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RESEARCH ARTICLE

External auditory exostoses, repetitive aquatic activity and increasing social complexity in Chalcolithic Cyprus: Specialists of the sea?

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Abstract

External auditory exostoses (EAEs) are dense osseous hyperostoses that protrude into the external auditory canal and are associated with repetitive aquatic activity. Clinically, the aetiology of EAEs is attributed to prolonged exposure to cold water through activities including swimming, surfing, diving, kayaking and sailing. The prevalence and distribution of EAEs within a particular archaeological context informs on human–environment interactions, activity and behavioural differences between the sexes, habitual aquatic activity (e.g., fishing, diving, swimming, bathing, seafaring, littoral zone resource procurement), marine and aquatic resource exploitation and subsistence patterns. This study aims to assess the prevalence of EAEs within a prominent Chalcolithic skeletal assemblage from Souskiou-*Laona*, in south-western Cyprus. Sixty-five auditory canals were examined macroscopically and microscopically to confirm the presence or absence of EAEs. Five adult individuals present EAEs (right auditory canals; left ear canals not sufficiently preserved) with a prevalence of 15.1% of all sufficiently preserved right ear canals (33). EAE prevalence is 25% in males and 14.2% in females. Earlier burials on the site, represented by bonestack (commingled) crania, display EAEs at 14.8% prevalence, whereas the last burials (articulated skeletons) show a prevalence of 16.7%. Malacological evidence from Souskiou-*Laona* cemetery attests marine resource procurement, including activity at the littoral zone. The EAEs at Souskiou-*Laona* likely reflect the diachronic exploitation of marine resources at the south coast of Cyprus from the foundation of the cemetery to the latest burials before abandonment of the site. Both males and females participated in these repetitive aquatic activities. The differential expression of EAEs in the population as a whole, and the different prevalences between males and females, may be interpreted in the context of increasing specialisation and social complexity during the Chalcolithic, consistent with the development of other specialised, standardised and gender-differential activities during this time period.

KEYWORDS
Chalcolithic Cyprus, external auditory exostoses, increasing social complexity, marine resource procurement, repetitive aquatic activity, specialisation, surfer's ear

1 | INTRODUCTION

External auditory exostoses (EAEs) are frequently associated with repetitive aquatic activity. Auditory exostoses are dense, osseous hyperostoses that protrude into the external auditory meatus (EAM; Trinkaus & Wu, 2017). Colloquially termed "surfer's ear," the clinical aetiology of EAEs is attributed to prolonged exposure to water and, in particular, cold water and/or cold winds through activities such as surfing, swimming, diving, kayaking and sailing (Kroon et al., 2002; Lobo, 2015). Within human bioarchaeology it is generally accepted that the aetiology of EAEs is chronic cold-water exposure (Evans & Cameron, 2017). EAE data inform on human–environment interactions, activity and behavioural differences between the sexes, habitual aquatic activity (e.g., fishing, diving, swimming, bathing, seafaring, littoral zone resource procurement), marine and aquatic resource exploitation and subsistence patterns, amongst other domains (Günay & Akpolat, 2009; Kennedy, 1986; Kuzminsky et al., 2016; Lambert, 2002; Özbek, 2012; Standen et al., 1997; Trinkaus et al., 2019; Velasco-Vazquez et al., 2000; Villotte et al., 2014). The nature of human–environment interactions and, particularly, habitual aquatic activity in ancient Cyprus is understudied in the archaeological record. Only one study assessing the prevalence of EAEs in Cyprus has been undertaken so far (Lorentz, 2020), focusing on an early aceramic Neolithic site, circa 10,000 years ago. Our current study aims to assess the prevalence of EAEs within a prominent Chalcolithic (circa 3000 BC) skeletal assemblage from Souskiou-*Laona*, in south-western Cyprus (Lorentz, 2019; Peltenburg et al., 2019; Figure 1). Considered within its broader sociocultural context, the occurrence of EAEs at Souskiou-*Laona* provides new data towards understandings of human–environment interactions, sex-differential behaviours and aquatic resource procurement in Chalcolithic Cyprus.

EAEs predominantly occur from the irritation of the mucoperiosteum of the EAM that puts tension on the periosteum and induces osteoblastic activity (Lobo, 2015; Trinkaus & Wu, 2017). Irritants may be chemical, mechanical and thermal, whereby the primary irritant is cold water (DiBartolomeo, 1979; Kennedy, 1986). In the EAM, bone lies under a thin epidermal layer. As cold water enters the EAM it exerts a cooling effect, stimulating the periosteum to form new bone. Repeated episodes of hyperaemia lead to the formation of EAEs (Pilch, 2000). Symptoms of EAEs generally occur after 10 years of continuous exposure to a cold-water environment. Susceptible individuals may exhibit EAEs after one to five years (Deleyiannis et al., 1996). This is supported by a laboratory experiment on guinea pigs: Bone formation was proportional to the frequency of cold-water exposure over the total elapsed time (Fowler & Osmun, 1942). EAEs are a progressive pathological condition: The number of years and intensity of engagement in repetitive aquatic activity within a cold-water environment influences the size and frequency of EAEs and

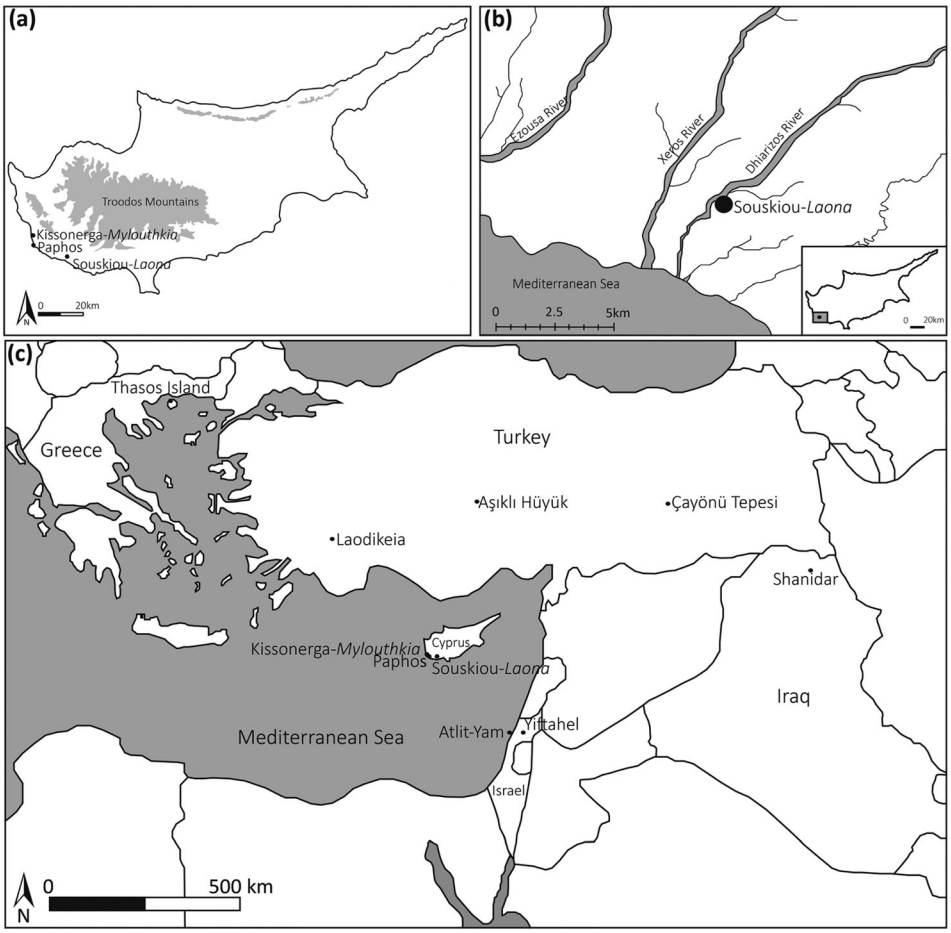

FIGURE 1 (a) Map of Cyprus indicating location of sites mentioned in the text; (b) location of Souskiou-*Laona* in relation to water bodies; (c) map of the Eastern Mediterranean and Middle East indicating location of sites presenting external auditory exostoses as mentioned in the text

thus the degree of occlusion of the EAM (Miladinović-Radmilović, 2010). It has been proposed that the location of EAEs corresponds to the ossification centres of the tympanic, squamous and mastoid epiphyseal plates (Evans & Cameron, 2017). Other suggested aetiologies of EAEs include a genetic component (Berry & Berry, 1967), cranial modification (Hrdlička, 1935) and otitis externa (Hutchinson et al., 1997). These proposed aetiologies are not currently considered valid. The association between chronic cold-water exposure and EAEs is termed the *thermal aquatic hypothesis* and is widely accepted as the aetiology of EAEs by clinicians (DiBartolomeo, 1979). Further studies have found that a combination of water and wind chill increases the development rate of EAEs (Timofeev et al., 2004).

Kennedy (1986) compared the presence of EAEs in archaeological skeletal assemblages globally to explore the *thermal aquatic hypothesis*. A high frequency of EAEs occurred in assemblages located between 30° and 45° latitude north and south of the equator, particularly within assemblages where aquatic resource exploitation is demonstrated by archaeological and ethnographic evidence. This supports a behavioural and environmental aetiology of EAEs (Kennedy, 1986). A high prevalence of EAEs within skeletal assemblages is often associated with subsistence practices and zooarchaeological evidence such as shell middens (e.g., Kuzminsky et al., 2016; Villotte et al., 2014). Comparisons of isotopic data and the presence or absence of EAEs in particular individuals has been used to determine whether an individual who was involved in fishing activities was also consuming them or if aquatic resources formed a greater part of the subsistence economy (Crowe et al., 2010; Villotte et al., 2014). A high proportion of Neanderthal specimens (56.5%) present EAEs and their aetiology has been attributed to aquatic resource exploitation (Trinkaus et al., 2019). The behavioural and environmental aetiology of EAEs has been used to discern division of activities by sex (e.g., Kennedy, 1986; Lambert, 2002; Standen et al., 1997). Bathing practices have also been identified as a possible aetiology of EAEs in the bioarchaeological literature (e.g., Günay & Akpolat, 2009; Lambert, 2002; Manzi et al., 1991). The EAM reaches adult size by nine years (White et al., 2012). The youngest individual to present EAEs in the literature is 13 years of age (i.e., Adams, 1951). Adams (1951) found EAEs in 14 males aged between 13 and 19 years who participated in a public swimming team and had swam repetitively for two to eight years.

EAEs have been found in skeletal assemblages from the Eastern Mediterranean and Near East (Figure 1). The Proto-Neolithic (10,600 ± 300 years Before Present [BP]) Shanidar cave displayed EAEs in 80% of adults, which were attributed to habitual and/or occupational activities, such as aquatic resource harvesting (Agelerakis & Serpanos, 2002). EAE prevalence from two Neolithic sites from Anatolia, Çayönü Tepesi (10,200–9000 to 8200–8000 years BP) and Aşıklı Hüyük (11,000 years BP) was assessed in adult and subadult crania. At Çayönü, 17.5% (17/97) of adult crania presented EAEs, comprising 15.46% (15/58) of males and 2% (2/39) of females. One adult presented EAEs at Aşıklı, being 3.57% (1/28) of assessable crania and 9% (1/11) of males. The difference in the prevalence of EAEs in Çayönü and Aşıklı was interpreted as differences in subsistence strategies: Çayönü produced mollusc and fish remains, whereas Aşıklı did not (Özbek, 2012). An EAE was found in a left temporal of an adult cranium recovered from the now submerged site of Atlit-Yam, Israel, dating to 8000 years BP. It was proposed that this EAE could reflect diving and marine resource exploitation, or a chronic ear infection (Hershkovitz & Galili, 1990). A large exostosis was observed in a right temporal of an adult cranium recovered from the inland Neolithic (seventh millennium BCE) site of Yiftahel, Israel (Arensburg et al., 1986). A male individual (2.1%, 1/47) from Thasos Island, Greece, dating to the Classical and Hellenistic periods (fifth to third centuries BC) presented bilateral EAEs. The authors surmised that this individual likely participated in maritime activities such as the specialised tasks undertaken by wooden boat craftsmen which includes diving (Agelarakis & Serpanos, 2010). Four adult males from ancient Laodikeia in South-west Anatolia, dating to the second and third centuries AD presented EAEs. The presence of public bathhouses at Laodikeia led the authors to infer that the EAEs reflected a bathing habit which incorporated multi-stage bathing phases including hot, warm and cool water (Günay & Akpolat, 2009).

In the case of ancient Cyprus, EAE evidence from only one site has been fully published (Lorentz, 2020). The Cypro-Pre-Pottery Neolithic B (9100–9300 BP, circa 8200–8600 Cal BC) site of Kissonerga-*Mylouthkia* in southwestern Cyprus (Figure 1), famous for the oldest known water wells in the world (Peltenburg et al., 2003), exhibited two adult males with EAEs. Zooarchaeological data suggests the procurement of marine resources at Kissonerga-*Mylouthkia*, with links to the Broad Spectrum Revolution and processes relating to the adoption of agriculture in the wider region (Lorentz, 2020). Additionally, three EAEs were recorded in Hellenistic and Roman period crania from Paphos, southwestern Cyprus, in one female and two unsexed individuals (Fox Leonard, 1997). The current study of EAE prevalence at Souskiou-*Laona* provides new insights into repetitive aquatic activity in Chalcolithic Cyprus and diachronic human–environment interactions. There is currently little malacological and ichthyological evidence attesting to any extensive use or exploitation of marine and aquatic resources as part of subsistence strategies at Souskiou. This study investigates the presence and use of such resources at the settlement and cemetery of Souskiou-*Laona* and their relationship with EAEs.

2 | MATERIALS AND METHODS

Souskiou is a Chalcolithic site in southwestern Cyprus, located 2 km inland from Kouklia (Figure 1). Souskiou-*Laona* is one of four cemeteries which compose the cemetery-settlement complex of Souskiou which has produced picrolite cruciform figurines emblematic of Chalcolithic Cyprus. Dating to the Middle Chalcolithic (circa 3000 BC), Souskiou-*Laona* is an extra-mural cemetery positioned on the *Laona* ridge at the entrance to the Dhiarizos River valley (Peltenburg et al., 2019; Figure 1). The Souskiou-*Laona* cemetery comprises 158 rock-cut features, including shaft tombs, which contained articulated skeletons, intentionally manipulated and stacked bones (bonestacks) and disturbed commingled remains (Lorentz, 2019). Thirty

discrete adult individuals and one subadult were recovered in situ, with a minimum number of individuals (MNI) of 203, recovered from both intact (117) and disturbed (86) burial contexts in the site (Lorentz, 2019). Adults and subadults presenting EAMs are included for analyses. A total of 65 temporal bones with EAMs were recovered from Souskiou-*Laona*, including 33 right and 32 left EAMs that are complete enough for the assessment of presence and absence of EAEs. Eleven EAMs (six right, five left) derive from ten articulated skeletons and 54 (27 right, 27 left) derive from 42 bonestack crania (Table 1). The EAMs reflect a total of 52 individuals which derive from 19 tombs. An additional infant cranium (1–2 years) presents a left EAM for analysis which has been excluded from prevalence counts due to its young age. The age, sex and stature of individuals is available from previous analyses published by Lorentz (2019) (Tables 1 and 2).

Temporal bones with observable EAMs are included in this study. The EAM is divided into four sections: anterior, posterior, superior and inferior, with each section accounting for 25% of completeness. Section presence is recorded for each EAM, and specimens with at least one observable section are included in Table 1. The presence or absence of EAEs are recorded for all observable specimens. EAMs were observed macroscopically, and those which present changes to the EAM were visually analysed with direct light, with a 10× magnifying glass, microscopically with a Leica EZ4 microscope (up to ×30) and with digital microscopy with a HIROX KH-8700 to validate the presence of EAEs. The location of exostoses on the wall of the EAM is recorded as anterior, posterior, superior, or inferior (Table 2). The relative size of the exostosis and its occlusion of the EAM is recorded in a three-stage grading system: Grade 1 is a small exostosis classified as any distinguishable osseous exostosis on the wall of the EAM which blocks less than one third of the canal; Grade 2 is a medium-sized exostosis blocking between one third and two thirds of the canal; and Grade 3 is a large exostosis blocking more than two thirds of the canal (Standen et al., 1997; Villotte et al., 2014). The shape of the exostosis is recorded as either spheroid or ovoid (Velasco-Vazquez et al., 2000). The side of exostoses is recorded, and where possible the unilateral or bilateral occurrence was observed. Due to the poor preservation of left EAMs, overall prevalence counts are presented for right EAMs. EAEs are differentially diagnosed from osteomata according to their shape, location and laterality. Differential diagnosis of osteomata and EAEs is imperative to recording and interpretation of these pathologies. They may be discerned morphologically and histologically. Osteomata are partly comprised of cancellous bone, have a small or

TABLE 1 Ear canals recovered from Souskiou-*Laona* (with age, sex, and stature estimates for discrete individuals as in Lorentz, 2019)

							Regions present (1 = present; blank = absent)				
Tomb	Context	Sex	Age	Stature	Side	Completeness	Anterior	Posterior	Superior	Inferior	EAE
108	Cranium B	cba	Adult	cba	L	>50%		1	1		No
125	Cranium A	cba	Adult	cba	R	<25%		1			No
125	Cranium D	Female	34-40	cba	R	>75%	1	1	1	1	No
125	Cranium E	cba	16-22	cba	R	>75%	1	1	1	1	No
					L	>75%	1	1	1	1	No
132	Cranium D	cba	20-32	cba	L	<50%		1		1	No
155	Individual B	Male	25-28	165	R	<75%	1	1	1	1	No
158	Cranium B	Male	Adult	cba	R	>75%	1	1	1	1	No
					L	<75%		1	1	1	No
158	Cranium D	Male	16-22	cba	L	>75%	1	1	1	1	No
158	Cranium E	Female	18-25	cba	L	<50%		1	1		No
158	Lab ID 4 (Bonestack)	cba	6-7	cba	R	<50%	1	1	1	1	No
159	Cranium A	Male	Adult	cba	R	>75%	1	1	1	1	Yes
					L	<25%			1		No
159	Cranium D	cba	5-6	cba	R	<50%	1	1	1	1	No
159	Cranium F	Female	Adult	cba	R	>75%	1	1	1	1	No
159	Cranium H	Female	26-32	cba	L	<75%	1	1	1	1	No
160	Individual E	Male	18 ± 2	164	R	<25%		1			No
					L	>50%	1	1		1	No
160	Cranium A	Female	26-32	cba	R	>75%	1	1	1	1	No
					L	>75%	1	1	1	1	No
160	Cranium B	Female	34-40	cba	R	<25%		1			No
160	Cranium C	cba	11 ± 2.5	cba	R	>75%	1	1	1	1	No
					L	>75%	1	1	1	1	No

(Continues)

TABLE 1 (Continued)

Tomb	Context	Sex	Age	Stature	Side	Completeness	Regions present (1 = present; blank = absent)				EAE
							Anterior	Posterior	Superior	Inferior	
161	Cranium C	Male	20-24	cba	L	>75%		1	1	1	No
165	Individual E	Male	18 ± 2	166	R	<50%		1	1		No
165	Individual F	Female	35-40	166	R	>50%		1	1		No
165	Cranium A	Female	32-38	cba	R	>75%	1	1	1	1	Yes
					L	<50%		1		1	No
165	Cranium C	Female	16-22	cba	L	>75%	1	1	1	1	No
165	Cranium D	Female	42-48	cba	L	<25%		1			No
168	Cranium B	Male	35-40	cba	R	<75%		1	1	1	No
192	Cranium B	Male	28-34	cba	R	<75%	1	1	1	1	No
192	Cranium C	Male	28-34	cba	L	<75%	1	1	1	1	No
192	Cranium D	cba	4-5	cba	L	>75%	1	1	1	1	No
192	Cranium E	Female	18-22	cba	R	>75%	1	1	1	1	No
					L	>75%	1	1	1	1	No
192	Cranium F	Female	18-22	cba	R	>75%	1	1	1	1	No
192	Cranium G	Female	Adult	cba	R	>50%		1	1		No
					L	>75%	1	1	1	1	No
193	Individual E	Male	18 ± 2	161	L	<75%		1	1	1	No
193	Cranium D	Male	16-20	cba	R	>75%	1	1	1	1	No
200	Individual C	Male	44-50	167	R	>75%	1	1	1	1	Yes
200	Individual D	Male	34-38	167-168	L	>75%	1	1	1	1	No
200	Cranium A	Male	Adult	cba	R	>50%		1	1	1	Yes
					L	<25%	1				No
201	Individual A	Male	30-36	163	L	<25%		1		1	No
201	Cranium B	Female	30-36	cba	R	>75%	1	1	1	1	No
					L	>50%		1	1		No
207	Cranium A	Female	Adult	cba	R	<75%	1	1	1	1	Yes
207	Cranium B	Male	Adult	cba	L	<75%	1	1	1	1	No
207	Cranium C	cba	c.12	cba	R	>75%	1	1	1	1	No
207	Cranium D	Female	Young adult	cba	R	>75%	1	1	1	1	No
					L	<75%		1	1	1	No
220	Individual A	Female	18 ± 2	166	R	>75%	1	1	1	1	No
220	Cranium B	Male	Adult	cba	R	>75%	1	1	1	1	No
220	Cranium C	Female	Adult	cba	R	<75%		1	1		No
					L	<50%		1	1		No
220	Cranium D	Female	Adult	cba	L	>50%		1	1		No
220	Cranium F	Male	24-30	cba	L	>75%	1	1	1	1	No
228	Cranium B	Male	Adult	cba	L	<75%		1	1		No
228	Cranium D	Female	Adult	cba	L	<75%	1	1	1	1	No
229	Cranium A	Male	18-24 or 25-35	cba	R	>25%		1			No
237	Individual E	Female	34-40	cba	L	100%	1	1	1	1	No
237	Cranium B	cba	26-32	cba	R	>75%	1	1	1	1	No

Note: The shaded rows indicate the individuals with EAEs present.
Abbreviation: cba, cannot be assessed.

TABLE 2 Souskiou-*Laona* ear canals with external auditory exostoses (age, sex, and stature estimates as in Lorentz, 2019)

Tomb		159	165	200	200	207
Individual ID/Context		Cranium A	Cranium A	Individual C	Cranium A	Cranium A
Sex		Male	Female	Male	Male	Female
Age		Adult	32-38	44-50	Adult	Adult
Stature (cm)		cba	cba	167	cba	cba
Side (right, left)		Right	Right	Right	Right	Right
Completeness of auditory canal	(%)	>75%	>75%	>75%	<75%	>75%
Completeness of auditory canal per region (1 = present; blank = absent)	Anterior	1	1	1		1
	Posterior	1	1	1	1	1
	Superior	1	1	1	1	1
	Inferior	1	1	1	1	1
Location of EAE		Posterior	Anterior	Posterior	Posterior	Posterior
Size and occlusion		Grade 1, <1/3 occl.	Grade 1, <1/3 occl.	Grade 1, <1/3 occl.	Grade 1, <1/3 occl.	Grade 1, <1/3 occl.
Shape		Ovoid	Spheroid	Ovoid	Ovoid	Ovoid
Laterality		cba	cba	cba	cba	cba
Description		A small osseous exostosis located on the posterior wall of the auditory canal, near the tympanomastoid suture. The exostosis is ovoid in shape and occludes the auditory canal less than 1/3.	A small osseous exostosis located medially on the anterior wall of the auditory canal. This exostosis is spheroid in shape, visibly protrudes into the auditory canal and occludes the auditory canal less than 1/3.	A small osseous exostosis located on the posterior wall of the auditory canal, near the tympanomastoid suture. The exostosis is ovoid in shape and occludes the auditory canal less than 1/3.	A small osseous exostosis located on the posterior wall of the auditory canal, near the tympanomastoid suture. The exostosis is ovoid in shape and occludes the auditory canal less than 1/3.	A small osseous exostosis located on the posterior wall of the auditory canal, near the tympanomastoid suture. The exostosis is ovoid in shape and occludes the auditory canal less than 1/3.
Visual estimation (mm)	Length	7.7	5	6.8	6.6	7.4
	Width	4.5	3.5	4	3.9	3.7
	Height	1	1.5	0.5	0.8	0.7

Abbreviation: cba, cannot be assessed.

pedunculated base and typically occur laterally in the EAM, isolated and unilateral. EAEs are characterised as dense, broad-based osseous growths that are often multiple and bilateral (DiBartolomeo, 1979; White et al., 2012). EAEs are generally benign and can cause conductive hearing loss and cerumen impaction (Trinkaus & Wu, 2017).

3 | RESULTS

Fifty-two of 203 individuals (25.6%) recovered from Souskiou-*Laona* present EAMs preserved enough for assessment of the presence or absence of EAEs. EAEs are observed in five individuals (T159 Cranium A [Figure 2]; T165 Cranium A [Figure 3]; T200 Individual C [Figure 4]; T200 Cranium A [Figure 4]; T207 Cranium A [Figure 5]) out of 52 individuals (Tables 2 and 3). All five EAEs occur in the right EAM (the corresponding left EAMs are not sufficiently preserved for assessment; laterality cannot be observed). These adult individuals include three males and two females (Table 3). All EAEs are Grade 1. Four EAEs (80%) are ovoid shaped and located at the posterior wall of the EAM, and one EAE (20%) is spheroid shaped and located medially on the anterior wall.

Adults present EAEs in 8.5% of 59 observable EAMs, including 17.2% of 29 right EAMs (Table 3). Five subadults ranging from four to 12 years of age present six EAMs for analyses (four right, two left), within which no EAEs occur. Three of 21 male individuals (14.2%) present EAEs (25%, 3/12 right EAMs), and two of 22 female individuals (9%) exhibit EAEs (14.2%, 2/14 right EAMs). One of 10 articulated skeletons (10%) displays an EAE (16.7% of right EAMs). Forty-two bonestack crania exhibit EAEs in 9.5% (N = 4) of individuals (14.8%, 4/27 right EAMs). Overall five individuals present EAEs, comprising 9.6% of the total number of individuals (N = 52) with complete enough EAMs to include in this study. EAE prevalence is 15.1% for

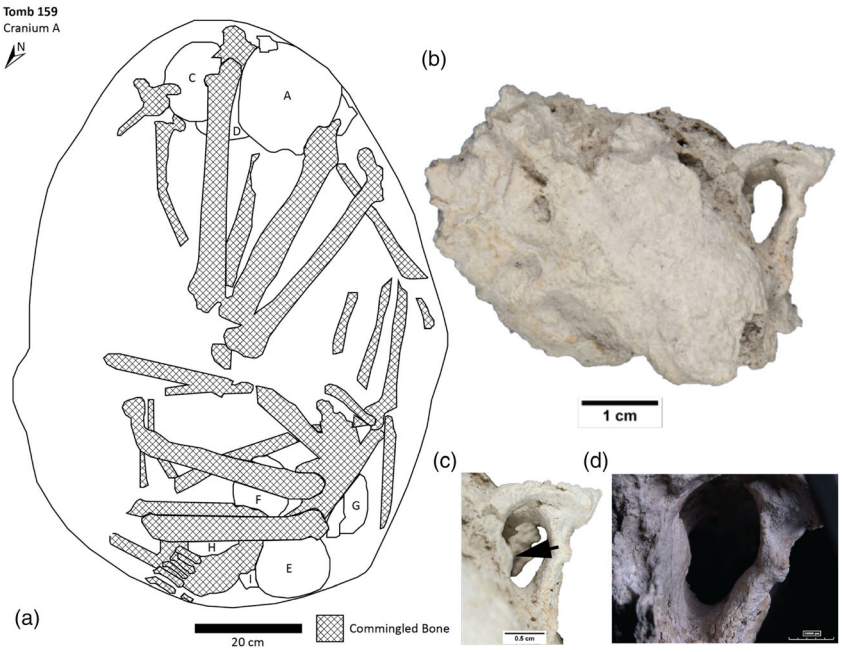

FIGURE 2 T159 Cranium A location within burial (a) (re-drawn by B. Casa after Peltenburg et al., 2019); right temporal bone lateral view (b); ear canal with EAE on the posterior surface (c); EAE on posterior surface of ear canal imaged by digital microscopy (d)

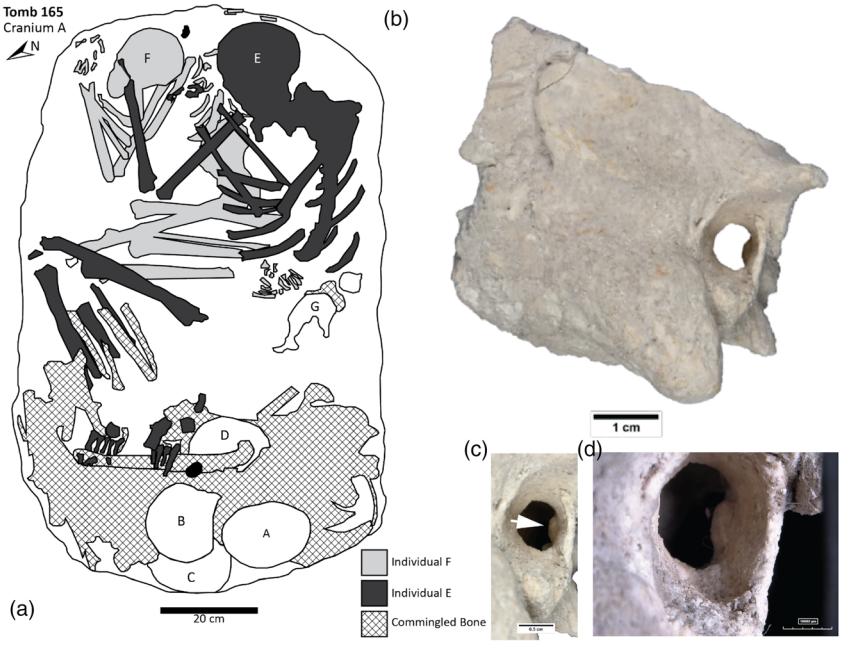

FIGURE 3 T165 Cranium A location within burial (a) (re-drawn by B. Casa after Peltenburg et al., 2019); right temporal bone lateral view (b); ear canal with EAE on the anterior surface (c); EAE on anterior surface of ear canal imaged by digital microscopy (d)

individuals with preserved right ear canals, including 25% of males and 14.2% of females (Table 3).

EAEs are observed in five individuals from 4 of 19 tombs (T159, T165, T200, T207) presenting preserved EAMs for analyses. These individuals include one articulated skeleton and four crania from bonestack individuals (Tables 1 and 4). Four individuals from tomb 159 display EAMs for analyses, where one presents an EAE (25%). Tomb 165 presents five individuals with preserved EAMs (three right, three left) of which 20% (1/5) display an EAE. Three individuals from tomb 200 produced preserved EAMs that exhibit EAEs in 66.6% (2/3). Tomb 207 presents observable EAMs in four individuals, of which 25% (1/4) display EAEs. Fifty-two individuals of the MNI of 105 recovered from 19 tombs present EAMs for analyses, of which 9.6% present EAEs (Table 4).

4 | DISCUSSION

Four of the five EAEs present at Souskiou-*Laona* are located on the posterior surface of the EAM, and one is located on the anterior surface. The lesions located on the posterior surface are ovoid shaped, whereas the lesion located on the anterior surface is spheroid shaped. There are no indications in the clinical literature if the shape and location of EAEs are linked. The location of these EAEs on the anterior

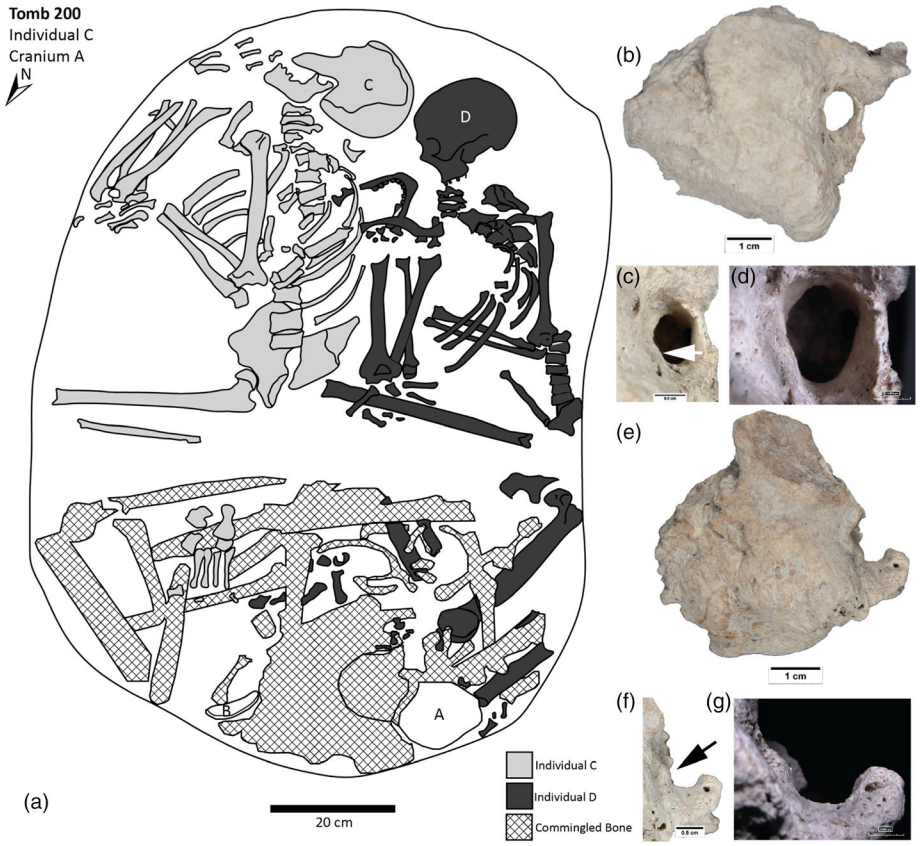

FIGURE 4 T200 Individual C and Cranium A burial position (a) (re-drawn by B. Casa after Peltenburg et al., 2019); Individual C right temporal bone lateral view (b); ear canal with EAE on the posterior surface (c); EAE on posterior surface of ear canal imaged by digital microscopy (d). Cranium A right temporal bone lateral view (e); ear canal with EAE on the posterior surface (f); EAE on posterior surface of ear canal imaged by digital microscopy (g)

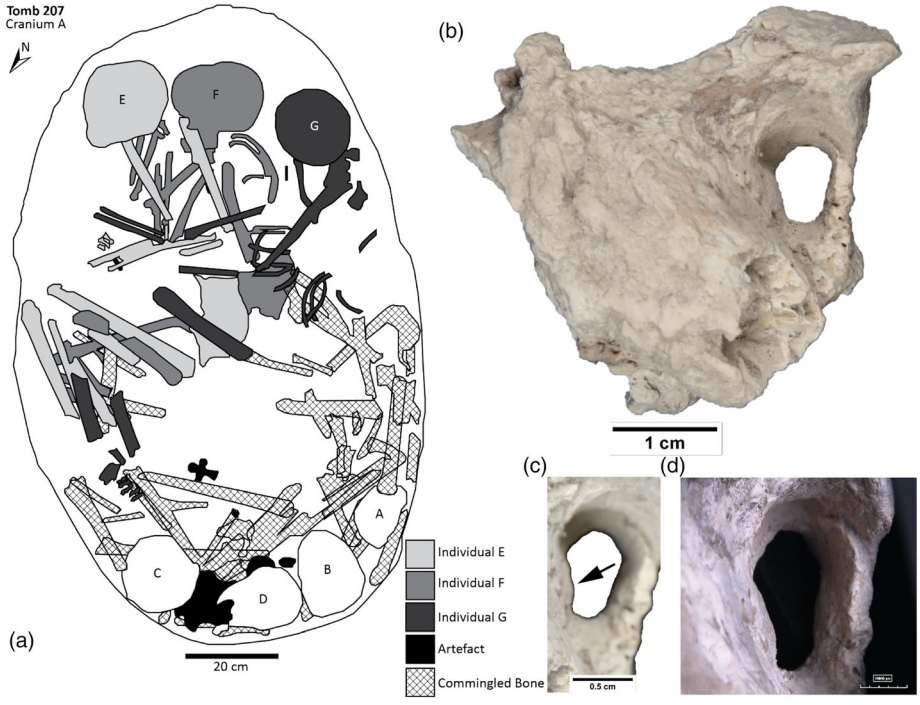

FIGURE 5 T207 Cranium A location within burial (a) (re-drawn by B. Casa after Peltenburg et al., 2019); right temporal bone lateral view (b); ear canal with EAE on the posterior surface (c); EAE on posterior surface of ear canal imaged by digital microscopy (d)

and posterior surfaces corresponds with known ossification centres of the temporal bone (Evans & Cameron, 2017). EAEs typically present at the tympano-squamous suture anteriorly and at the tympanomastoid suture posteriorly and can occur at one or both of these surfaces (Lobo, 2015). The majority (four out of five) of the EAEs at Souskiou-*Laona* occur on the posterior surface. The location of these EAEs anteriorly and posteriorly indicates that they are independent of tympanic plate development. The delineated shape of the

TABLE 3 Prevalence of external auditory exostoses at Souskiou-*Laona*

	Total number of ear canals complete enough for assessment			EAE in articulated skeletons (right and/or left assessable ear canals)		EAE in bonestack crania (right and/or left assessable ear canals)		EAE prevalence, right ear canals		EAE prevalence, left ear canals		EAE occurrence, all ear canals		Individuals[a] presenting EAE (left and right ear canals)	
Context	**Right**	**Left**	**Total**	**Number**	**Percentage**	**Number**	**Percentage**	**Number**	**Percentage**	**Number**	**Percentage**	**Number**	**Percentage**	**Number**	**Percentage**
Adults	29	30	59	1/10	10%	4/37	10.8%	5/29	17.2%	0/30	0%	5/59	8.5%	5/47	10.6%
Subadults	4	2	6	0	0%	0/5	0%	0/4	0%	0/2	0%	0/6	0%	0/5	0%
Males	12	13	25	1/7	14.2%	2/14	14.3%	3/12	25%	0/13	0%	3/25	12%	3/21	14.2%
Females	14	15	29	0/3	0%	2/19	10.5%	2/14	14.2%	0/15	0%	2/29	6.9%	2/22	9%
Articulated skeletons	6	5	11	N/A	N/A	N/A	N/A	1/6	16.7%	0/5	0%	1/11	9%	1/10	10%
Crania (bonestack individuals)	27	27	54	N/A	N/A	N/A	N/A	4/27	14.8%	0/27	0%	4/54	7.4%	4/42	9.5%
Total EAE prevalence	5/33	0/32	5/65	1/10	10%	4/42	9.5%	5/33	15.1%	0/32	0%	5/65	7.7%	5/52	9.6%

Abbreviation: N/A, not applicable.

[a]Individuals = bonestack crania + articulated skeletons.

TABLE 4 Prevalence of external auditory exostoses by discrete individuals per tomb contexts, presenting ear canals for assessment

Tomb	Number of articulated skeletons	Bonestack MNI (crania)	Total tomb MNI (individuals[a])	Assessable ear canals of articulated skeletons		Assessable ear canals of bonestack crania		Total ear canals complete enough for assessment			Individuals[a] with assessable ear canals	Individuals[a] with EAE			EAE prevalence in individuals with assessable ear canals (left and right)		EAE prevalence in each tomb (assessable right ear canals only)	
				Right	Left	Right	Left	Right	Left	Total		Right	Left	Total	Number	Percentage	Number	Percentage
108	1	1	2	0	0	0	1	0	1	1	1	0	0	0	0/1	0%	0	0%
125	0	10	10	0	0	3	1	3	1	4	3	0	0	0	0/3	0%	0/3	0%
132	2	3	5	0	0	0	1	0	1	1	1	0	0	0	0/1	0%	0	0%
155	2	0	2	1	0	0	0	1	0	1	1	0	0	0	0/1	0%	0/1	0%
158	1	8	9	0	0	2	3	2	3	5	4	0	0	0	0/4	0%	0/2	0%
159	0	9	9	0	0	3	2	3	2	5	4	1	0	1	1/4	25%	1/3	33.3%
160	1	4	5	1	1	3	2	4	3	7	4	0	0	0	0/4	0%	0/4	0%
161	1	2	3	0	0	0	1	0	1	1	1	0	0	0	0/1	0%	0	0%
165	2	5	7	2	0	1	3	3	3	6	5	1	0	1	1/5	20%	1/3	33.3%
168	0	4	4	0	0	1	0	1	0	1	1	0	0	0	0/1	0%	0/1	0%
192	1	7	8	0	0	4	4	4	4	8	6	0	0	0	0/6	0%	0/4	0%
193	1	3	4	0	1	1	0	1	1	2	2	0	0	0	0/2	0%	0/1	0%
200	2	3	5	1	1	1	1	2	2	4	3	2	0	2	2/3	66.6%	2/2	100%
201	1	1	2	0	1	2	0	2	1	3	2	0	0	0	0/2	0%	0/2	0%
207	3	4	7	0	0	3	2	3	2	5	4	1	0	1	1/4	25%	1/3	33.3%
220	1	5	6	1	0	2	3	3	3	6	5	0	0	0	0/5	0%	0/3	0%
228	1	4	5	0	0	0	2	0	2	2	2	0	0	0	0/2	0%	0	0%
229	1	5	6	0	0	1	0	1	0	1	1	0	0	0	0/1	0%	0/1	0%
237	1	5	6	0	1	1	0	1	1	2	2	0	0	0	0/2	0%	0/1	0%
Total	22	83	105	6	5	28	26	34	31	65	52	5	0	5	5/52	9.6%	5/34	14.7%

Note: The shaded values are the most important values for the reader, as regards EAE prevalence. These values are referred to in the text.

Abbreviation: MNI, minimum number of individuals.

[a]Individuals = crania + articulated skeletons.

EAEs also confirms that they are not inflammation of the tympanic plate (Standen et al., 1997).

The prevalence of EAEs at Souskiou-*Laona* comprises 9.6% of individuals with EAMs preserved enough for analyses, and 17.2% of adults (Table 3). EAEs have only been recorded at two other sites in Cyprus thus far: Kissonerga-*Mylouthkia* presented two adult male individuals exhibiting EAEs from a commingled assemblage with no other assessable EAMs (Lorentz, 2020), and one female and two unsexed individuals with EAEs were recovered from Hellenistic and Roman Paphos (Fox Leonard, 1997; Figure 1). The prevalence of EAEs at Souskiou-*Laona* is higher than EAE prevalence at some sites in the wider region of the Eastern Mediterranean and the Middle East, including Classical and Hellenistic Thasos Island, Greece, with 2.1% of individuals exhibiting EAEs, and Neolithic Aşıklı Hüyük, Turkey, where 3.6% of crania display EAEs (Agelarakis & Serpanos, 2010; Özbek, 2012). The Souskiou-*Laona* prevalence is, however, lower than at Neolithic Çayönü Tepesi, Turkey, where 17.5% of individuals present EAEs (Özbek, 2012), and at Proto-Neolithic Shanidar Cave in Iraqi Kurdistan where 80% of adults display EAEs (Agelerakis & Serpanos, 2002). The differential occurrence of EAEs indicates that only some members of the community of Souskiou-*Laona* were actively engaging in repetitive aquatic activity. This activity may have taken the form of various habitual practices such as the procurement of marine and aquatic resources, be that for subsistence or cultural practices; bathing; other maritime activities; and other socio-culturally specific behaviours.

Twenty-five percent of males and 14.2% of females from Souskiou-*Laona* present EAEs (Table 4). These findings are consistent with the hypothesis that both males and females engaged in habitual aquatic activity. It is tempting to focus on the higher prevalence for males, but sample sizes are small. It cannot be ascertained whether the repetitive aquatic activities females and males engaged in were different or similar, that is, to what extent there was a division of labour by sex. Not all members of the society seem to have engaged with repetitive aquatic activity. This may indicate something of the context of the repetitive aquatic activities which led to the development of the EAEs observed: There may have been some specialists in terms of marine resource procurement—not everyone was involved in this activity through habitual household tasks. These specialists, if we accept this concept, were both female and male. No subadults display EAEs, however, this does not wholly exclude the participation of children within aquatic activities. Rather, these children may not have lived long enough to develop EAEs or did not engage in water-based activities frequently enough to develop changes to the EAM.

A survey of 111 (76 males, 35 females) breath-hold divers at an international freedive competition in Ibiza, Spain, analysed the severity of EAEs in relation to years of exposure, sea surface temperature and exposure latitude. Breath-hold divers typically spend approximately 45 min in the water, of which approximately 2.5 min of this time is spent submerged at depth. Subsequently the sea surface temperature effects the rate of evaporative cooling of the EAM. The results of this study indicated that the number of years of exposure and sea surface temperature impact EAE development, whereby there is an increased development of stenosis of 0.64% for every year of exposure to these temperatures and an increased development of stenosis of 2.45% for every 1°C drop in sea surface temperature (Sheard & Doherty, 2008). All observed EAEs from Souskiou-*Laona* were of Grade 1. The individuals presenting EAEs are all adult, with one female aged between 32 and 38 years (T165 Cranium A), one adult female (T207 Cranium A) and two adult males (T159 Cranium A, T200 Cranium A) with no age diagnostics and a male at 44–50 years at death (T200 Individual C). These individuals engaged in aquatic activity long enough for chronic exposure over a prolonged time period. (Table 2). Although it cannot be discerned whether individuals encountered cold and wet environments in frequent sessions over some years (intensive), or rather, with less frequent sessions over a longer period of time (extensive), the seasonal water temperatures of southwestern Cyprus must be considered. In modern times, the temperature of the Levantine sea fluctuates between 17°C and 28°C, and the upwelling caused by north-westerly winds causes cooling events in the southwestern coastline of Cyprus in the summer months (June–August; Mauri et al., 2019). The waters of the Levantine sea were warmer between 5500 and circa 4000 years before present whereby sea temperatures in the nearby Aegean Sea dropped between 1°C and 2.5°C approximately every 2300 years throughout the Holocene (Finné et al., 2011; Marino et al., 2009). Although water temperatures of 17.5°C and below are classified as cold enough to promote EAEs (Fowler & Osmun, 1942), evidence of EAEs persists in 70% of warm water surfers from the Gold Coast, Queensland, Australia, where the water temperatures vary between 20.6°C and 28.2°C from winter to summer (Simas et al., 2020). No Grade 2 or 3 EAEs were observed among specimens from Souskiou-*Laona*, even among older adults, though this may reflect the small samples size and differential preservation.

The size and severity of EAEs are linked to the length and frequency of exposure to (cold) water and (cold) wind (Kroon et al., 2002). In the case of Souskiou-*Laona*, all EAEs were small and not severe (Table 2) and therefore suggest that although these individuals were exposed to (cold) water and wind long enough for an osseous reaction, they were not exposed to the extent promoting a severe response. This may reflect prolonged engagement in activities such as the collection of resources along the coastline or diving for resources. The species present, number of specimens and the dominance of beach-worn marine invertebrate remains recovered from the Souskiou complex, including the *Laona* settlement and the *Laona* and *Vathrykakas* cemeteries, support inferences that the inhabitants collected resources from the coastline over a prolonged time period (Table 5; Peltenburg, 2006; Peltenburg et al., 2019). The presence of marine invertebrates at these sites attests to their procurement at the coast. Souskiou is located approximately 2–3.5 km from the ancient south coast (approximately 500 m further inland than at present), a 30- to 60-min walk. The Mediterranean Sea is visible from the *Loana* ridge. The coastal zone was rich in resources such as crabs, shellfish, octopus and fish (Peltenburg et al., 2019). The presence of two (perforated) fish vertebrae in the Souskiou-*Laona* cemetery demonstrates that fishing was practised, although their limited remains

TABLE 5 Marine and freshwater invertebrates and fish recovered from the Soukiou-*Laona* and Souskiou-*Vathrykakas* Chalcolithic cemeteries

			Souskiou-Laona (Ridout-Sharpe, 2019)	Souskiou-Vathrykakas (Ridout-Sharpe, 2006)
Phyla	**Species**	**Common name**	**NISP**	**MNI**
Marine Bivalves	*Glycymeris glycymeris*	Dog cockle	5	
	Glycymeris nummaria	Bittersweet clams	3	
	Barbatia barbata	Ark clams	1	
	Pinna nobilis	Mother-of-pearl; mussel	36	
	Spondylus gaederopus	Thorny oyster	5	
	Ctena decussata		1	
	Loripes lucinalis		5	
	Cerastoderma glaucum	Lagoon cockle	57	
	Acanthocardia tuberculate	Rough cockle	1	
Marine Gastropods	*Patella caerulea*	Limpet	35	52
	Patella lusitanica (= Patella rustica)	Limpet	1	
	Gibbula adansonii	Top shell	4	1
	Bolma rugosa	Turban shell	2	
	Potamides conicus	Whelk	48	1
	Cerithium vulgatum	Common cerithe	29	17
	Erosaria spurca	Cowry	2	1
	Phalium granulatum	Bonnet shell		3
	Charonia variegata	Triton shell	60	
	Muricopsis cristata	Murex	1	
	Tonna galea	Giant tun	52	2
	Columbella rustica	Rustic dove shell	5	
	Euthria cornea	Spindle euthria; whelks	2	
	Homalopoma sanguineum	Dwarf turbans	1	
	Conus mediterraneus	Cone shell		5
	Conus ventricosus	Mediterranean cone	5	
	Haliotis tuberculata lamellosa	Abalone; ormer snail	1	
	Phorcus turbinatus	Turbinate monodont	2	
	Hexaplex trunculus	Murex shell	18	1
	Jujubinus exasperatus	Rough top shell	1	
	Neverita josephinia	Moon shell	1	
	Nassarius incrassatus	Thick lipped dog whelk	1	
	Luria lurida	Cowry shell	1	
	Galeodea echinophora	Spiny bonnet; helmet shell	1	
	Semicassis granulata	Scotch bonnet	7	
	Turritella communis	Common tower shell	1	
	Vexillum ebenus	Ebony mitre	1	
	Phorcus articulatus	Articulate monodont	2	
	Osilinus turbinate	Thick top shell		1
	Tricolia pullus	Pheasant shell		7
	Tricolia speciosa	Mediterranean pheasant shell		6
	Unidentified	N/A		3

(Continues)

TABLE 5 (Continued)

Phyla	Species	Common name	Souskiou-Laona (Ridout-Sharpe, 2019) NISP	Souskiou-Vathrykakas (Ridout-Sharpe, 2006) MNI
Scaphopoda	*Dentalium* cf. *sexangulum*	Dentalia, Tusk shells	9	89 (NISP)
	Antalis (Antalis inaequicostata, Antalis panorama, Antalis rossati, Antalis vulgaris)		2597	
	Antalis inaequicostata			2423 (NISP)
	Antalis vulgare			4 (NISP)
Decapoda	*Potamon potamias*	Freshwater crab	52	
Estuarine and Freshwater Molluscs	*Melanopsis buccinoidea*	Freshwater snail	41	
Fish	Unknown	Unknown	2	

Abbreviations: MNI, minimum number of individuals; N/A, not applicable; NISP, number of individual specimens.

and their lack of provenance (marine or freshwater) limits further interpretations of fishing techniques used (Peltenburg et al., 2019). At the contemporaneous site of Kissonerga-*Mylouthkia*, several species of marine invertebrates were collected dead on the beach, similar to Souskiou-*Laona*; however, numerous marine molluscs were collected alive and fishing was also heavily practised (Peltenburg et al., 2003).

Four hundred and twenty-seven mollusc and crustacean samples were recovered from the settlement and cemetery areas of Souskiou-*Laona*, with the latter introduced through human agency (Table 5). A large portion of the molluscs in the settlement were likely accidentally introduced to the site, though several species may have been eaten including giant tun (*Tonna galea*), topshells (*Phorcus turbinatus*), murex (*Hexaplex trunculus*) and ceriths (*Cerithium vulgatum*). Shellfish likely did not comprise a dominant part of the diet or they were consumed offsite, although where present, edible species are predominantly located on the settlements rather than the cemetery (Ridout-Sharpe, 2019). Dentalia were the most abundant shells recovered from the settlement and cemetery comprising 96.2% of marine shells (2516 dentalia), with 63 of 142 rock-cut features yielding dentalia (Table 5). The local species of *Antalis* (*Antalis inaequicostata*, *Antalis rossati* and *Antalis vulgaris*) dominated the dentalia present, with only six examples of other dentalia species present. At the *Vathrykakas* cemetery, 32 of 107 tombs contained marine shells, with 15 species represented by 2616 individuals (Table 5; Ridout-Sharpe, 2006). Fossilised *Dentalium* cf. *sexangulum* was recovered from both the *Laona* and *Vathrykakas* cemeteries. They were not modified, and the species does not currently live in the Eastern Mediterranean. These shells may have been imported from the Hatay Basin in the Turkish Levant, from where the same species found at Çatalhöyük was sourced (Table 5; Ridout-Sharpe, 2006, 2019). Live dentalia reside offshore in the sand and mud. All dentalia from both Souskiou-*Laona* and *Vathrykakas* were incomplete, presenting wear and abrasions, and many were beach worn, indicating that they were collected from the beach dead (Ridout-Sharpe, 2006, 2019). The large number of dentalia shells present at both *Laona* and *Vathrykakas* may reflect intensive shell collections after a storm where a large number have washed ashore, or their collection from the beach over a long time period (Ridout-Sharpe, 2006). Differences between the marine non-scaphopod mollusca present at the *Laona* and *Vathrykakas* cemeteries reflect opportunistic collection. As the majority of marine shells from *Laona* and *Vathrykakas* evidence beach collection, it is unlikely that the inhabitants of Souskiou actively dived in the sea to procure these resources. As with many countries positioned on the Mediterranean Sea, Cyprus does not experience high tides or tidal fluctuations. The Chalcolithic inhabitants of Souskiou-*Laona*, however, engaged in repetitive aquatic activity to the extent sufficient to induce EAEs. Some evidence of fishing is present at Souskiou-*Laona* with the presence of two beads made of perforated fish vertebrae of unidentified species in two separate disturbed tombs; however, as the species cannot be deduced it is not clear if these were procured from the sea or freshwater sources. The limited ichthyological remains suggest that fishing was not heavily practised, or not deemed important in mortuary display, at either Souskiou-*Laona* or *Vathrykakas*. Freshwater resource exploitation is also evidenced at Souskiou-*Laona* with the presence of freshwater crab claws (*Potamon potamias*; Ridout-Sharpe, 2019). The Dhiarizos River valley lies directly adjacent to the site and was likely the source of these freshwater crabs (Peltenburg et al., 2019). It seems that the presence of EAEs at Souskiou-*Laona* corresponds with the procurement of marine and, to an extent, freshwater aquatic resources, used for cultural and mortuary practices (Ridout-Sharpe, 2019). The malacological remains coinciding with EAEs at Souskiou-*Laona* imply that the coastal region was part of the minimum resource catchment area which was exploited by the community of Souskiou, encompassing the surrounding river valleys and south coast region (Figure 1).

Tombs containing individuals with EAEs did not yield substantially greater amounts of dentalia and shells than those without, suggesting that those who may have been engaged in collecting the shells did not necessarily (exclusively or predominantly) use or display them. This may be analogous to other contemporaneous sites including Chalcolithic Kissonerga-*Mosphilia* (Irving, 1998) and Chalcolithic

Kissonerga-*Mylouthkia* (Cerón-Carrasco, 2003; NB. Neolithic Kissonerga-*Mylouthkia* presents EAEs) which present evidence of fishing. Minimal fishing evidence was found at Souskiou-*Laona* where several individuals exhibit EAEs. EAE prevalence in bonestack individuals (crania), representing the earlier burials at the site is 14.8%. EAE prevalence is 16.7% for articulated skeletons, the last burials in the cemetery before abandonment (Table 3). This demonstrates that people were continually engaging in repetitive aquatic activities, such as marine resource procurement, diachronically at Souskiou-*Laona*, though these interpretations are constrained by the preservation of the assemblage.

Maritime activities including trade were likely practised at Souskiou-*Laona*. These maritime-related activities may include seafaring and tasks associated with vessel maintenance, as demonstrated by ethnographic data from Thasos Island, Greece (Agelarakis & Serpanos, 2010). The coastal zone accessible by the population of Souskiou included one of the major harbours on Cyprus for several millennia; however, the scale, frequency and complexity of local shipping activities during the Chalcolithic period are unknown (Peltenburg et al., 2019). Maritime activities may explain the presence of fossilised *Dentalium* cf. *sexangulum* at Souskiou-*Laona* and *Vathrykakas*, likely imported from the Turkish Levant (Ridout-Sharpe, 2019). The earliest example of faience on the island was recovered from Souskiou-*Laona*. This faience artefact was not made in Cyprus but was imported from elsewhere. Further evidence of imported goods includes some metal objects. These faience and metal artefacts indicate an international trade network, which may have used the shoreline to connect the wider island communities in Cyprus with mainland populations (Peltenburg et al., 2019).

Chalcolithic Cyprus has been regarded as an egalitarian society. However, there is evidence of increasing social and economic complexity towards the end of the Middle Chalcolithic period. The transition from communal activities to individual practices, the development of expansive trade networks and the rise of elites were facilitated by increasing demand for valuable goods for mortuary display (e.g., dentalia) and, in particular, imported goods (i.e., copper, metals, faience) and picrolite cruciform figurines, stone figurines and anthropomorphic pottery (Knapp, 2013; Peltenburg et al., 2019). The practice of secondary burial (e.g., intentionally manipulated bonestacks) and increasing demand for valuable burial accoutrements led to the emergence of craft specialists (e.g., figurine makers, bead and pendant makers) and thus the intensification of trade. Souskiou-*Laona* was a major production centre of picrolite artefacts and demand for these products increased diachronically. This may be an analogous process to marine resource procurement by specialists intentionally exploiting dentalia for elaborate mortuary displays. Dentalium shells are the most common objects deposited at the Souskiou-*Laona* cemetery. The individuals involved with the procurement, manipulation and circulation of these products at Souskiou may have enhanced their economic and social status. This increase in social complexity, the emergence of specialists and elites, inequality and potential conflict are further evidenced by the first metacarpal fractures from Souskiou-*Laona*, which have been interpreted as related to interpersonal violence in the form of fist-fighting (Lorentz & Casa, 2020)

The differential expression of EAEs at Souskiou-*Laona* may be another indication of specialisation, together with indications of craft specialists (figurine makers, vessel makers, unique stone tool production, pendant and bead makers; Peltenburg et al., 2019) and mortuary specialists (with detailed anatomical knowledge of the human body and skeletal elements evidenced in their complex, fully intentional manipulations Lorentz, 2019).

5 | CONCLUSION

Five individuals from the Chalcolithic cemetery of Souskiou-*Laona* present EAEs, accounting for a total prevalence of 17.2% in adults. Twenty-five percent of males and 14.2% of females exhibit EAEs, reflecting that both sexes actively engaged in repetitive aquatic activities. The earlier bonestack burials display EAEs in 14.8% of the individuals (crania), whereas the later articulated skeletons present EAEs in 16.7% of individuals. These results indicate that males and females engaged in repetitive aquatic activities diachronically at Souskiou-*Laona*. However, sample sizes are small and therefore inferences of population and sex-specific behaviours are limited and may reflect preservation, or a lack thereof that has impacted observation of differences in EAE prevalence. The occurrence of EAEs at Souskiou-*Laona* is differential in terms of population and sex and may be interpreted in the context of emerging specialisations evident in the Middle Chalcolithic societies of the time. A key marine resource used in mortuary contexts are the dentalium shells, presumably used in necklaces and potentially as adornments in clothing, both with display value during life and death. Although contemporary Chalcolithic settlement sites in Cyprus contain evidence for edible fish and molluscs, Souskiou-*Laona* cemetery marine resource finds are limited almost exclusively to dentalium shells of no culinary use, but exclusively for display. This may simply reflect differences between cemetery and settlement. In the future, where preservation status allows (cf. Goude et al., 2018), we will explore further evidence for marine resource consumption by the inhabitants of Souskiou-*Laona*, both of those with EAEs and those without, using stable isotope ratios of C and N. The differential expression of EAEs in the population as a whole (bonestack crania and articulated skeletons) and the different prevalence between males and females may be interpreted in the context of increasing specialisation and social complexity during the Chalcolithic, consistent with the development of other specialised, standardised and gender-differential activities during this time period. The specialists of the sea emerge.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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