SVENSKA INSTITUTEN I ATHEN OCH ROM
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Opuscula

Annual of the Swedish Institutes at Athens and Rome

16
2023

STOCKHOLM

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Published with the aid of a grant from The Swedish Research Council (2020-01217)
The English text was revised by Rebecca Montague, Hindon, Salisbury, UK

Opuscula is a peer reviewed journal. Contributions to *Opuscula* should be sent to the Secretary of the Editorial Committee before 1 November every year. Contributors are requested to include an abstract summarizing the main points and principal conclusions of their article. For style of references to be adopted, see https://ecsi.se. Books for review should be sent to the Secretary of the Editorial Committee.

ISSN 2000-0898
ISBN 978-91-977799-5-1

Printed by PrintBest (Viljandi, Estonia) via Italgraf Media AB (Stockholm, Sweden) 2023
Cover illustration from Robin Rönnlund in this volume, p. 123, fig. 6. Photograph by Robin Rönnlund. Courtesy of Ministry of Culture and Sports—Directorate for the Administration of the National Archive of Monuments—Department for the Administration of the Historical Archive of Antiquities and Restorations.

ANNA TORNBERG

The humans of ancient Hermione

The necropolis in the light of bioarchaeology

Abstract

Bioarchaeology has the potential to substantially inform about ancient lifeways through osteological analyses of the remains of the once-living individuals. This article provides insights of the demography and health of the people of ancient Hermione (Geometric–Roman period). A minimum number of 85 individuals from the Hermione necropolis was osteologically analysed. Although the analysis was limited by taphonomic processes and the long period of use of the necropolis, the results point towards a population affected by urban hazards, such as infections, high child mortality, and, possibly, decreased opportunity to survive into senescence. Further, stunted growth, evidence of general stress primarily in the juvenile skeletal assemblage, and a possible case of child abuse informs of the hardships experienced by children in ancient Hermione. The osteological analysis also confirms that the two individuals buried in the "Warrior Tomb" were of both sexes. The skeletal remains were unfortunately too poorly preserved for detailed analyses of trauma or other health-related patterns. The practice of burying all age groups and both sexes in collective graves between the 6th–5th and 2nd centuries BC might correspond to the necropolis as a communal burial ground, while older and younger graves were assigned for single individuals only.*

Keywords: bioarchaeology, Hermione, necropolis, palaeodemography, palaeopathology, Warrior Tomb

https://doi.org/10.30549/opathrom-16-06

* I wish to thank Dr Alcestis Papadimitriou for the opportunity to undertake the osteological analysis and publish the material. I am grateful to the staff at the Archaeological Museum in Nafplion, and especially Angeliki Kossyva, for the possibility to work with the osteological remains from ancient Hermione and for creating such a warm and welcoming atmosphere. My sincere gratitude to Prof. Henrik Gerding and Ass. Prof. Jenny Wallensten for welcoming me into the project as well as reading and commenting on drafts of the manuscript. Thanks also to Ass. Prof. Giacomo Landeschi for help with the 3D model of the Hermione necropolis. Last, but not least, I want to thank Enbom's donationsfond for generous financial support to conduct this study.

Introduction

The ancient Greek *polis* of Hermione on the Argolid peninsula was situated at the same place and was of the same size as modern Ermioni (*Fig. 1*), which now covers the ancient remains. Archaeological campaigns, mostly non-destructive, have been carried out at the site since 2015, as a co-operation between the Swedish Institute in Athens, Lund University, and the Greek archaeological authorities.

By 1909, a substantial number of graves had been excavated by Alexandros Philadelpheus in the vicinity of Ermioni.[1] Almost a hundred years later, when a new school was to be built near the road to Kranidi, a group of Classical and Hellenistic grave monuments was detected, probably belonging to the same necropolis. The Greek archaeological authorities thus excavated the necropolis between 1991 and 1994. Further fieldwork was conducted in 2016–2017, through a joint project between the Greek archaeological authorities, Lund University, and the Swedish Institute in Athens. Archaeological reports from the excavations have been published,[2] but the substantial osteological material from 1991–1994 and 2016–2017 has not previously been analysed.

The grave monuments can be described as monumental collective graves (or burial enclosures) which are separated into individual compartments (*Fig. 2*). Some of the graves seem to have developed around, and on top of, older graves. Some of these graves date back to the Geometric period and one or more seem to have been reused during the Roman period. Thus, the time of use of the necropolis is approximately 1,500 years.[3] The graves have recently been thoroughly described by Angeliki Kossyva,[4] with a particular focus on the architecture, find material, and relative dating of the tombs.

[1] Kossyva 2021, 157.
[2] Papadimitriou & Spathari 1991; Papadimitriou 1994; 2012; Kossyva 2021.
[3] Kossyva 2021, 157.
[4] Kossyva 2021.

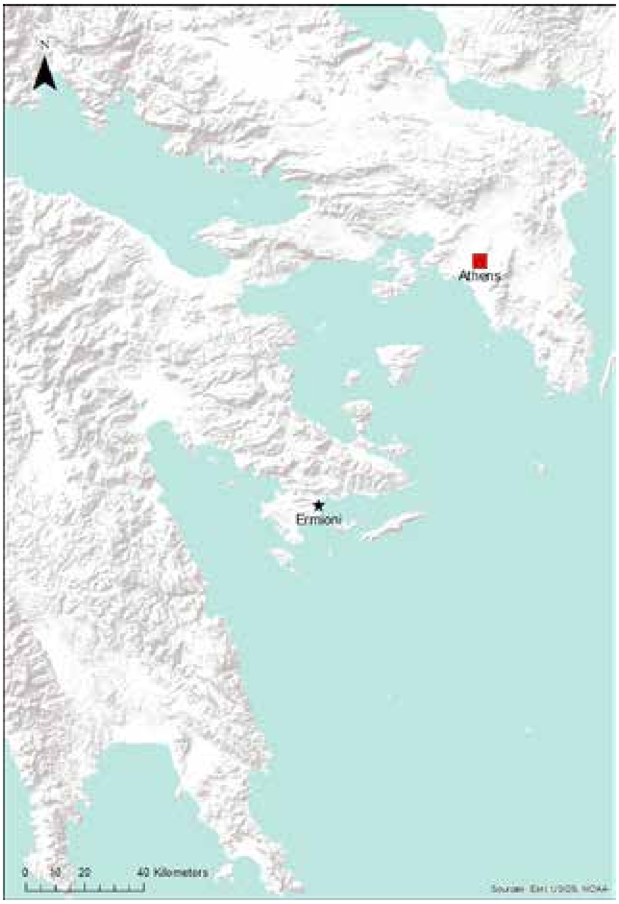


Fig. 1. Map showing the location of present-day Ermioni, which overlays the remains of the ancient polis *of Hermione. Map created using Esri ArcGIS 10.5.1.*

The grave monuments seem to be oriented along the road leading into the city, but geophysical surveys inform that they are rather arranged as separate clusters than as a single unit.[5] Collective graves of this kind, or rather reuse of earlier graves, are known from Greece from the 5th century BC onwards.[6] In his thorough investigation of social identity and status through burial analyses, Nikolas Dimakis describes the Hermione burials as being Group 2 type of burials (Groups 1–3).[7] He defines Group 2 cemeteries as having some mortuary variability and being clearly spatially arranged. In his grouping system this would put the Hermione cemetery in an intermediate position, plausibly reflecting intermediate social differences and organization.[8] The social dimensions of burials have long been important for the inference of past societies, as differences between burials could be said with some confidence to mirror differences in social status.[9] Sarah B. Pomeroy argues that it is plausible that Greek city burials might reflect an approximate cross-section of the society when it comes to sex but that the skeletal population always is skewed when it comes to social status, especially regarding the lowest classes.[10] The find of a helmet of Corinthian type, as well as other prestigious objects, in Burial Enclosure ΣΤ, however provides evidence of inhumations of individuals of some social importance in the Hermione necropolis, although the interpretation of a warrior should perhaps be considered with some caution due to the scarcity of evidence.[11] Dimakis further discusses the complexity of the cemetery as being connected to population size. An estimate of a population of *c.* 4,250 individuals in Hermione in the 4th century BC is given;[12] however, population estimates based on schematic calculations of settlement size and number of houses are always somewhat problematic and should be viewed as highly approximate numbers. Further, it is plausible that the population size of Hermione varied over time. The population density of Hermione is of interest in the bioarchaeological investigation, as living conditions affect morbidity and mortality in a population. Living in early urban societies brought substantially greater and different health risks than living in rural settlements with low population density.

The osteological material was examined by the author during autumn 2018 and spring 2019. The purpose of the analysis was primarily to evaluate demography and health in the early urban town of Hermione, but general aspects, such as the number of inhumed individuals, were also of interest. There are some limitations to the availability of osteological analyses of human remains from ancient Greece to non-Greek-speaking scholars since many reports and articles are published in Greek. This important inaccessibility of burial data significantly limits interpretations of identity, status, and social life.[13] The burial practice between adults and children sometimes deviates, and the general taphonomic loss of nonadult bones skews the record as there is loss of burial data of children.[14] The skeletal remains from geographically close Asine are studied in some detail, both considering the Helladic and the Hellenistic remains.[15] The

5 Dimakis 2016, 33; Kossyva 2021, 157.
6 Dimakis 2016, 35–36.
7 Group 1 cemeteries are densely arranged spatially and evidence significant mortuary variability. Group 3 cemeteries are small with only slight mortuary variability (Dimakis 2016, 22)
8 Dimakis 2016, 21–22.
9 See, for example, Chapman 2003 for a review; Parker Pearson 1999; Tarlow & Nilsson Stutz 2013.
10 Pomeroy 1997, 116.
11 Kossyva 2021, 158; Whitley 2002.
12 Jameson *et al.* 1994, appendix B, table B.2; Dimakis 2016, 21.
13 Dimakis 2016, 13.
14 Pomeroy 1997, 115.
15 Angel 1982; Ingvarsson-Sundström 2003.

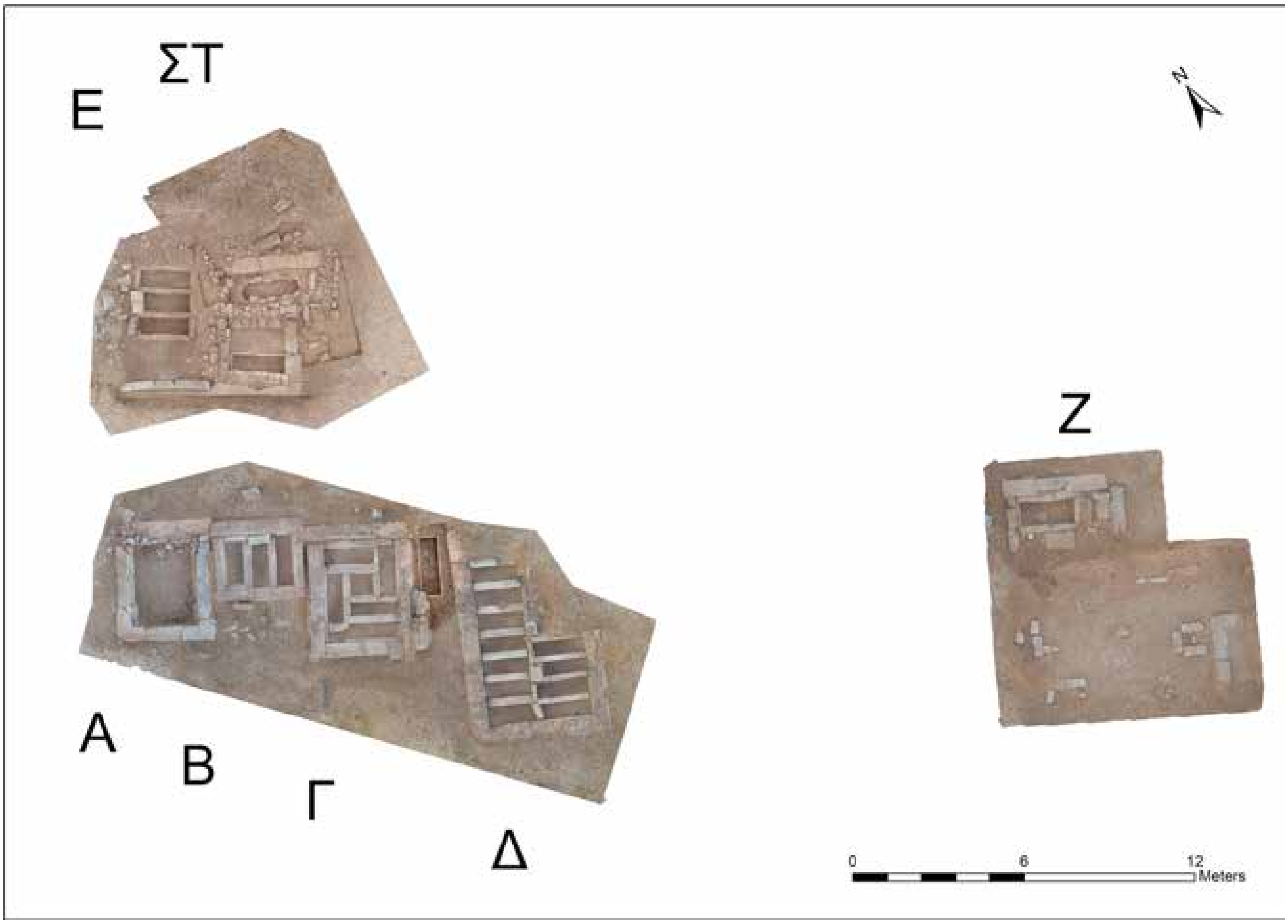


Fig. 2. The distribution and orientation of the seven Burial Enclosures A, B, Γ, Δ, E, ΣT, and Z from the excavated part of the Hermione necropolis. Courtesy of Professor Henrik Gerding and Associate Professor Giacomo Landeschi, Lund University.

doctoral thesis of Anne Ingvarsson-Sundström nicely contextualizes the skeletal remains of Middle Helladic Asine,[16] providing important knowledge about living conditions for children in ancient Greece. Bioarchaeology has the possibility to substantially contribute to the understanding of life, and sometimes death, of past populations due to the entanglement between culture (lifeway) and biology (skeletal remains). Bioarchaeology thus provides unsurpassed information of ancient lifeways through analyses of the remains of the actual individuals of the society under study.

In this paper I present the results from the bioarchaeological investigation with a focus on demography and health of the people inhumed in the Hermione necropolis.

Material and methods

The sample comprised all skeletal material from the site, hence, both the campaigns of the 1990s and of 2016–2017 were considered. All osseous material was noted, but the focus was on human skeletal remains. Animal bones were thus only registered as present/absent and in general no further attempt for species identification was made. Overall, presence of animal bones was scarce, except for sheep/goat astragali that were found in substantial numbers. Therefore, the assemblage of sheep/goat astragali will be presented in some detail.

The human skeletal remains of more than one individual were often commingled in the same grave, especially regarding the postcranial skeleton,[17] and could therefore not always be linked to specific individuals. This limited the analysis and a Minimum Number of Individuals (MNI) approach had to

[16] Ingvarsson-Sundström 2003.

[17] All skeletal elements except the cranium and mandible.

be conducted.[18] MNI was calculated using the most frequent skeletal element with distinguishing features and with age and sex as discriminators. MNI was calculated for each compartment in the burial enclosures and then summarized. It is important to note that an MNI approach always underestimates the true number of inhumations,[19] and it is thus plausible that the actual number of buried individuals was originally higher. It is plausible that a Most Likely Number of Individuals (MLNI) approach,[20] with pairing of morphologically and morphometrically matching elements, would have provided a more precise estimate of the number of analysed individuals, but this was not performed due to the restricted time available for the osteological analysis. Division of individuals was always attempted with the aid of photographic documentation using age, sex, and size characteristics. Some of the postcranial bones could thus with sufficient confidence be attributed to specific crania. However, large portions of the postcranial bones were too fragmented or with insufficient features to be separated. A minimum number of 85 individuals were analysed from the necropolis. A majority of the individuals were from burial enclosure Δ, probably due to the high number of tombs, and burials in several layers.

Sex and age were estimated using standard osteological protocol when possible.[21] Due to poor preservation, age indicators were limited to the dentition (formation and attrition) for most of the individuals, and most sex estimations were based on morphological characteristics of the cranium, which are less reliable than characteristics of the pelvis. Size was considered for preliminary sex estimation in a few cases. These correspond to postcranial bones that are either notably small and gracile (females) or notably large and robust (males). Postcranial bones of intermediate size were not assessed to sex.

Stature was estimated using the model formulated by Torstein Sjøvold,[22] which is based on organic correlation (a wheigted line of available information of stature/long bone proportion) from a wide range of populations, which neutralized possible differences in bone lengths with ethnicity. The model is valid for both sexes.

Palaeopathological lesions were registered as present and absent using visual examination only; the use of radiography for analysis was unfortunately not possible. If present, pathological lesions were described regarding location, morphology, and severeness, and were, if possible, diagnosed.

Results

THE CHRONOLOGICAL DISTRIBUTION OF THE INHUMATIONS

Archaeological evidence reveals that the use of the necropolis spanned over several centuries. The oldest burials date to the Geometric period and were found below and outside Burial Enclosure A, and the necropolis was much later reused in the Roman era, as evidenced by a find of an iron strigil in Burial Enclosure Δ, Tomb 8.[23] The long period of use severely complicates analyses and interpretations of burial practice, demography, and health of the Hermione population(s). It is likely that nutritional and health pressures, population structure, and for whom the burials were dedicated varied profoundly through these centuries. To enable demographic and palaeopathological analyses, the skeletal remains were thus divided by chronology when possible. The relative chronology in this article is based on publications by Dimakis and Kossyva.[24] Although the time of use of the necropolis was long, it is evident that most inhumations were performed in the 4th and 3rd centuries BC, and that the necropolis developed and expanded from the 6th–5th centuries BC (*Table 1*), probably corresponding to a posited cementation of Hermione as a *polis* of importance.[25] The pattern of increase in burials from the 5th century BC with a peak in burials in the 4th and 3rd centuries BC is in accordance with the general pattern in the Argolid.[26] The decrease in burials after the 2nd century BC might be associated with a change in burial practice with graves primarily being placed elsewhere, or a decrease of the population. Michael H. Jameson, Curtis Neil Runnels, and Tjeerd H. Van Andel estimate a decrease in population from 4,220 to 2,835 individuals from the Classical/Hellenistic to the Hellenistic/Middle Roman period (200–400 AD) in Hermione[27] Henrik Gerding, on the other hand, argues that a relocation of the cemetery might rather correspond to a reorganization of the settlement due to an increased population caused by in-migration from surrounding settlements and Hermione's function as a *polis* of some importance in the 4th century BC.[28]

18 White 1953.
19 Lyman 2008, 38–82.
20 Adams & Konigsberg 2004.
21 Buikstra & Ubelaker 1994.
22 Sjøvold 1990.

23 Kossyva 2021, 162.
24 Dimakis 2016; Kossyva 2021.
25 Gerding 2021, 78.
26 Dimakis 2016, 127, fig. 31.
27 Jameson *et al*. 1994, appendix B, table B.2.
28 Gerding 2021.

Date	Graves	# adults	# juveniles	Total
Geometric	Burial Enclosure Α, Tomb 1; (trench?*)	3	0	**3**
Classical	Burial Enclosure Δ, Tomb 13	1	1	**2**
6th–5th centuries BC	Burial Enclosure Δ, Tomb 5; Burial Enclosure Ε, Tomb 4; Burial Enclosure ΣΤ1; ΣΤ1 cist tomb	7	3	**10**
4th century BC	Burial Enclosure Δ, Tombs 4, 6, 12	4	11	**15**
Hellenistic	Burial Enclosure Ε, Tombs 1, 2, 3	4	2	**6**
3rd century BC	Burial Enclosure Γ, Tombs 1, 3, 5; Burial Enclosure Δ, Tombs 2, 3, 4, 8, 10	20	2	**22**
2nd century BC	Burial Enclosure Δ, Tombs 2, 7, 9, and ΣΤ north extension	9	3	**12**
Roman	Burial Enclosure Δ, Tomb 8	4	0	**4**
2nd century AD	Burial Enclosure Δ, Tomb 10	5	0	**5**
Unknown	Burial Enclosure Δ, Tombs 11, 14	2	4	**7**

*Table 1. The chronology of the graves with the minimum number of individuals for each period. The approximate dates for each burial have been established in reference to Dimakis (2016) and Kossyva (2021). Burials that are not assessed to specific century are separated and reported as period only. Each tomb might correspond to more than one date due to muliple burials.*The "trench" refers to bones marked with "trench" in the museum storage. It is somewhat unclear where this trench is situated, but it is plausible that it refers to inhumations found south of Burial Enclosure Α and Β, and hence probably of Geometric date.*

THE WARRIOR TOMB—BURIAL ENCLOSURE ΣΤ, TOMB 1

One of the most prominent graves was Tomb 1 in Burial Enclosure ΣΤ. As well as containing a Corinthian-type helmet, the grave was richely furnished with imported ceramics and a bronze mirror among other items. The grave has been described in depth by Kossyva, who argues that the inhumed must have been from the upper social class, one of whom was perhaps a warrior.[29] The grave included remains from two individuals. The individuals were archaeologically sexed as a man and a woman based on the grave goods. Considering the special nature of the artefacts retrieved from the grave, there was hope that the osteological analysis could bring some clarity regarding the individuals.

Unfortunately, the remains from this burial were poorly preserved and could not provide information about any palaeopathological lesions or health indicators, such as stature. The remains were heavily fragmented and usually absent of original bone surfaces, and no elements were suitable for detailed age estimations. All visible epiphyses of the long bones were fused, which indicates adult age for both individuals. Further, the remains originate from two individuals of significantly different sizes, plausibly one female and one male. The morphological characteristics of one of the skulls are more in accordance with a female than a male. Thus, the osteological analysis confirms the archaeological sex assessment of the buried but cannot either confirm or dismiss any pathological lesions related to battle activities or provide more information about general health of the inhumed.

THE PALAEODEMOGRAPHY OF THE HERMIONE NECROPOLIS

It is evident that the graves of the Hermione necropolis were used differently, spanning from single burials to up to ten inhumations in each grave (*Table 2*). It is possible that this difference partly depends on the length of time the grave was in use. The graves with the highest number of inhumed individuals are primarily dated between the 4th and 2nd centuries BC and could correspond to a tradition of family graves. However, it cannot be excluded that the graves with lower number of exhumed individuals have suffered from taphonomic loss and that the original number of inhumed individuals was higher.

In some of the graves there seems to be a division between primarily juvenile and primarily adult inhumations.[30] This is especially accentuated in Burial Enclosure Δ, Tomb 12, with burials dated to the 4th century BC,[31] where a majority of the individuals (seven out of ten) are juveniles of different ages. The ages spans from foetal to adolescence with four children being at or under the age of five, two between 10–15, and one adolescent. The adults correspond to two adult males and one adult female. It is possible that the foetus is related to the in-

[29] Kossyva 2021, 158–159.

[30] The term "Juveniles" refers to skeletal remains that are not yet fully grown (i.e., with fused epiphyses) and used interchangeably with sub-adult/non-adult/immature (see e.g. Cunningham *et al.* 2016, 8).

[31] Kossyva 2021, 163.

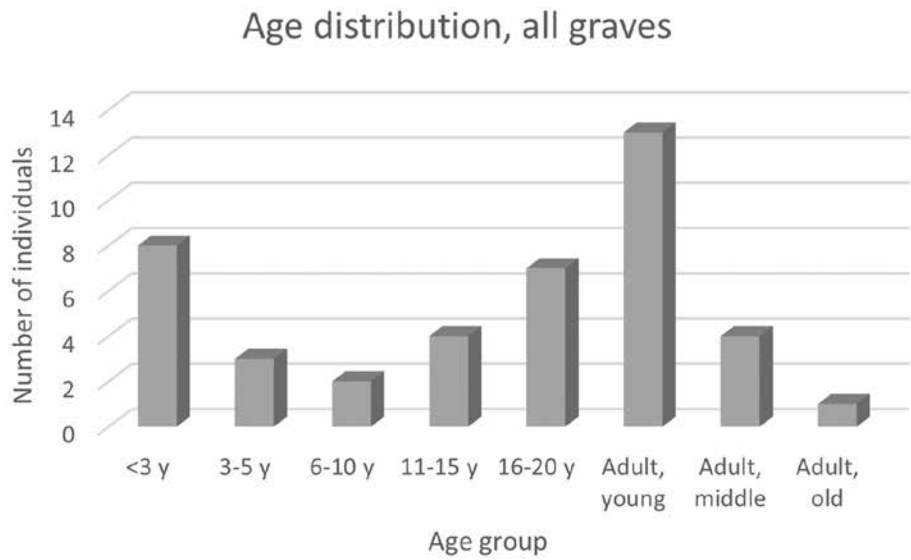
Burial Enclosure	Tomb	MNI	no. adults	no. juveniles	no. females	no. males	no. indeterments
1991–1994 Excavations							
Α	1	1	1	0	1	0	0
Β	1	2	2	0	1	0	1
Γ	1	1	1	0	0	1	0
Γ	3	3	2	1	0	1	2
Γ	4	1	1	0	1	0	0
Γ	5	5	4	1	2	1	2
Δ	2	1	1	0	0	1	0
Δ	3	3	3	0	1	2	0
Δ	4	1	1	0	0	0	1
Δ	8	2	2	0	1	0	1
Δ	10	3	3	0	1	1	1
Ε	1	2	1	1	0	2	0
Ε	2	1	1	0	0	1	0
Ε	3	3	2	1	0	0	3
Ε	4	3	2	1	1	1	1
ΣΤ	1(IV)	2	2	0	1	0	1
n.a.	trench	2	2	0	0	1	1
2016–2017 Excavations							
ΣΤ	1	2	2	0	2	0	0
Cist tomb	2	2	1	1	0	0	2
North extension	4	1	0	1	0	0	1
Δ	5	3	1	2	1	1	1
Δ	6	4	1	3	0	0	4
Δ	7	7	6	1	0	2	5
Δ	8	4	4	0	1	2	1
Δ	9	3	2	1	0	1	2
Δ	10	5	5	0	1	2	2
Δ	11	5	1	4	0	0	5
Δ	12	10	3	7	1	2	7
Δ	13	2	1	1	0	0	2
Δ	14	1	1	0	0	0	1
Total		**85**	**59**	**26**	**16**	**22**	**47**

Table 2. The distribution of individuals, divided by sex and age, from all osteologically analysed graves. Tombs 1–14 correspond to tombs excavated in the 2016–2017 campaigns. The campaigns have been divided since there is a discontinuity of the way the tombs were named. The tombs from the 2016–2017 excavations are presented in numerical order.

humed female. Without higher chronological resolution and DNA analyses of possible kinship relationships, it is not possible to confirm or discard the grave as a family grave. Further, there is the possibility of taphonomic problems both in assessing the number of inhumations and the frequency of juvenile burials, since immature remains suffer from higher risks of taphonomic loss due to the higher proportion of organic to mineral composition,[32] so that some of the graves are biased towards adult remains.

Although spanning a long chronological period, the distribution of adult vs. juvenile remains is to be considered normal in early urban societies, with 69.4% (n = 59) being adults and 30.6% (n = 26) being juveniles. The distribution is the same when only considering individuals from the dominant period of use (6th–2nd centuries BC): 69.5% (n = 41) adults and 30.5% (n = 18) juveniles, which could reflect a relatively stable population from the 6th century BC onwards. It is evident that the commingling and fragmentation of the skeletal remains of all ages has provided problems in assessing the biological sex. Only 38 individuals could be sexed, corresponding to 64.4% of the adult remains. From these 38 individuals, 42% were assessed to be females and 58% were assessed as males. There is sex bias in the material, but it is plausible that this is a result of the high proportion of individuals with indeterminate sex. Females are generally more difficult to sex in severely fragmented remains since the assessment is based on the lack of discriminating morphological characteristics that are visible in males. Hence, females are more likely to be included in the indeterminate category.

32 Lewis 2007, 23–26.



Fig, 3. Distribution of ages in the sample where it has been possible to age individuals in more detail (n = 42). Age ranges following those of Buikstra & Ubelaker 1994. Foetus = <birth; Infant = 0–3 y; Child = 3–12 y; Adolescant = 12–20 y; Young adult = 20–35 y; Middle adult = 35–50 y; Old adult = 50+ y. Illustration by Anna Tornberg.

From the total sample of 85 individuals, it has been possible to age in more detail 42 individuals—24 juveniles and 18 adults. The higher number of aged juveniles is a result of the more accurate age estimation methods, reliant on bone and tooth maturation, than those for adult remains that rely on morphological charactereristics of skeletal and dental attrition. Regarding the juvenile remains, it is evident that most juveniles represented in the sample died during their first years (*Fig. 3*). However, a relatively large proportion of the juvenile remains correspond to ages of late childhood and adolescence, where mortality normally is low. It is possible that the increase in mortality in the older age groups corresponds to breakouts of infectious disease, which usually reflects as increased late child mortality.[33] Since the sample spans over a long period, this interpretation may be based on coincidence, and no definite conclusions should be drawn from the mortality patterns that appear to be represented here. Adult mortality is mostly represented by young adults, and only one survived into senescence (above 50–60 years). This pattern is in discrepancy with normal demography where mortality in young adulthood is low, showing increasing mortality with age. High mortality in young adulthood can be linked to risks associated with pregnancy and childbirth in females and high levels of violence in males, but infectious outbreaks of some severity might also affect adult mortality. The presence of the remains from two foetuses might provide evidence for pregnancy-related mortality in ancient Hermione, but the overall pattern of young adult mortality is more likely reflective of biases in the age estimation method, and the highly fragmented and commingled state of the remains. Recent studies have questioned the accuracy of traditional osteological methods for age estimations and have provided strong evidence for that these methods have low correlation with actual age at death.[34] Considering that a majority of the adult individuals have not been possible to assess to more specific age, a division between the sexes is not considered to provide relevant data in this sample.

STATURE

Stature is a good measurement of general health since it is influenced both by genetic (80%) and environmental factors (20%).[35] When addressing stature on a population level variation in stature seems to correctly reflect more and less beneficial living conditions. The World Health Organization uses stature as a measurement of physical status since poor living conditions can stunt growth in children. Growth retardation could however be balanced through catch-up growth when living conditions get better. If the bad conditions persist catch-up growth fails, resulting in short adult stature.[36] In modern reference Malawi, a country with one of the lowest gross domestic product (GDP; a common measure of a nation's wealth) in the world, have male mean statures of 165.7 cm, while Sweden, with one of the highest GDP of the world, have male mean statures of 180.5 cm.[37] Stature in Sweden has dramatically increased (*c.* 167–180 cm) from the mid-19th century to present (called secular trend; increasing statures between generations as a result of improved living conditions),[38] as Sweden transformed from a poor agricul-

33 E.g., Lewis 2007, 86; Black *et al.* 2008.

34 Boldsen *et al.* 2002; Milner *et al.* 2021.

35 E.g., Carmichael & McGue 1995; Carson 2012.

36 Steckel 2012.

37 The NCD Risk Factor Collaboration, country-specific data. Data from 2019 for 19-year-old boys. See NCD-RisC 2023, listed in bibliography.

38 Cole 2000; 2003; Stinson 2012; Bogin 2013.

tural society to the welfare state of today. Male stature fluctuates more, since males biologically invest excess energy in lean weight (height), while females invest excess energy in body fat to increase reproductive success.[39] It might therefore be more relevant to primarily evaluate male statures when discussing health changes in past populations.

Unfortunately, it was only possible to measure three long bones for stature reconstruction. Of the three bones, two were from the same individual (a fibula and an ulna), a young adult of unknown sex. Since bones of the lower extremities better correspond to living stature, only the fibula was used for stature estimation. The fibula measured 31.4 cm with a calculated living stature of 149.04 ±4.1 cm. Considering the low stature it is likely that the individual is of female sex. The other individual, an adult female, could be estimated to a living stature of 154.26 ±4.49 cm by a measurable femur of 40 cm. Mean female statures have been reported as 157.5 ±5.31 cm in the Roman period,[40] and ranging between 153.4 and 160.4 cm for the complete span of Hellenic antiquity (Mesolithic–Early Byzantine times).[41] Both individuals from Hermione thus evidence statures below, or in the lower end of, contemporaneous females. Although it is possible that the individuals have genetically low statures, it is likely that poor living conditions in childhood stunted growth in ancient Hermione.

PALAEOPATHOLOGY

Evidence of pathological lesions in the Hermione remains is relatively low, and most lesions are associated with degenerative changes with increasing age, such as osteoarthritis and degenerative changes in the vertebral column. Considering the fragmented and commingled state of the remains, accurate diagnosis could seldom be made, and so the morphology of the lesions is described without stating a diagnosis. It is evident that of the complete Hermione sample, most individuals with pathological changes were exhumed during the 2016–2017 excavations, which probably reflects differences in excavation procedure between the campaigns: only five individuals from the campaign in the 1990s showed evidence of any pathological lesions. A full description of the pathological lesions (dental pathologies excluded) can be found in the *Appendix*.

Dental health

The material is severely affected by taphonomy, possibly due to excavation methodology. The majority of teeth recovered from the necropolis primarily come from the excavations of 2016–2017; this is the case also for small postcranial bones such as carpals. It is likely that the lack of teeth and small bones from the excavations in the 1990s is due to a lack of sieving. A total of 349 teeth were studied, of which 244 teeth were post-canine. Of the 244 teeth, 243 teeth could be scored for dental caries. A total of 14 carious teeth were recorded, with as many lesions. This adds up to a frequency of 5.8% of the scorable post-canine teeth. Stable isotope analyses of remains from ancient Greece provide evidence for a diet primarily based on terrestrial products of C_3 plant material[42] and animal protein,[43] but in some cases C_4 plants, such as millet, and aquatic resources seems to have been important contributions to the diet.[44] The pattern of low amount of dental caries in the Hermione material might correspond to the low age at death, as the risk of carious lesions increases throughout life. It is evident that most individuals only suffered from one lesion and the number of individuals with dental caries is eleven. That adds up to a total of 12.9% of the individuals suffering from dental caries (n = 85). Most of the cavities were interproximal and moderate in severity, but a few cases of cervical caries, large caries, and one case of occlusal caries was also present. All but one of the individuals were adults; four males, three females, and three of indeterminate sex. The only juvenile exhibiting dental caries was a small child of the age of three–four years, who also showed pathological pitting of the left temporal, possibly related to C-vitamin deficiency.[45] C-vitamin deficiency causes swelling and bleeding of the gingiva,[46] and it is plausible that the swollen gingiva, together with a starch-rich, cereal-based diet caused the carious lesion. There is no evident chronological difference in the presence of dental caries. The suffering individuals date to the 6th–5th centuries BC (n = 2), the 3rd century BC (n = 3), the 2nd century BC (n = 4), the 2nd century AD (n = 1), and the Roman period (n = 1).

Dental calculus (calcified plaque) was relatively uncommon, but 13 individuals showed evidence of calcified plaque on one or more teeth. The causes of the mineralization of dental plaque are still somewhat unknown, but it is likely that bacteria play an important role. The deposit of plaque is however linked both to poor oral hygiene and high intake of carbohydrates.[47] Severe dental calculus formation causes

39 Wells 2012, 411.
40 Koukli *et al.* 2021.
41 Koukli 2020.

42 C_3 and C_4 plants have different types of photosynthesis. C_3 plants are the most common and usually found in temperate environments. C_4 plants are less common (millet, maize), and usually found in arid environments. C_4 plants have similar isotopic ^{13}C signal as marine organisms. For more details, see e.g., Richards 2019, 130–133.
43 Ingvarsson-Sundström *et al.* 2009; Petroutsa & Manolis 2010; McConnan Borstad *et al.* 2018.
44 Vika 2011; Dotsika & Michael 2018.
45 Buikstra 2019, 532–537.
46 Roberts & Manchester 2007, 234–235.
47 Hillson 1996, 254–257.

Fig. 4. Linear enamel hypoplasias (LEH) on anterior teeth from one of the Hermione children/adolescents (Burials enclosure Δ, tomb 5). The hypoplasias occur on several teeth and are probably associated with prolonged health stress and premature death. Photograph by Anna Tornberg. Copyright: Euphorate of Antiquities of Argolid, Hellenic Ministry of Culture.

Fig. 5. Possible evidence of anaemia through evidence of substantial thickening of the diploëic structure of the frontal and parietal bones, which would be visible on radiography as a "hair-on-end" appearance. Human remains found in Burial Enclosure ΣT, Tomb 1. Photograph by Anna Tornberg. Copyright: Euphorate of Antiquities of Argolid, Hellenic Ministry of Culture.

periodontal disease, and in advanced stages *ante-mortem* toothloss. None of the individuals showed evidence of severe calculus formation that would have affected general health in any profound way.

Evidence of general stress

Enamel hypoplasia, or defects in the formation of the enamel during childhood, is normally associated with general stress, such as poor nutrition or infectious disease, but could also be linked to localized trauma or heredity.[48] Enamel hypoplasia could be recorded from 313 teeth from 79 individuals. A total number of 25 teeth from nine individuals exhibited enamel hypoplasia, all of which were linear enamel hypoplasias (LEH) (*Fig. 4*). This corresponds to a frequency of 8% of the teeth and 11.4% of the individuals. It is noteworthy that all but two of the individuals were children or adolescents, clearly showing an increased risk of dying prematurely associated with LEH. One of the individuals died at the young age of two–three years (Burial Enclosure Δ, Tomb 12), two individuals between the ages of 5–10 years (Burial Enclosure Δ, Tombs 6, 10), three individuals between the ages of 10–15 years (Burial Enclosure Δ, Tombs 9, 11, 13), and one (Burial Enclosure Δ, Tomb 5) between the ages of 15–20 years. Both adults died as young or middle adults (Burial Enclosure Δ, Tombs 8, 10). The date of the burials spans from 6th–5th centuries BC to the Roman period, and there is no obvious difference in the presence of LEH between periods. It is likely that the LEH in the children and adolescents correctly reflects events of past physiological stress that might have affected the health status of the individuals for a long time.

Only three individuals showed any evidence of *cribra orbitalia* (CO). CO is visible as pitting of the orbital roof and has traditionally been seen as indicative of iron-deficiency anaemia.[49] The aetiology has however been debated the last decades and might rather be reflective of general physiological stress.[50] It is noteworthy, however, that all three individuals in the Hermione sample are adult females, and that all cases are healed. However, due to the severely fragmented state of the remains the number of observable orbits is low, and the frequency of CO is probably biased downwards. Usually, CO is common, visible in up to 75% of ancient populations,[51] but the frequency varies greatly. Studies of remains from the Greek colony of Himera (Sicily), dated to the 6th–5th centuries BC, provide evidence of CO in 20–30% of the individuals.[52] It is likely that the real incidence of CO in Hermione was much higher than is visible in the skeletal data. The relatively high frequency of LEH suggest that general physiological stress was rather common, as teeth are more resistant to taphonomic processes.

One female individual (Burial Enclosure ΣT, Tomb 1) however suffered from probable haemolytic anaemia (sickle cell anaemia or thallasaemia). In contrast to iron-deficiency anaemia, inherited haemolytic anaemia increases the bone marrow responsible for producing red blood cells, which leads to, for example, thickening of the skull (diploëic bone) and is visible as a "hair-on-end" appearance on radiography.[53] Co-evolutionary processes have increased the prevalence of genetically induced anaemia in areas with high risk of malaria

[48] E.g., Roberts & Manchester 2007, 75.

[49] Roberts & Manchester 2007, 229–234.
[50] Waldron 2009, 136–137.
[51] Roberts & Manchester 2007, 231.
[52] Kyle *et al*. 2018; Keenleyside & Panayotova 2006.
[53] Waldron 2009, 136.

infection, since both heteryzygotic sickle cell anaemia and thallasaemia offers some protection against the disease.[54] In the case of Hermione the individual evidences a significant thickening of the skull (*Fig. 5*). To be able to conclude a "hair-on-end appearance", the aid of radiography is necessary, which is why the diagnosis is somewhat uncertain at present.

Pathologies of the spine

The vertebral column was relatively often associated with signs of pathologies. A total of nine individuals, all adults, evidenced changes to one or more of the vertebrae. Degenerative changes of the superior and inferior articular surfaces were relatively common vertebral pathologies, especially among adults over the age of 30–40 years. The degenerative changes were seen as pitting and lipping, and, in one case, as eburnation and furrows caused by bone moving against bone. Other vertebral changes consist of Schmorls' nodes, *ligamenta flava*, and intervertebral disc disease (IVD), as well as marginal lipping (osteophytes) of the vertebral body. It is not likely that any of these pathologies caused profound discomfort for the individuals; in fact, osteophyte formation and Schmorls' nodes are to be considered normal "wear and tear" with advancing age. Schmorls' nodes, seen as depressions on the joint surface of the vertebral body, are caused by protrusions of degenerated intervertebral discs into the body surface, and are very common throughout antiquity. The development of osteophyte formation starts in the 30s and by the age of 50 a majority will evidence marginal lipping of the vertebrae, with some stiffness as a result.[55] Osteophyte formation is relatively rare in the Hermione assemblage, recorded in single individuals only. This likely corresponds to the general low ages at death in the buried population, as highlighted in the palaeodemographic analysis above. Ossification of the *ligamenta flava* in the vertebral arcus is relatively common (4–6% in modern populations). It usually does not cause symptoms and can develop as early as in the 20s.[56] On rare occasions, the ossified ligaments, when profound, can protrude into the spinal cord and cause neurological problems.[57]

Osteoarthritis

Three individuals evidenced diagnostic criteria for osteoarthritis (OA). Only evidence of eburnation, i.e., polishing and densification of bone due to bone grinding against bone because of total lack of joint cartilage, was considered diagnostic for OA.[58] Marginal lipping and porosity of joint surfaces was not diagnosed as OA since the lesions are not pathognomonic. It is plausible that some of the cases of marginal lipping and surface pitting are associated with earlier stages of OA, but other diagnoses cannot be ruled out. There is no consistency to which joints were affected by OA, but this may be a result of the sparse number of observations. An adult female suffered from OA in her thumb, one adult male from OA in the lower spine, and an adult individual of unknown sex suffered from OA in its foot, probably secondary to an ankle fracture. It is likely that both the female and the male were older adults, but no age indicative elements were present for analysis. Generally, OA increases dramatically with age, and most individuals in senescence suffer from OA in at least one joint. The aetiology of OA is somewhat questioned; both activity and genetics seem to play important roles.[59] It is however likely that the OA in the thumb of the female at least partly depend on repetitive use of the thumb throughout life, but specific activities are extremely difficult to assess with any confidence.

Infections

Infectious diseases are always under-estimated in palaeopathological analyses, because most infections have an acute course of disease from which you either recover or die in a few days to weeks, and as a result only a few infectious diseases last long enough to develop skeletal changes. Some infections, however, are or can develop to be chronic, and thus leave skeletal marks. Examples of chronic infections are tuberculosis and brucellosis, both being zoonoses, i.e., transmittable between humans and animals.[60] Both diseases were common before the practice of pasteurization since they often transmit between bovids and humans through dairy products. Sometimes these diseases leave pathognomonic traces on the skeleton, but more often skeletal symptoms are diffuse and could be caused by a variety of pathogens. Usually, characteristics throughout the skeleton must be considered for adequate diagnosis, an endeavour impossible in heavily fragmented and commingled remains. Therefore, it is better to discuss signs of infections and non-specific inflammation in the Hermione context.

Two individuals showed signs of maxillary sinusitis. Maxillary sinusitis is generally difficult to assess since it is seldom possible to examine the sinuses due to their anatomical position. Some studies conclude that urban societies exhibit higher frequencies of sinusitis than rural societies, due to higher exposure to air pollution.[61] In other studies, such patterns are

[54] Durham 1991, 103–153; Waldron 2009, 136.
[55] Roberts & Manchester 2007, 163–164.
[56] Kudo *et al.* 1983.
[57] van Oostenbrugge *et al.* 1999.
[58] Waldron 2009, 28.
[59] Waldron 2009, 28.
[60] Roberts & Buikstra 2019, 321.
[61] E.g., Boocock *et al.* 1995; Lewis *et al.* 1995; Sundman & Kjellström 2013.

missing,[62] which is why the aetiology of sinusitis is somewhat inconclusive. Generally, cooking food and heating houses with an open fire increases the risk of sinusitis,[63] and overall high prevalence is to be expected in ancient remains.

Three individuals evidenced mild periostitis of the fibula and one female individual (Burial Enclosure Δ, Tomb 3) suffered from severe periostitis of both the tibia and the fibula (*Fig. 6*). Periostitis could depend on activity-induced inflammation or local venous stasis, but more often by infections caused by a variety of pathogens.[64] The infection could either spread directly to the periosteum by local trauma and through the blood from other parts of the body. In the case of the female in Burial Enclosure Δ, Tomb 3, the severity of the periostitis rather points to an infectious cause of pathology. It is however not possible to conclude if the infection was due to local soft tissue trauma or if it is associated with general infection. No other pathological lesion was detected in the remains. Periostitis is one of the most common pathological conditions found in ancient remains, sometimes adding up to 18% of the population.[65]

One adult individual of unknown sex in Burial Enclosure Δ, Tomb 13 shows evidence of infection of the cervical vertebrae, the left femoral head, and lipping of the distal first right metacarpal. It is likely that the documented pathologies are associated with a specific infection, but the absence of pathognomonic changes makes a diagnosis too insecure.

A possible case of child abuse

Evidence of trauma and violence is sparse in the Hermione remains. One individual suffered from a fractured ankle with secondary OA (see above), and another individual showed evidence of two healed rib fractures. Rib fractures could correspond to violence but could equally be caused by accidents or even severe and prolonged coughing.[66] There is however one case of a young child, aged five–six years, in Burial Enclosure Δ, Tomb 12, that might have been the victim of child abuse.

In medicolegal cases, child abuse is always difficult to assess with certainty since children often suffer from trauma due to accidents when playing. However, the pattern and timing of trauma can provide information about when the trauma is intentionally induced.[67] In young children the head and chest regions are more commonly traumatized while the head and long bones are more likely to be fractured in older children.

Fig. 6. Significant new bone deposits of the fibula (left) and distal tibia (right) due to periostitis. Shown distal end up. Human remains from Burial Enclosure Δ, Tomb 3. Photograph by Anna Tornberg. Copyright: Euphorate of Antiquities of Argolid, Hellenic Ministry of Culture.

Further, abused children are more likely to have poor dental hygiene and stunted growth because of general neglect.[68] A well-documented example of child abuse in ancient Greece is reported in individual AA 26a from the Agora Bone Well. The small child of only 16–18 months showed evidence of an *ante-mortem* fracture to the skull and *perimortem* fractures to three ribs as well as periosteal responses to traumatic injuries in several other skeletal elements.[69] The pattern of both healed and unhealed fractures is often used as evidence of child abuse in medicolegal cases.[70]

In Hermione, the child shows evidence of a 10 × 15 mm healed blunt force trauma on the midline of the frontal bone, as well as a healed rib fracture (*Fig. 7*). Depressed skull fractures are generally associated with intentional violence, while falls usually result in linear fractures.[71] Further, the temporal bones are pitted, indicative of physiological stress, plausibly anaemia (*Fig. 8*). It is possible that general neglect resulted in insufficient nutrition. There is no *perimortem* trauma evident in the remains, and the cause of death is unknown.

62 Panhuysen *et al*. 1997.
63 Roberts & Manchester 2007, 174–176.
64 Roberts & Manchester 2007, 172–174.
65 Roberts & Manchester 2007, 199.
66 Hanak *et al*. 2005.
67 Symes *et al*. 2012, 354–361.
68 Symes *et al*. 2012, 359.
69 Liston *et al*. 2018, 32–36.
70 Symes *et al*. 2012, 354–361.
71 Walker 1989; Lovell 1997; Symes *et al*. 2012; Li *et al*. 2021.

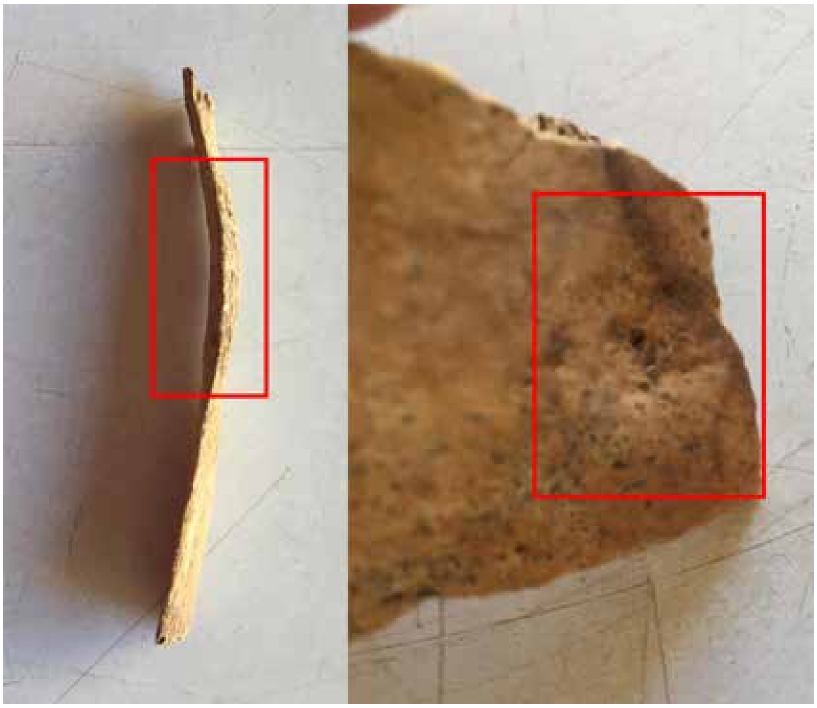


Fig. 7. Healed fracture to the midshaft of the rib (left) and a healed depressed fracture of the frontal bone (right) of the possibly abused child in Burial Enclosure Δ, Tomb 12. Photograph by Anna Tornberg. Copyright: Euphorate of Antiquities of Argolid, Hellenic Ministry of Culture.

Fig. 8. Pitting of the temporal bone of the child in Burial Enclosure Δ, Tomb 12, possibly connected to physiological stress due to general neglect. Photograph by Anna Tornberg. Copyright: Euphorate of Antiquities of Argolid, Hellenic Ministry of Culture.

OTHER OSSEOUS REMAINS

As well as human skeletal remains, some additional osseous material from the necropolis was documented during the osteological analysis. Most animal bones were astragali from sheep and/or goats. No thorough zooarchaeological analysis was conducted since this was not the aim of the present osteological examination, and hence more detailed reference to species has not been made. More than 50 astragali (one drilled from both sides) were found in the osseous material, divided over six graves in Burial Enclosure Δ, Tombs 2, 6, 7, 9, 12, and 13. All the graves were excavated during the 2016–2017 campaign and all graves included remains from one or several children. None of the graves with only adult remains included astragali from sheep and/or goat. With the dates of the graves spanning from Classical period/4th century BC to 2nd century BC it is evident that the practice of ritual deposits of sheep/goat astragali in the Hermione necropolis reflects a long tradition.

Sheep/goat astragali are commonly found in ritual contexts in the ancient Mediterranean and have been interpreted as both as cultic objects (some inscribed with the names of deities), and as dices of ancient games.[72] It is likely that astragali should be given different functions depending on context; large hoards of astragali plausibly reflect religious purposes, while smaller deposits in graves and settlements might rather reflect a profane function. Matthew Susnow *et al.*, discuss drilled astragali as being related to the divine realm.[73]

It is possible that the presence of astragali only in graves with interred children in Hermione is indicative of a special ritual practice connected to age. However, all the graves also contain remains from adults, which is why a definite conclusion cannot be drawn. Astragali have previously been found in graves of all ages and both sexes.[74] The astragali could have been deposited as grave goods representing dices for games, but ritual or religious properties seem evident considering the inherent ritual connotation of a burial context. Further, the presence of one drilled astragalus should plausibly be interpreted as a pendant with ritual qualities.

[72] E.g., Gilmour 1997; Susnow *et al.* 2021.
[73] Susnow *et al.* 2021; Thomas *et al.* 2022.
[74] Thomas *et al.* 2022.

Discussion

The bioarchaeological analysis of the remains from the necropolis provides some insight into the mortality patterns as well as pathological lesions and general health of the population(s) of ancient Hermione. The long continuity of the necropolis, however, limits interpretations of the populations' structures as well as health conditions since it is likely that living conditions changed over time. The study is further limited by both burial tradition and taphonomic processes, which resulted in heavily fragmented and commingled skeletal remains, often lacking original bone surfaces, small bones, and elements with higher content of trabecular (spongy) bone, which are more at risk of taphonomic loss. These limitations were especially apparent in the case of the presumed Warrior Tomb (Burial Enclosure ΣΤ, Tomb 1), which was one of the graves most affected by taphonomic processes. This is unfortunate, since the special features of the grave might be supportive of at least one of the individuals being actively involved in ancient warfare. Possible violence-related trauma might therefore have provided insight in warfare strategies, as well as, possibly, the cause of death. It is probable that the individuals were of social, and possibly, economic importance,[75] and the possibility of more detailed bioarchaeological analyses of these two individuals would have provided the opportunity for insight into health of the upper social class.

Although it is somewhat difficult to assess demographic patterns in the Hermione remains, there are some tendencies that should be noted and discussed further, especially in the light of Hermione as an early urban society. There are usually differences between patterns of mortality depending on living conditions, especially population density. Palaeodemographers usually distinguish between three different types of mortality patterns; a Type 1 Mortality where deaths primarily occur in senescence, a Type 2 Mortality where the likelihood of deaths are relatively even throughout the lifespan, and a Type 3 Mortality, where the highest risk of dying is within the first few years of the lifespan. These types all correspond to the Siler Parameters of William Siler's competing-risk model of mortality.[76] The Type 1 Mortality is probably a modern western phenomenon, where child mortality is extremely low, while the Type 2 Mortality might be reflective of populations with low population density such as in early prehistoric societies.[77] The Type 3 Mortality is however consistent with pre-industrial urban societies where child mortality, and fertility, was high.

The Hermione remains exhibit high levels of immature remains (*c*. 30%), with a substantial number of individuals with an age at death of under three years. The age distribution of the Hermione material then clearly shows a decline in mortality in older children, in line with the mortality decline suggested by Siler.[78] Considering that the sample is relatively small, but predominantly commingled, fragmentary, and spanning over a long period of time, it is problematic to draw definite conclusions of survival from the Hermione remains. However, most individuals seem to have died in young adulthood, which is at odds with a "normal" mortality as suggested by, for example, Michael Gurven and Hillard Kaplan.[79] According to them, mortality rates should remain low from older childhood until the onset of senescent-increased risk of mortality, at about the age of 40 years. Mortality among young adults is usually related to hazards of fertility, occupation, and/or trauma.[80] As previously presented in the "*Results*" section, it is likely that the seemingly high mortality in young adulthood in the Hermione sample is reflective of problems in the adult age estimation methods,[81] and it is possible that the patterns are coincidental due to the long period of use. Given these problems, it is likely that a higher proportion of the population survived to middle or old adults, than is reflected in the skeletal remains. The relatively high frequency of degenerative changes of the spine in the Hermione material strengthen this assumption. As such, it might be more relevant to discuss demographic patterns in relation to the proportion of adult to juvenile individuals in these commingled and fragmented remains. Doing this, the Hermione remains have clear resemblance to other pre-industrial urban societies from all over Europe,[82] both when it comes to the complete samples and when only considering the sub-sample of 6th–2nd centuries BC.

Dimakis discusses the possibility of family graves in the Hermione necropolis.[83] He argues that it is plausible, however not conclusive, that families, or at least extensive family groups, are organized in the cemeteries in similar ways as in life, i.e., living closely together in groups in life and being closely reunited in death. Aspects of kinship and family are always difficult to assess archaeologically, as it is not always clear what the concept of kinship was during life.[84] Biological kinship is likewise difficult to assess through osteological methods. Although genetic traits are inherited and could as such indicate biological kinship, many genetic traits are common

[75] Kossyva 2021, 165.
[76] Siler 1979; 1983; Wood *et al*. 2002.
[77] Ahlström 2015; Tornberg 2018.
[78] Siler 1979; 1983.
[79] Gurven & Kaplan 2007.
[80] Lewis 2007, 86.
[81] Milner *et al*. 2021.
[82] Lewis 2007, 82.
[83] Dimakis 2016, 32–33.
[84] For a nuanced and thoughtful review and discussion about aspects of kinship I recommend the publication by Sahlins 2013.

and might therefore bias the interpretation.[85] To assess biological kinship more accurately, the aid of DNA is necessary. Considering the relatively poor preservation of the Hermione remains, it is, however, likely that such efforts would be fruitless. If only considering the demography of the necropolis, it is possible, but far from conclusive, that the graves were in fact family graves. There is a relatively even distribution between the sexes, and there are inhumations of individuals of all ages. It is also evident that children and adults were buried in the same grave. Juvenile remains were accompanied by adult remains in all but one grave (Burial Enclosure Δ, Tomb 4), maybe signalling kinship. Although these features could also correspond to a community necropolis where families would not be buried together, the separation and organization of the graves might correspond to the division of families as suggested by Dimakis.

In the Hermione necropolis, child burials are present from all periods except the Geometric and the Roman periods. Given these results, it is likely that the necropolis was used as a communal burial site from the 6th–5th centuries to the 2nd century BC, while earlier and later burials were assigned for single individuals only. There is no clear difference between adult and child burials, but the presence of sheep/goat astragali only in graves with juvenile remains might reflect a specific burial tradition related to children. What is clear is that many children suffered from nutritional and/or health stress, visible, not only as presence of linear enamel hypoplasia, but also through the clearly elevated risk of premature death associated with the enamel hypoplasias, as well as a possible case of C-vitamin deficiency. Seven out of nine individuals exhibiting enamel hypoplasia died before the age of 20. One possible case of child abuse provides further evidence of the hardships experienced by children in ancient Hermione.

Living in pre-industrial urban societies means an increased risk of infectious disease. Aidan Cockburn argues that, to sustain infections for a lengthier period, a population of more than 5,000 individuals is needed.[86] This is of course interesting since the population size of ancient Hermione is estimated to just above 4,000 individuals. Although the population of Hermione is to be considered relatively low (if the estimate is correct), the function of a *polis* provides health hazards that are not only related to population size. Urban settlements are more likely to be a social and political centre than rural settlements, which means that people from both the city itself and from outside regularly meet and have the potential of infecting other people in communal and domestic arenas. Urban settlers are thus likely to meet higher numbers of people daily than their rural counterparts. However, there are several examples of infectious disease affecting both rural and small urban societies,[87] and the Cockburn argument should as such be considered as increased risk, and not as an absolute. Another aspect of urbanism is population density, where individuals in urban settlements are more likely to live in crowded spaces than rural ones. Considering these aspects, it is appropriate to discuss health of the ancient people of Hermione from an urban perspective.

Infection is the most common cause of death among children in pre-industrial societies,[88] but also leads to increased mortality for all ages. Specific infections are usually difficult to assess osteologically, but the presence of non-specific infections, visible through periosteal reactions, in the Hermione remains clearly shows that infections were present. Further, two individuals evidenced maxillary sinusitis, which could possibly be linked to infections, but air pollution is also a plausible cause. The presence of enamel hypoplasia might also reflect events of infectious disease in childhood. It should, however, be noted, that the aetiology of enamel hypoplasia is multifactorial, and studies have shown that there is no obvious difference in the distribution of enamel hypoplasia between rural and urban assemblages when comparing data from prehistoric and historic Europe.[89] The low level of *cribra orbitalia* is somewhat surprising but might rather reflect poor preservation than actual low incidence. Lastly, although only two individuals were suitable for stature estimation, both individuals evidenced statures below or in the lower ends of mean female statures from ancient Greece. It is likely that, in childhood, both pressure from infectious disease and possibly poor nutrition stunted the growth of the people of Hermione, at least for females. Coupling the low statures with the evidence of elevated mortality risk associated with enamel hypoplasia, the prolonged health effects might have eliminated the possibility of catch-up growth in adolescence.

[85] Larsen 1997, 326–329.
[86] Cockburn 1977, 109.
[87] E.g., Rascovan *et al.* 2019; Kjellström 2020; Davies-Barrett *et al.* 2021.
[88] Lewis 2007, 86.
[89] Bereczki *et al.* 2019.

Conclusions

The long period of use as well as the fragmented and commingled state of the remains from the Hermione necropolis have substantially limited the bioarchaeological analysis. The osteological analysis confirms the earlier archaeological (artefact-based) sex assessment of the two buried individuals in the Warrior Tomb (Burial Enclosure ΣΤ, Tomb 1) as being one male and one female. The poor preservation of the remains however excluded the possibility of pathological analysis of possible war-related trauma. The demographic analysis of the remains supports that the necropolis was used as a communal burial ground between the 6th–5th centuries to the 2nd century BC, while earlier and later burials probably were assigned for single individuals only. Children were buried in the same graves as adults. The presence of children only in graves which also include adults might reflect kinship bonds between the individuals, but this could not be concluded without the aid of DNA analyses. The correlation between sheep/goat astragali and graves including immature remains might reflect a specific burial tradition for children. Both the palaeodemographic and palaeopathological analyses reflect a population ridden by infectious disease, with high child mortality, non-specific infections, low statures, and general stress indicators as a result. These features are plausibly related to health hazards associated with preindustrial urban living, even if the population size of the Hermione *polis* was not exceptionally high. Stunted growth, increased child mortality associated with signs of general stress, as well as a possible case of child abuse also provides insight in the hardships experienced by children in ancient Hermione.

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Appendix

In the table on the next page, each pathological lesion of the Hermione skeletal material is described and divided by tombs, and, when possible, individuals (indicated by: "individual"), with information about sex and age. Ad = adult age with no observable characteristics for more precise estimates; Mat = maturus; Sen = senilis; n.o. = not observable due to taphonomic loss; n.a. = not available due to undeveloped sex characteristics. Abbreviations for pathological conditions: OA = osteoarthritis; CO = *cribra orbitalia*; IVD = intervertebral disc disease; MSM = musculoskeletal stress markers; DJD = degenerative disc disease; AM = *ante-mortem*.

Burial Enclosure	Tomb	Age	Sex	Pathology/diagnosis
1991–1994 Excavations				
Α	1	38.2 ± 10.9 y	F?	Vertebra lumbalis: exostosis at left processus articularis *inferior*.
Β	1:1	Mat–Sen	M?	Scapula dexter: mild marginal lipping; costa 1 sinister: mild lipping of caput; vertebra cervicalis 7: lipping dexter processus articularis inferior; vertebrae thoracicae: Schmorles' nodes no. 5 inferior, marginal lipping no. 6 superior + inferior, IVD no. 6–7, no. 8 inferior with lipping; vertebra lumbalis: mild lipping processus articularis (1 vertebra).
Β	1:2	40–44 y	F?	Healed CO.
Γ	3	30–40 y	M	Lipping, acetabulum.
Δ	3	Ad	F?	One vertebra thoracicus with Schmorles' nodes; fibula, proximal: erosion and new bone formation; tibia diaphysis: massive active periostitis laterally/distally; fibula diaphysis: massive active periostitis. Substantial thickening of the bone.
Δ	10	Ad	F?	Metacarpus1 dexter: OA with eburnation proximal.
2016–2017 Excavations				
ΣΤ	1:2	Ad	F	Healed CO; maxillary sinusitis, sinister.
ΣΤ	1:1	Ad	F	Os frontale: enlarged frontal sinuses, thick skull—porotic hyperostosis? Porotic hyperostosis/anaemia.
Cist	2	3–4 y	n.a.	Os temporale: numerous pitting over complete surface—C-vitaminotosis?
Δ	5	Ad	F	Vertebrae cervicale: pitting processus articularis inferior/superior of two vertebrae. Infectious appearance.
Δ	5	Ad	n.o.	Tibia distal dexter: massive lipping towards tarsi and fibula; fibula dexter: massive new bone formation distally; calcaneus dexter: totally destroyed joints with pitting and massive lipping. Healed fractures of the joint surface; Metatarsus 1 dexter: OA with eburnation distally; phalax 1 pedis dexter: OA with eburnation; phalanx 3 pedis dexter: lipping without pitting and eburnation proximally—secondary OA. *Ligamenta flava* vertebrae thoracicae 9–12.
Δ	6	Ad	n.o.	Vertebrae thoracicae: 4 fragments with *ligamenta flava*.
Δ	7	Ad	n.o.	Clavicula dexter: inflammation laterally; costae: healed fractures of at least 2 ribs, lipping of 2 joint surface might be connected to these fractures; humerus sinister: MSM laterally, subproximal, lipping; humerus dexter: MSM laterally, lipping; ulna dexter: mild degenerative changes of the joint surface with some new bone formation; sacrum: spina bifida (oculta), at least 2 vertebral segments; fibula dexter: mild periostitis.
Δ	7	Ad	n.o.	Vertebra lumbalis: lipping proc articularis; fibula: mild periostitis of 2 fragments; ischium sinister: marginal lipping; femur sinister: erosion in fovea capitis with new bone formation.
Δ	7	Ad	n.o.	Button osteoma, os frontale.
Δ	8	Ad	n.o.	Fibula dexter: mild periositis, healed.
Δ	8	Ad	M?	Pitting over large parts of the skull, including os sphenoidale. More in accordance with new bone formation than hyperostosis. Avitaminosis C? Avitaminosis C/D/porotic hyperostosis.
Δ	10	Ad	n.o.	Vertebra thoracicus: marginal lipping; acetabulum: lipping on one fragment.
Δ	10	Ad	n.o.	*Antemortem* toothloss of upper molar1 & 2.
Δ	10	Ad	n.o.	Phalanx 2 pedis: marginal lipping.
Δ	10	Ad–Sen	n.o.	Metacarpus1 dexter: DJD, pitting + lipping, no eburnation; phalanx 1 pedis: partly healed fracture of proximal joint. Fracture line visible, but lipping and new bone formation evidence healing. Caused by OA?
Δ	11	Ad	n.o.	Calcaneus sinister: eroded around joint and body, pseudopathological or infection/fungus?; phalanx 1 pedis sinister + dexter: eroded around joint and body. New bone formation evident. Erosion might be pseudopathological.
Δ	12	Ad	n.o.	Femur dexter: new bone formation intracondularly; tibia distal dexter: bone spickules medially and laterally; patella dexter: mild new bone formation medially; vertebrae lumbale: 2 arcus with *ligamenta flava*; vertebra lumbalis: OA processus articularis inferior, furrows and eburnation; vertebrae thoracicae: 4 arcus with *ligamenta flava*; vertebra thoracicus: spickules/new bone formations in arcus. Inflammatory; costa sinister: healed fracture; mandibula sinister: *antemortem* toothloss molar 1–2; mandibula dexter: *antemortem* tooth loss prmolar2–molar1 or molar1–2. Paradontosis; os frontale dexter: sinusitis; healed CO.
Δ	12	5–6 y	n.a.	Trauma, blunt force, *c.* 10 × 15 mm frontale dexter midline; pitting os temporale at processus mastoideus—avitaminosis C?
Δ	13	Ad	n.o.	Clavicula dexter: pitting laterally; vertebrae cerviclae: IVD/infection; femur sinister: active inflammation in fovea capitis; metacarpus1 dexter: lipping distally, brucellosis?

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