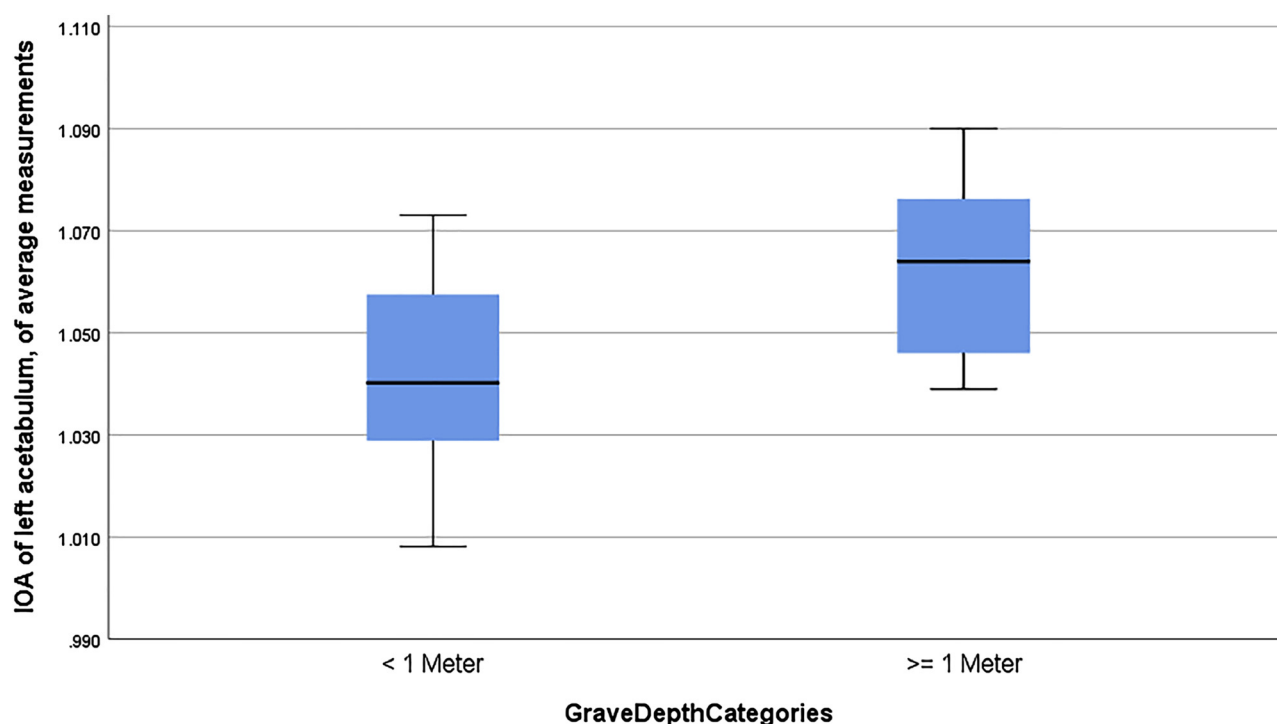


Fig. 3. Mean Index of Ovalization (IOA) of the left acetabulum in “low-status” (depth of grave less than 1.00 m) and “high-status” burials (depth of grave = 1.00 m or more); adult male population of the Avar cemetery of Wien 11-Csokorgasse ($n = 38$)

($M = 1.063$, $SD = 0.018$, $n = 9$) than in “low-status” males buried at a depth of less than 1.00 m ($M = 1.041$, $SD = 0.018$, $n = 29$). The results of the T -test were significant, $t(36) = -3.145$, $P = 0.003$.

For the right acetabulum (Fig. 4), the IOA was higher in “high-status” males buried at a depth of 1.00 m or more ($M = 1.063$, $SD = 0.018$, $n = 13$) than in “low-status” males buried at a depth of less than 1.00 m ($M = 1.040$, $SD = 0.019$, $n = 27$). The results were highly significant, $t(38) = -3.617$, $P = 0.001$.

Hence, the hypothesis was verified for both sides, with highly significant results for the right side.

Prevalence of Poirier’s facet in the male population (age group adult and older) of the Avar cemetery of Wien 11-Csokorgasse

Figures 5 and 6 illustrate that a typical Poirier’s facet was present in 22.8% (13/57) of the adult male individuals with an observable left proximal femur and in 32.6% (15/46) of the male individuals with an observable right proximal femur. In addition to this, a “slight facet” was present in 12.3% (7/57) of the male individuals with an observable left proximal femur and in 2.2% (1/46) of the male individuals with an observable right proximal femur. A combination of these two separate categories of facets would mean that, overall, facets are present in 35.1% (20/57) of the male individuals with an observable left proximal femur and in 34.8% (16/46) of the male individuals with an observable right proximal femur.

Prevalence of archaeological criteria for socioeconomic status in the adult male population of the Avar cemetery of Wien 11-Csokorgasse

Figures 7–10 illustrate the prevalence of different archaeological “indicators” of socioeconomic status in the male population buried in the Avar-period cemetery of Wien 11-Csokorgasse: Fig. 7 shows that 28.6% of adult male burials in the Wien 11-Csokorgasse cemetery have a depth of 1.00 m or more: This group of “deep” burials is classified – for the purposes of our research – as the group of “high-status” male burials. Furthermore, Fig. 8 demonstrates that multi-part belt sets were present in 28.6% of adult male burials in the Wien 11-Csokorgasse cemetery. Similarly, Fig. 10 shows that arrowheads were present in 31.2% of adult male burials in the Wien 11-Csokorgasse cemetery. However, as Fig. 9 shows, other weapons were only present in 19.5% of adult male burials in the Wien 11-Csokorgasse cemetery.

DISCUSSION

Assuming that the ovalization of the acetabulum is indeed, as discussed above, an important characteristic of the horse riding syndrome, it is possible that the highly significant differences in the Index of Ovalization of Acetabulum (IOA) between “high-status” and “low-status” adult males (see Section “Differences in IOA between socioeconomic groups...”, above) could reflect considerable differences in lifestyle and/or habitual activity patterns between these two

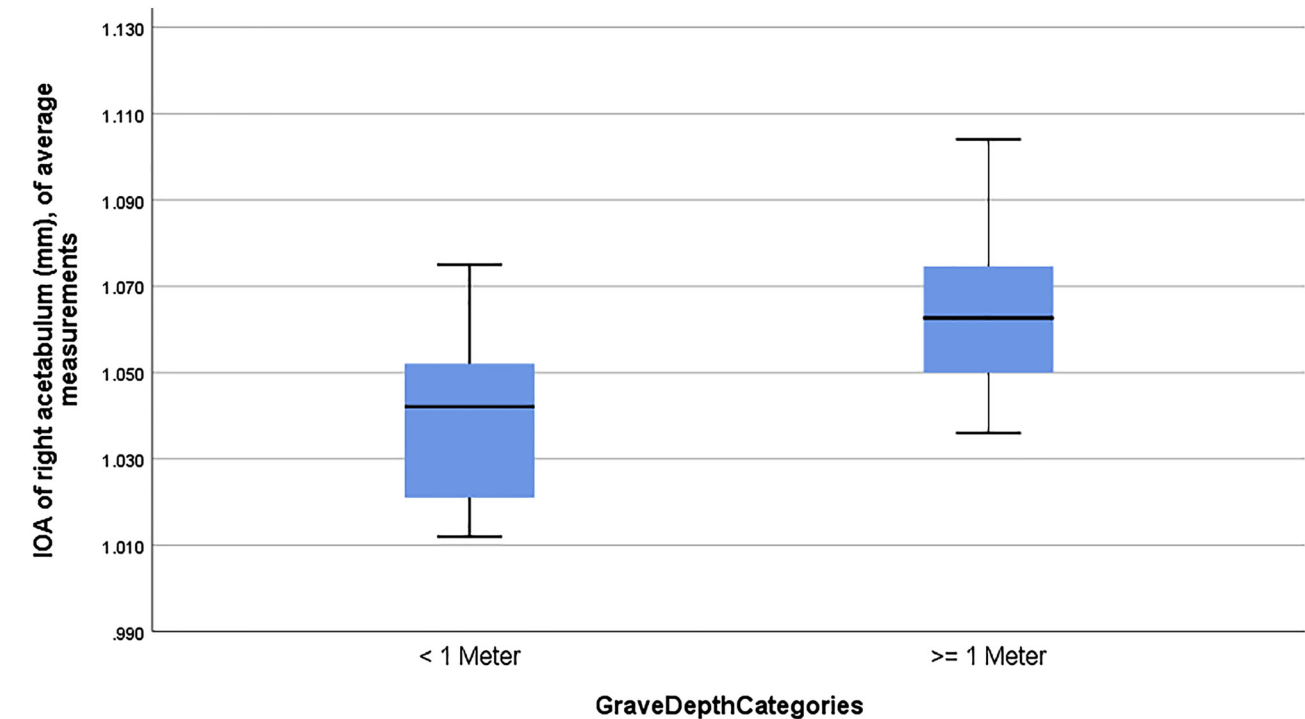


Fig. 4. Mean Index of Ovalization (IOA) of the right acetabulum in “low-status” (depth of grave less than 1.00 m) and “high-status” (depth of grave = 1.00 m or more) burials; adult male population of the Avar cemetery of Wien 11-Csokorgasse (*n* = 40)

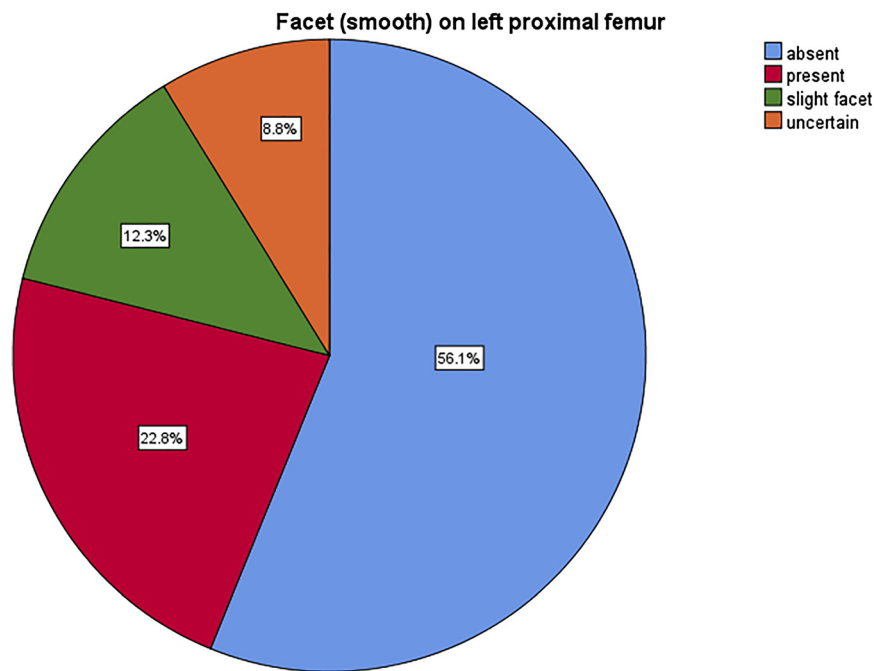


Fig. 5. Prevalence of Poirier's facet in the adult male population of the Avar cemetery of Wien-Csokorgasse (left proximal femur, *n* = 57)

groups of the Avar-period male population from Wien 11-Csokorgasse. Due to the historical and archaeological context of the Avar Empire, these results may indicate differences regarding the prevalence of habitual horse-riding activity between “high-status” and “low-status” adult male burials in this cemetery.

Hence, with the help of a major criterion of the horse riding syndrome – the ovalization (vertical elongation) of the acetabulum – we may have identified a group of “high-status” Avar warriors, whose lifestyle appears to have differed from that of the “lower-status” male population buried within the Avar cemetery in question. However, more



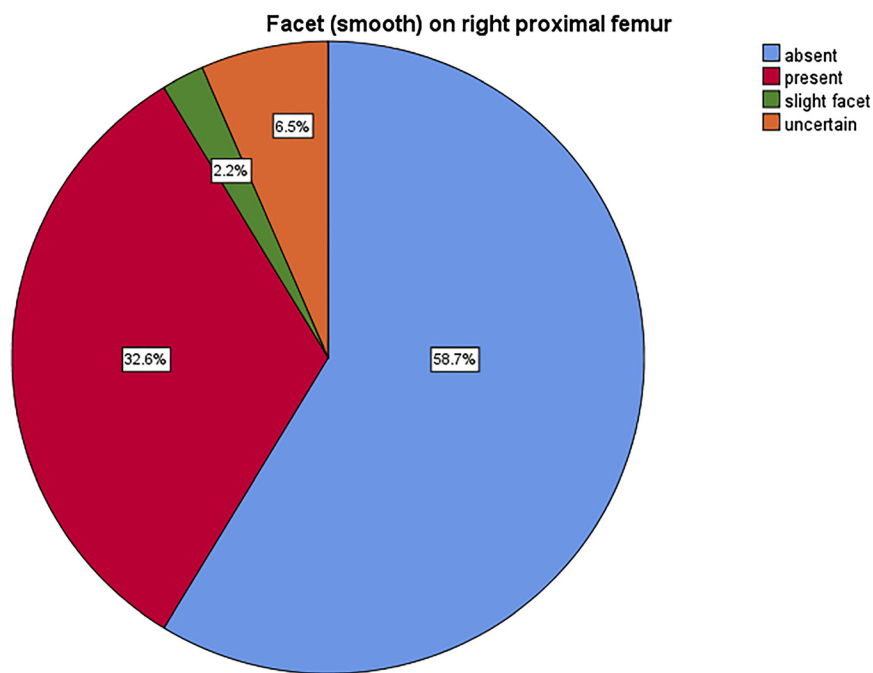


Fig. 6. Prevalence of “Poirier’s Facet” in the adult male population of the Avar cemetery of Wien-Csokorgasse (right proximal femur, $n = 46$)

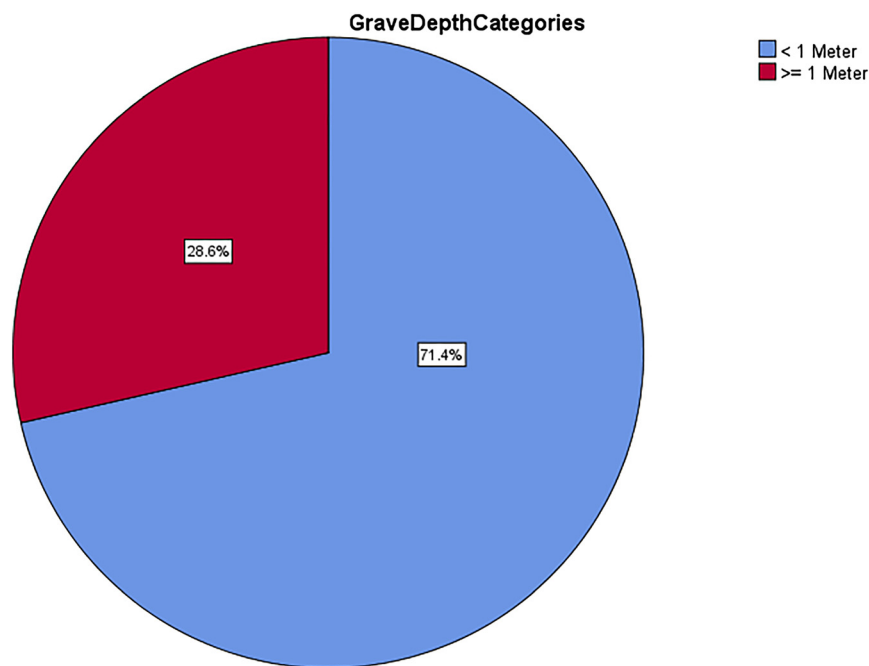


Fig. 7. Proportion of “low-status” (depth of grave less than 1.00 m) and “high-status” burials (depth of grave = 1.00 m or more) in the adult male population of the Avar cemetery of Wien 11-Csokorgasse ($n = 77$)

research – using additional criteria and comparative material from other sites – is required in order to support this assumption.

The results in Section “Prevalence of Poirier’s facet...” illustrate that the prevalence of Poirier’s facet in the adult male population of the Avar cemetery of Wien 11-

Csokorgasse (20–35%; see Figs 5 and 6) is in a remarkably similar range as the prevalence of “high-status” male burials in the same cemetery (using above-average grave depth and the presence of belt sets and arrowheads and other weapons as proxies of high status; see Figs 7–10 in Section “Prevalence of archaeological criteria...”):

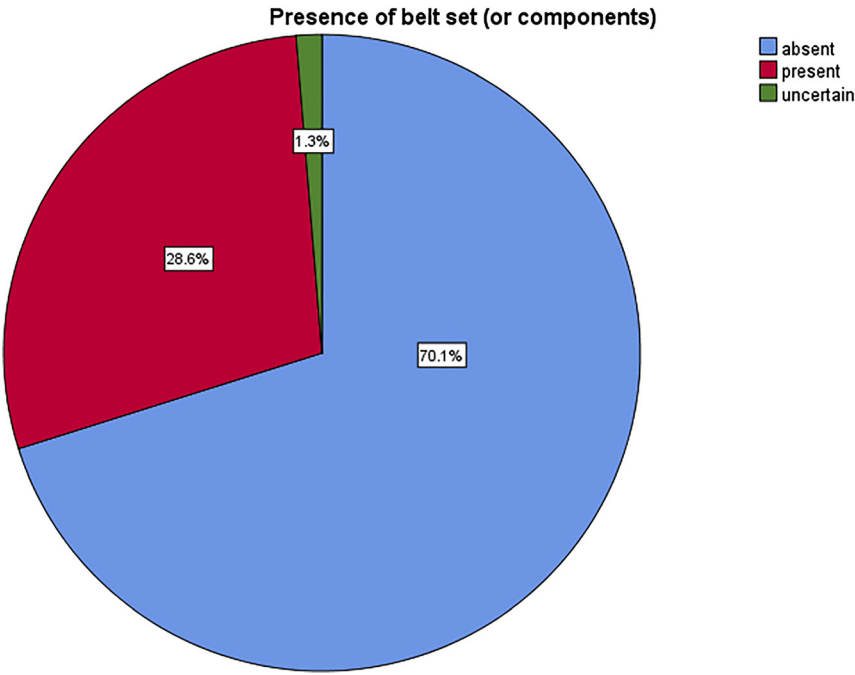


Fig. 8. Proportion of burials with/without multi-part belt sets in the adult male population of the Avar cemetery of Wien 11-Csokorgasse ($n = 77$)

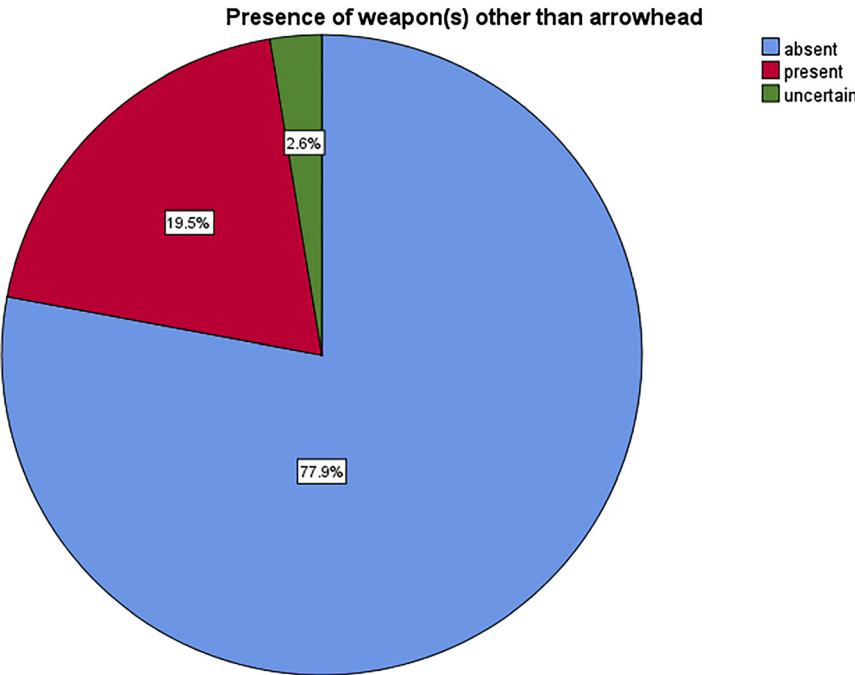


Fig. 9. Proportion of burials with/without weapons (bow, sabre, sword, axe) in the adult male population of the Avar cemetery of Wien 11-Csokorgasse ($n = 77$)

Similarly to the ovalization of the acetabulum, the presence of Poirier’s facet on the anterior proximal femur is considered a major characteristic of the horse riding syndrome by many researchers. The fact that the percentage of “high-status” male burials is always in a range of 20–30%

when different indicators of “status” such as depth of burial, multi-part belt sets, weapons are used (see Figs 7–10) could also be relevant in this context. Hence, these additional results, presented in Sections “Prevalence of Poirier’s facet...” and “Prevalence of archaeological criteria...” (Figs 5–10),



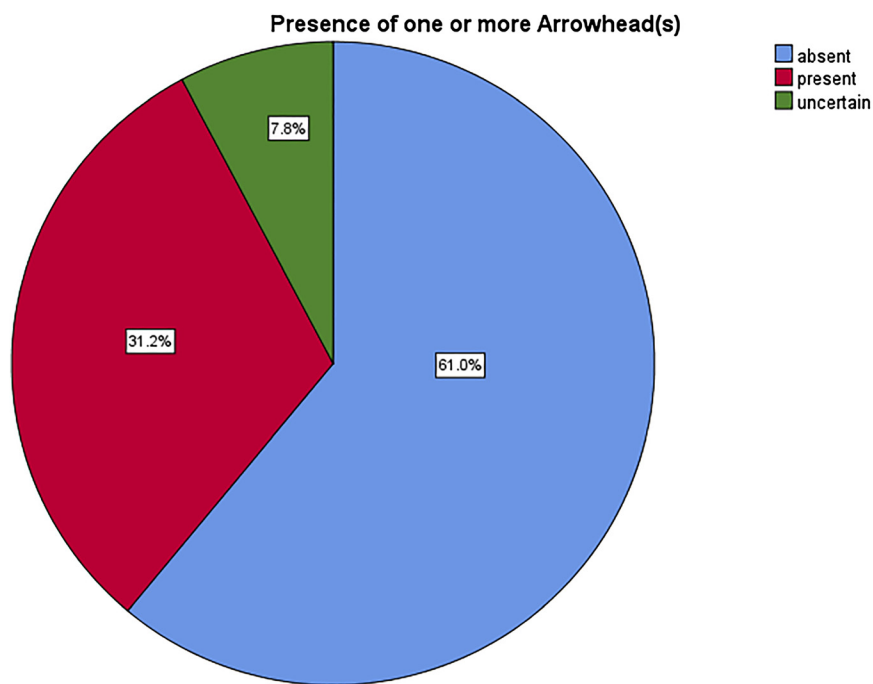


Fig. 10. Proportion of burials with/without arrowheads in the adult male population of the Avar cemetery of Wien 11-Csokorgasse ($n = 77$)

could provide further support for our hypothesis of lifestyle differences between different socioeconomic groups of the Avar male population (see Section “Differences in IOA between socioeconomic groups...”). However, more interdisciplinary research combining the osteological traits of the horse riding syndrome with the archaeological indicators of socioeconomic status is required, from other Avar cemeteries and with larger samples. This research could be extremely valuable for an investigation of the social organization of the Avar Empire.

Similarly, the results presented here could also be relevant for the issue of an increased prevalence of human-horse burials³⁸ along the north-western border of the Avar Empire in the Late Avar Period II–III (second half of the eighth century AD), in particular in present-day Slovakia and eastern Austria. In view of the results presented in the above, this phenomenon could be more than just a distant reflection of the “steppe nomadic” past of Avar society. Instead, it could suggest that a particular, “high-status” group of men preserved “mounted warrior traditions” – a lifestyle dominated by training for mounted combat as well as hunting – even at a time when the vast majority of the “lower-status” inhabitants of the Avar Empire led a very different lifestyle, focusing on agriculture. In order to reach the level of proficiency ascribed to them by historical sources such as the Byzantine *Strategikon*³⁹ from around 600 AD, Avar mounted warriors must have begun their training at an early age and devoted a considerable amount of time every day to perfecting their skills. Mounted

archery, in particular, requires an extraordinary amount of training because the technique of taking aim is instinctive, which can only be effective if the archer acquires sufficient routine in shooting from horseback.

CONCLUSION

Osteological research on the adult male population of the Avar period cemetery of Wien 11-Csokorgasse suggests that with the help of the horse riding syndrome, we may have succeeded in identifying a group of “high-status” Avar warriors, whose lifestyle appears to have differed from that of the “lower-status” male population buried in the same cemetery. These results could also be relevant for the issue of an increased prevalence of human-horse burials along the north-western border of the Avar Empire in the Late Avar Period II–III (second half of the eighth century AD), in eastern Austria and north-western Slovakia. In view of our results, this phenomenon could be more than just a distant reflection of the steppe nomadic past within Late Avar Society. Instead, it could suggest that a particular, “high-status” group of men preserved “mounted warrior traditions” – a lifestyle dominated by training for mounted combat as well as hunting – even at a time when the vast majority of “lower-status” inhabitants of the Avar Empire led a very different lifestyle, focusing on agriculture. In this context, the results of recently published archaeogenetic research on Avar populations from Hungary are relevant: “The detected East-Central Asian maternal and paternal genetic composition of the elite was preserved through several generations after the Avar conquest of the Carpathian Basin. This result suggests a consciously

³⁸See, for example, Trugly (1987).

³⁹Dennis (1984).

maintained closed society, probably through internal marriages or intensive contacts with their regions of origin. The results also hold valuable information regarding the social organisation of the Avar period elite. The mitochondrial DNA data suggest that not only a military retinue consisting of males migrated, but an endogamous group of families.⁴⁰ The concept of the Avar elite as a “closed society” is compatible with the idea of a “conservative”, mounted-warrior lifestyle preserved by high-status men up to the end of the Avar period (late eighth century AD), as documented by human-horse burials such as those found in Wien 11-Csokorgasse.⁴¹ Furthermore, this concept correlates well with the evidence for habitual horse riding provided by the osteological research presented in this paper.

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⁴⁰Csáky et al. (2020).

⁴¹Streinz (1977).



APPENDIX

Intra-observer reliability of VEAC and HOAC measurements

Measurements 1 and 2 were taken for all individuals, on the same day, and were utilized to calculate the arithmetic mean VEAC/HOAC, which was then used to calculate the IOA.

Measurement 3 was taken for 10 randomly selected individuals, in a separate measurement session several months after the session for measurement 1 & 2.

Table 1 shows that the correlation coefficient is in all cases well above 0.900, which can be considered satisfactory.

The correlation coefficient of the randomly selected control measurements taken in a separate session (measurement 3; $n = 10$) with the average of the same-day measurements (measurement 1 and 2) is in the range of 1.000 to 0.976.

Although the range is larger, this is not much lower than the correlation coefficient for measurements 1 and 2, which is 0.999 to 0.997.

Table 1. Overview of intra-observer reliability of VEAC and HOAC measurements

Spearman-Rho Correlation Coefficient	VEAC of left acetabulum	HOAC of left acetabulum	VEAC of right acetabulum	HOAC of right acetabulum
Measurement 1 vs. measurement 2	0.999	0.998	0.998	0.997
	($N = 78$; $P = 0.000$)	($N = 78$; $P = 0.000$)	($N = 80$; $P = 0.000$)	($N = 80$; $P = 0.000$)
Arithmetic mean of measurement 1 and 2 vs. measurement 3	0.997	1.000	0.976	0.985
	($N = 10$; $P = 0.000$)	($N = 10$; $P = 0.000$)	($N = 10$; $P = 0.000$)	($N = 10$; $P = 0.000$)