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Bioarchaeological research in Cyprus: A review

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Abstract: *We present a review of the history of human bioarchaeological research in Cyprus through the examination of published literature. We survey and discuss past and current trends, indicate gaps, highlight developments within recent years, propose future directions and provide an up-to-date literature review. While scholarly studies of ancient Cypriot human remains had already begun to emerge towards the end of the 19th century, continuing intermittently throughout the 1900s, significant changes took place during the 1980s. This later flourishing of human bioarchaeology in Cyprus, in contrast to conventional archaeological research, which had been making significant contributions to the investigation of ancient Cyprus since the early 20th century, is aligned with international developments. During the last two decades of the 20th century, human bioarchaeology in Cyprus sees a significant development towards a more scientific orientation in contrast to previous years. To date, 201 publications on Cypriot archaeological human remains have been found in journals, bulletins, books, monographs, proceedings and postgraduate research theses. The 1980s mark the beginning of a new era within human bioarchaeology in Cyprus. The number of problem-oriented human bioarchaeological studies focusing on archaeological questions as well as the number of studies drawing on scientific techniques beyond the standard morphological and metric approaches have increased significantly within the last decades. The number of researchers focusing on human bioarchaeology in Cyprus has also increased. Recent years have seen state-of-the-art approaches increasingly applied to the investigation and analysis of human remains, taking place within an interdisciplinary archaeological framework. These developments and the introduction of further cutting-edge methods and techniques are contributing towards key interpretations about the ancient inhabitants of the island and their lifeways.*

Key words: human osteology; science history; literature review

Introduction

Cyprus has a remarkably rich historical and archaeological research record and has attracted the attention of researchers and collectors since the 19th century. The island is

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located in the most eastern part of the Mediterranean Sea, surrounded by Europe, Asia and Africa. According to current archaeological consensus, the earliest human presence on the island dates back to the 11th millennium BC (Papademetriou & Pilides 2012). Due to its unique location and the availability of raw materials such as copper and timber, Cyprus rapidly developed connections with major civilizations in other regions, such as the Aegean, Egypt and the Levant, through long distance trade. Throughout the centuries, Cyprus linked societies of the Eastern Mediterranean region as the diverse civilizations of the region (e.g., Phoenicians, Egyptians, Assyrians, Greeks) engaged with the island, either as traders and travellers, or as conquerors (Karageorghis 2012; Papademetriou & Pilides 2012).

Initiation of research on ancient Cypriot human remains dates back to the 19th century (Virchow 1884) and the early 20th century (e.g. Buxton 1920, 1931; von Fürst 1933; Schaeffer 1935; Rix & Buxton 1938), following common trends of research in physical anthropology, now human bioarchaeology, in Europe and beyond. Researchers during the 19th and early 20th centuries focused primarily on anatomical and osteological studies, conducting metric measurements of cranial and post-cranial skeleton, stature estimations, age and sex identifications (Little & Sussman 2010; Márquez-Grant et al. 2016). Early research on Cypriot ancient human remains follows the European trends and focuses on anatomical studies and descriptive osteology. During these early stages of research on ancient human remains on the island, a number of works were published. These publications comprise reports and academic research focusing mainly on ethnology, metric and craniometrics analyses and comparisons, recording and describing of human remains with no further archaeological interpretations (Buxton 1920; Schaeffer 1935; Rix & Buxton 1938).

The development of research on human remains in Cyprus towards an interdisciplinary framework took place relatively recently. According to Harper and Fox (2008) factors delaying this development were related to poor legislation, inadequate equipment, facilities, and a historical bias towards other archaeological approaches and material during the last century. Issues of preservation (i.e., erosion, weathering, commingling) among Cypriot archaeological human remains assemblages was also among the factors contributing to this delay, hindering the usage of a range of scientific techniques and approaches such as aDNA (Calabrisotto et al. 2017). Lastly, a significant number of human remains from numerous sites have never been studied comprehensively, having only been reported partially, if at all (Harper & Fox 2008).

Harper and Fox (2008) conducted a comprehensive literature review on human bioarchaeology in Cyprus up to 2008, highlighting research trends divided by chronological periods. Their paper includes a comprehensive bibliography of osteological and bioarchaeological research conducted up to that time, however, the work presents only limited descriptive statistical analyses. In addition, they included examples of

methodologies applied, research projects, types of inferences presented, and future directions. We focus on extending this initial research by bringing the review of human bioarchaeology in Cyprus up-to-date through the inclusion of research conducted over the last thirteen years (2008–2022) along with a more systematic assessment of the trends and developments of the field since its inception through statistical analyses of existing publications since 1884. Further, we identify gaps, opportunities and future directions for the study of human bioarchaeology in Cyprus.

Material and methods

Data on human bioarchaeological literature in Cyprus were collected from a variety of sources. These sources include books, journals, bulletins, conference proceedings and published and unpublished postgraduate dissertations. While presentations in conferences, seminars and workshops has increased during the last years, (e.g. bioarchaeology sessions in international/regional/local events such as the International Congress on Archaeological Sciences in the Eastern Mediterranean and the Middle East (ICAS-EMME), the European Association of Archaeologists (EAA) annual meetings, the Postgraduate Cypriot Archaeology (PoCA) meeting, the Archaeological Research Unit (ARU) annual lecture series and the Cyprus American Archaeological Research Institute (CAARI) annual lecture series), they are not included here, nor is grey literature or any other unpublished documents. In collecting all data possible, we have proceeded in a thorough examination of literature in a variety of sources. These include online web search engines, websites and tools (i.e., Google Scholar, Microsoft Academic, Academia.edu, ResearchGate, Elsevier, Wiley Online Library, Mendeley) as well as library catalogues and archives by performing keyword research and citation tracking. The presentation of the data and the discussion were conducted in two parts. The first part presents the results from the analysis of the papers published in all national, regional and international sources. The second part presents the results from the analysis of the papers published in the Report of the Department of Antiquities of Cyprus (RDAC) solely. RDAC is the major regional journal publishing papers on Cypriot archaeology since 1934 and it is therefore of interest to analyse the number and types of human bioarchaeology papers within this journal since its establishment. In both parts, we explore the number and type of papers, trends, and archaeological, geographical and chronological foci. The complete list of publications on Cypriot human remains is presented in the **Supplementary File**. Descriptive statistics for the presentation and investigation of data and inferential statistics for associations were carried out using SPSS. Data recorded include decade of publication, type (i.e., journal paper/in books/thesis), content (i.e., problem-oriented/osteology report), geographical focus and chronological focus. Papers focusing on more than

one chronological period were recorded as "syntheses". Papers focusing on more than one geographical area were recorded as "multiregional".

Results

Through our survey, we identified 201 published research sources on Cypriot human bioarchaeology. **Figure 1** shows the chronological distribution of studies by decade. As observed, the first studies on ancient Cypriot human remains had been conducted relatively early, during the 19th (Virchow 1884) and early 20th centuries (Buxton 1920) but they are significantly fewer in number. No studies were published between 1885 and 1919, while studies from 1920 to 1959 are also very few (n=15, 7.5%). From the 1960s (n=10, 5%) and 1970s (n=9, 4.5%) the number of studies begins to increase. During the decades of 1980 (n=23, 11.5%) and 1990 (n=24, 12%) studies continue to increase, reaching a peak at the turn of the millennium. The data acquired indicate that, over time, there is a continuous increasing trend of human bioarchaeology research focusing on Cyprus.

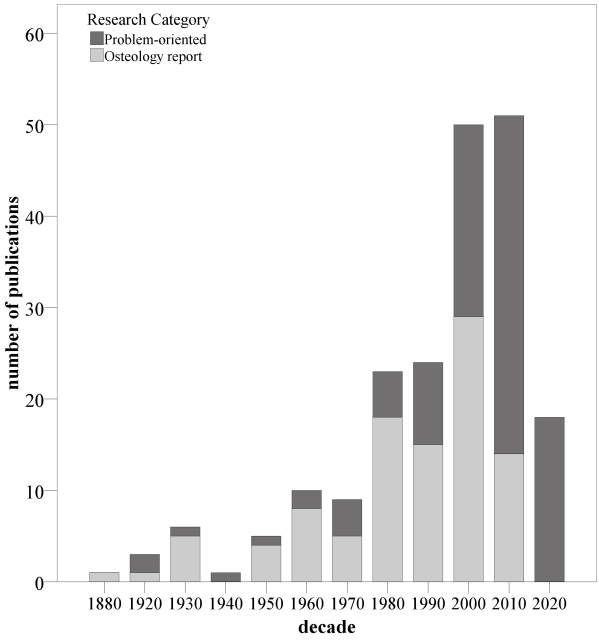

Figure 1. Distribution of papers by research category per decade. The distribution does not include decades with no publications.

Table 1. List of journals with papers on human bioarchaeology in Cyprus. See **Supplementary File** for complete references.

No.	Journal	n	Category	References
1	American Journal of Physical Anthropology	1	Bioarchaeology	Angel 1964
2	Archaeologia Cypria	1	Archaeology	Chrysostomou & Violaris 2018
3	Anthropologie	1	Bioarchaeology	Le Mort 2000
4	Anthropologischer Anzeiger	1	Bioarchaeology	Buxton 1931
5	Archivo per l'Anthropologia e la Etnologia	1	Anthropology	Massari 1929
6	Australian Journal of Biblical Archaeology	2	Archaeology	Longmore 1975, Walker 1975
7	Bioarchaeology of the Near East	1	Bioarchaeology	Harper & Fox 2008
8	Biometrika	1	Methodological	Buxton 1920b
9	British Dental Journal	1	Dental	Lunt 1984
10	Bulletin de correspondence hellénique	3	Archaeology	Moyer 1984, Charles 1960, Crubézy et al. 2003
11	Bulletin de Museum d'Histoire Naturelle de Marseille	1	Sciences	Charles 1962b
12	Bulletin of the Institute of Classical Studies	1	Archaeology	Bright 1995
13	Bulletin of the American Schools of Research	1	Archaeology	Rupp et al. 1999
14	Bulletin of the Council for British Research in the Levant	1	Archaeology	Gamble 2009
15	Current Anthropology	1	Archaeology	Pinhasi & Pluciennik 2004
16	Ethnographisch-Archäologische Zeitschrift	1	Archaeology	Lorentz 2004b
17	European Journal of Archaeology	1	Archaeology	Lorentz 2014a
18	Homo	1	Bioarchaeology	Kurth 1958
19	Human Biology	1	Human Biology	Angel 1972b
20	International Journal of Paleopathology	4	Bioarchaeology	Lorentz 2020, Lorentz et al. 2021, Anastasiou & Mitchell 2013, Baker & Bolhofner 2013
21	International Journal of Osteoarchaeology	3	Bioarchaeology	Lorentz & Casa 2020, Lorentz & Casa 2021, Lorentz et al. 2021
22	Journal of Archaeological Science (& Reports)	4	Archaeology	Lorentz 2016c, Voskos & Vika 2020, Calabrisotto et al. 2020
23	Journal of Clinical Periodontology	1	Dental	Mitsis & Taramidis 1995
24	Journal of Roman Archaeology	1	Archaeology	Fox 2003
25	Journal of the Royal Anthropological Institute of Great Britain and Ireland	1	Bioarchaeology	Buxton 1920a
26	L'Anthropologie	1	Bioarchaeology	Schaeffer 1935
27	Levant	1	Archaeology	Down 1982
28	Man	1	Anthropology	Rix & Buxton 1938
29	Medical College of Virginia Quarterly	1	Medical	Angel 1978
30	Near Eastern Archaeology	1	Archaeology	Harper 2008
31	Odontostomatoloyiki Proodos	1	Dental	Nyqvist 1980
32	Opuscula Atheniensia	1	Archaeology	Nyqvist 1980
33	Ossa	1	Bioarchaeology	Fischer & Noren 1988
34	Paléorient	2	Archaeology	Harter-Lailheugue et al. 2005, Le Mort 1995
35	PLoS Genetics	1	Sciences	Fernandez et al. 2014
36	Radiocarbon	2	Sciences	Calabrisotto et al. 2017, Calabrisotto et al. 2013
37	Report of the Department of Antiquities of Cyprus	40	Archaeology	see **Table** 7 for details
38	Science	1	Sciences	Angel 1966
39	Stanford Journal of Archaeology	1	Archaeology	Lorenz 2003b
40	Quaternary International	1	Methodological	Nikita et al. 2021

Regional and international sources

According to the gathered data, 92 (45.8%) studies have been presented in a total of 40 journals (including the RDAC and bulletins), 94 (46.8%) in books, manuscripts and proceedings and 15 (7.5%) as postgraduate dissertations. From the 92 papers, 43% (n=40) were published in RDAC, with the other 57% (n=52) being published in other regional or international journals and bulletins. Looking at the type of journals,

it can be observed that apart from the RDAC there is no specific journal in which researchers have chosen to publish their work. **Table 1** presents the complete list of journals in which papers have been published as well as the number published in each journal. Only a small number of papers per each journal have been published so far: between one to four publications per journal. The number of journals is relatively high (n=40). In order to further analyse journal selection and research foci, journals were clustered into seven categories: (1) archaeology, (2) bioarchaeology, (3) sciences, (4) medical/dental, (5) anthropology, (6) methodological/new approaches and (7) human biology/genetics.

According to the results, the majority of papers were published in journals focusing on archaeology (n=61, 66.3%). Only 18.5% (n=17) were published in journals focusing on bioarchaeology (e.g., *International Journal of Osteoarchaeology*, *American Journal of Physical* (now *Biological*) *Anthropology*, *International Journal of Paleopathology*). Journals focusing on sciences (n=5, 5.4%), medical/ dental (n=4, 4.3%), methodological/new approaches (n=2) and human biology/genetics (n=1) number just a few papers. Examining the geographical focus of these journals, as listed in **Table 1**, it can be observed that the majority focus on the Eastern Mediterranean and the Near East (e.g., *Levant*, *Near Eastern Archaeology*, *Bioarchaeology of the Near East*, *Paléorient*, *Journal of Mediterranean Anthropology and Archaeology*). Journals with wider geographical foci or other specific research domain foci are less represented (e.g., *International Journal of Osteoarchaeology*, *American Journal of Archaeology*, *American Journal of Biological Anthropology*, *PLoS Genetics*, *Lancet*).

Further analysis on the content of published research has been conducted to explore trends within the literature. Publications were clustered into two groups: (1) problem-oriented and (2) descriptive osteological reports. The distinction between the publications follows Mackinnon (2007). The term 'problem-oriented' refers to studies that answer specific, archaeological or bioarchaeological questions by exploring and comparing data derived from the analysis of human remains and investigating larger-scale patterns in human health (MacKinnon 2007; Temple & Goodman 2014). Papers categorised as descriptive osteological reports are those focusing on descriptive reporting and analyses of human remains (i.e., inventories, metrics and sex/age estimations, identification of pathologies) rather than contributing towards answering archaeological questions.

Table 2 presents the distribution of journal papers divided by content category. Almost half of the articles in journals are problem-oriented human bioarchaeological studies (n=43, 46.7%) while 53.3% (n=49) were identified as descriptive osteological reports, with the majority of the latter published in RDAC (n=34, 17.0%). Examining the content of papers that are published in journals, excluding those published in RDAC, the percentage of papers identified as descriptive osteological reports is

Table 2. Journal papers divided by content category.

Content category	Excluding RDAC		Including RDAC	
	n	%	n	%
Problem-oriented	38	73.1%	43	46.7%
Descriptive	14	26.9%	49	53.3%
Total	52	100.0%	92	100.0%

significantly lower (n=14, 26.9%). This difference is statistically significant ($p<0.05$) indicating a correlation between paper content and RDAC.

In regard to content analysis across journal categories, our results show that journals focusing on archaeology have been mostly publishing osteological reports (n=44, 48.4%). Problem-oriented studies have been mainly published in journals focusing on bioarchaeology (n=14, 15.4%), on medical/dental studies (n=4, 4.4%) and sciences (n=4, 4.4%) (**Figure 2**). There is a statistically significant different between paper content and journal category ($p< 0.0003$).

Of the total 201 publications on Cypriot human remains, 49.8% (n=100) were identified as descriptive osteological reports and 50.2% (n=101) as problem-oriented.

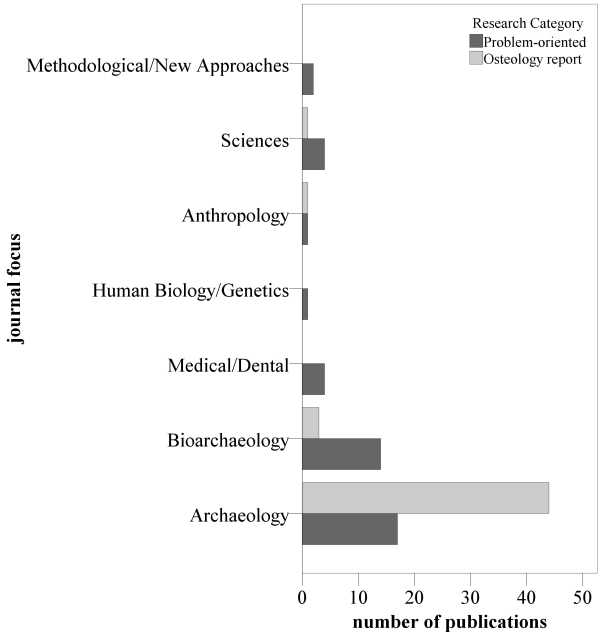

Figure 2. Distribution of journal papers per research category.

Table 3. Distribution and percentages of papers per research category across publication type.

Publication category	Problem-oriented	Descriptive	Total
Journals: count	43	49	92
% within group	46.7%	53.3%	100%
% of all literature	21.4%	24.4%	45.8%
Books: count	43	51	94
% within group	45.7%	54.3%	100%
% of all literature	21.4%	25.4%	46.8%
Theses: count	15	0	15
% within group	100%	0%	100%
% of all literature	7.5%	0%	7.5%
Total: count	101	100	201
% of all literature	50.2%	49.8%	100%

Table 4. Bioarchaeology in Cyprus divided by period (all literature).

Chronological period	n	%
Neolithic (10th millennium – 3900 BCE)	39	19.4%
Chalcolithic (3900–2500 BCE)	22	10.9%
Bronze Age (2500–1050 BCE)	51	25.4%
Geometric (1050–750 BCE)	5	2.5%
Archaic (750–475 BCE)	6	3.0%
Classical (475–312 BCE)	4	2.0%
Hellenistic (312–58 BCE)	3	1.5%
Roman (58 BCE – 395 CE)	7	3.5%
Early Christian (395 – mid-7th c. CE)	4	2.0%
Byzantine/Medieval (mid-7th c. – 1571 CE)	13	6.5%
Synthesis	47	23.4%
Total	201	100.0%

The distribution of descriptive osteological reports is slightly higher both in journals (n=49, 53.8%) and in books (n=51, 54.3%). **Table 3** shows in detail the distribution of studies by research category across the publication categories. Further analysis on the content category of published research showed that descriptive osteological papers show a higher prevalence until the 2000s. From the 2010s onwards, problem-oriented human bioarchaeological studies have significantly increased (**Figure 1**). There is a statistically significant difference between the decade of publication and research category ($p<0.05$).

Looking at the overall distribution of all sources (books, papers, theses) as to the archaeological time periods they focus on, Bronze Age (n=51, 25.5%) is the period that has been most studied so far (**Table 4**). The Neolithic (19.5%) and the Chal-

Table 5. Distribution of studies on Cypriot human remains across the districts of Cyprus.

District	Total		Category		
	n	%	In journals	In books	Theses
Multiregional/Synthetic	63	31.3%	28	25	10
Paphos	54	26.9%	25	25	4
Larnaka	39	19.4%	18	20	1
Limassol	25	12.4%	13	12	0
Nicosia	14	7.0%	7	7	0
Kyrenia	4	2.0%	1	3	0
Ammochostos	2	1.0%	0	2	0
Total	201	100.0%	92	94	15

colithic (11.0%) periods have also attracted major interest, while later chronological periods revealed a smaller number of papers, indicating that they have been less studied. From the 201 studies, 47 (23.5%) were recorded as 'syntheses' as they focus on more than one chronological period and/or they are synthetic theoretical works (e.g., Angel 1964, 1978; Fox 1997; Mina 2010, Voskso & Vika 2020).

This review enabled the geographical identification of sites from which human remains have been excavated, studied and published to-date. According to the results, a large number of studies comprise multiregional or more synthetic works (n=63,

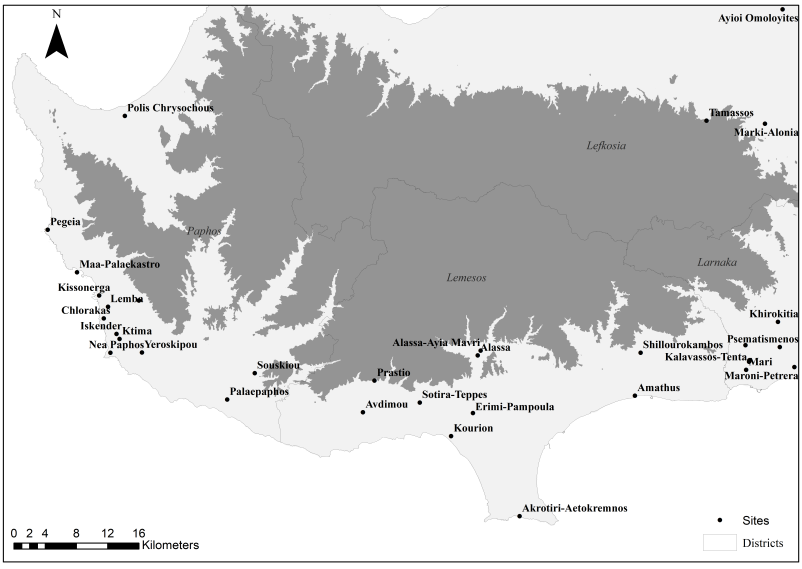

Figure 3. Map of Central-western Cyprus indicating sites where human remains have been excavated, studied and published. Drawing by by Grigoria Ioannou.

Table 6. Distribution of human bioarchaeology papers published in RDAC divided based on their context.

Category	n	%
Synthetic analysis papers	6	15%
Osteology reports in appendix	26	65%
Osteology reports in main text	8	20%
Total	40	100%

31.3%), focusing on human remains from more than one archaeological site or dealing with approaches pooling data from more than one archaeological site (**Table 5**) (e.g., Angel 1964, 1966, 1978; Parras 2004; Domurad 1986; Mina 2010; Monaco 2021). Based on the results, human remains from across Cyprus have been studied and published. **Figure 3** and **Figure 4** show close ups of western and eastern Cyprus with all the sites identified through this review. The district of Paphos (n=54, 26.9%), and Larnaka (39, 19.4%) showed a higher prevalence of studies compared to the other districts (e.g., Domurad 1985, 1987, 1988; Lunt 1995; Fox 1997; Ioannou 2013; Lorentz 2014a, 2014b, Lorentz & Casa, 2020, Lorentz 2020; Lorentz et al. 2021). This review has also shown that human remains from several archaeological sites with mortuary contexts, published in RDAC, have not been studied or/and published yet.

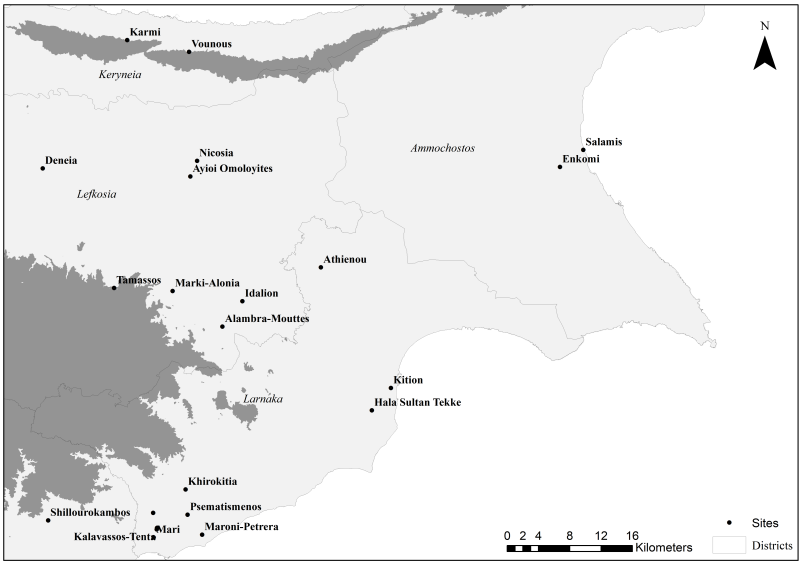

Figure 4. Map of Central-eastern Cyprus indicating the sites where human remains have been excavated, studied and published. Drawing by Grigoria Ioannou.

Table 7. Record of papers on human remains published by RDAC from 1936–2021.

No.	Year	Reference	Paper category	Period
1.	1936	Guest 1936	Report in appendix	Neolithic
2.	1938	Rix 1938	Report in appendix	Neolithic
3.	1955	Angel 1958	Report in appendix	Roman
4.	1964	Charles 1964	Report in appendix	Bronze Age – Roman
5.	1966	Charles 1966	Report in appendix	Hellenistic – Roman
6.	1979	Schulte-Campbell 1979	Report in appendix	Bronze Age
7.	1985	Domurad 1985	Report in appendix	Hellenistic
8.		Galloway 1985	Report in appendix	Hellenistic – Roman
9.		Moyer 1985	Report in appendix	Bronze Age
10.	1986	Domurad 1986	Report in appendix	Chalcolithic
11.	1987	Domurad 1987a	Report in appendix	Chalcolithic
12.		Domurad 1987b	Report in appendix	Classical
13.	1988	Domurad 1988	Report in appendix	Hellenistic
14.	1989	Cadogan & Domurad 1989	Report in main text	Bronze Age
15.	1990	Fessas 1990	Report in appendix	Archaic
16.	1993	Herscher & Fox 1993	Report in main text	Bronze Age
17.	1994	Lunt 1994	Report in appendix	Chalcolithic
18.	1997	Agelarakis 1997	Synthetic analysis	Hellenistic & Medieval
19.		Fox 1997	Report in appendix	Archaic
20.		Moyer 1997	Report in appendix	Bronze Age
21.	1998	Chapman 1998	Synthetic analysis	Roman
22.	1999	Parks & Chapman 1999	Report in main text	Roman
23.	2000	Dietrich 2000	Report in appendix	Bronze Age
24.		Harper 2000	Report in main text	Roman
25.	2001	Fox 2001	Report in appendix	Archaic
26.		Harper 2001	Report in main text	Roman
27.		Lorentz 2001	Report in appendix	Classical
28.	2002	Harper 2002	Report in appendix	Roman
29.	2004	Vassiliou & Stylianou 2004	Report in main text	Bronze Age
30.		Vavouranakis et al. 2004	Synthetic analysis	Neolithic
31.	2005	Crewe et al. 2005	Synthetic analysis	Chalcolithic
32.	2007	Fox 2007	Report in appendix	Bronze Age
33.	2009	Lorentz 2009	Report in appendix	Classical
34.	2010	Frankel & Webb 2010	Report in main text	Bronze Age
35.		Mina 2010	Synthetic analysis	Chalcolithic – Bronze Age
36.		Lorentz 2010	Report in appendix	Bronze Age
37.	2017	Croft et al. 2017	Synthetic analysis	Neolithic
38.		Gamble 2017	Report in main text	Neolithic
39.		Stylianou 2017	Report in appendix	Bronze Age
40.	2018	Chrysostomou 2018	Report in appendix	Bronze Age – Geometric

Report of the Department of Antiquities of Cyprus

The Report of the Department of Antiquities (RDAC) is published annually by the Department of Antiquities of Cyprus (DoA). DoA, officially established in 1935, is

responsible for the management of archaeological heritage, museums, excavations and archaeological activity in Cyprus. RDAC publishes scientific work conducted by researchers with a focus on Cypriot archaeology, art, history and preservation. The first *Cyprus Department of Antiquities Report for 1934* was published in 1935 (Karageorghis 1985). There was an interruption between the years 1949–1962 and 2012–2017. The primary purpose of the RDAC is to publish preliminary reports of excavations and research directed by archaeological officers of DoA, as well as foreign archaeological missions in Cyprus. RDAC also accepts research papers from scholars in the fields of Cypriot archaeology, history, conservation, culture and art. In total, 1291 RDAC papers have been published since the 1st RDAC volume until the latest published volume in 2018. Volumes 1940–1948 were published in a single volume in 1958. From these, 143 (11.1%) focus on mortuary archaeology. Of these only 40 papers (27.9% and 3% of the total RDAC number) include work on human remains; 34 (85%) papers are defined as osteological reports and six (15%) papers include bioarchaeological interpretations. RDAC papers can be further divided in three sub-categories: (i) human remains reported in the appendices of archaeological papers, (ii) reports of human remains in the main text and (iii) synthetic analysis papers. Twenty-six works (65%) fall within the first category and only eight (15%) comprise osteological reports published within the main text of archaeological papers. **Table 6** shows the distribution of RDAC papers by category and **Table 7** shows the complete record of articles on human remains published by the RDAC.

When the RDAC human bioarchaeology papers are divided by decade of publication it can be observed that only six (15%) papers were published between the 1930s and the 1970s. Papers show a significant increase from 1980 onwards and this increase drops between 2012 to 2017, as a result of the temporary pause of RDAC between these years (**Figure 5**). The early RDAC papers and those published until 1989, comprise descriptive osteological reports. These reports are included within the appendices of archaeological articles (i.e., Guest 1936; Rix 1938; Charles 1964; Schulte-Campbell 1979). From 1980 onwards, the number of papers on human remains increases significantly. This increase continues until the first decade of 2000, with a total of 14 papers published during this decade. The last decade shown on the graph (2010–2019) remains incomplete as the 2019 RDAC is yet to be published, and thus the number of papers on human remains shown for this decade is likely to change.

Divided by chronological period, RDAC has published papers focusing on the majority of the archaeological periods identified on Cyprus. However, papers on human remains dating either to the Geometric or to the Ottoman periods have not yet been published in the RDAC. There is a clear preponderance of focus on human remains from the Bronze Age (n=11, 27.5%) (**Figure 6**). Six papers have been cate-

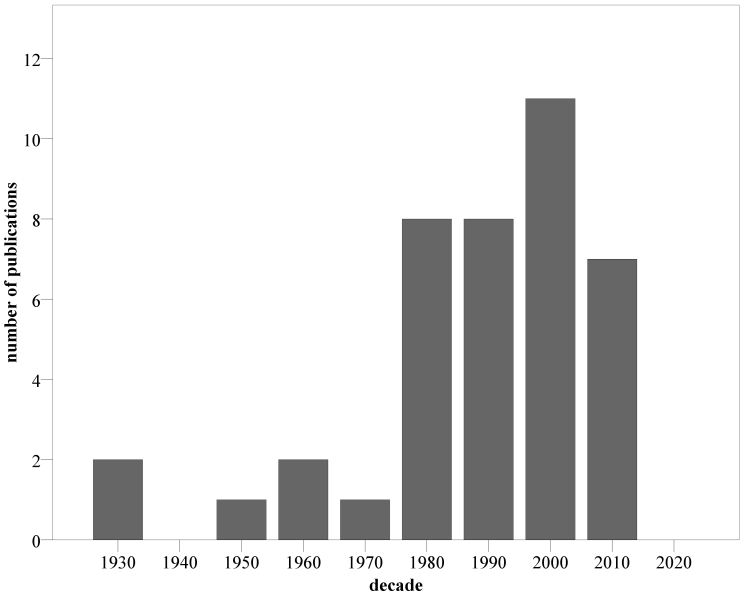

Figure 5. Number of papers on Cypriot ancient human remains published per decade in RDAC.

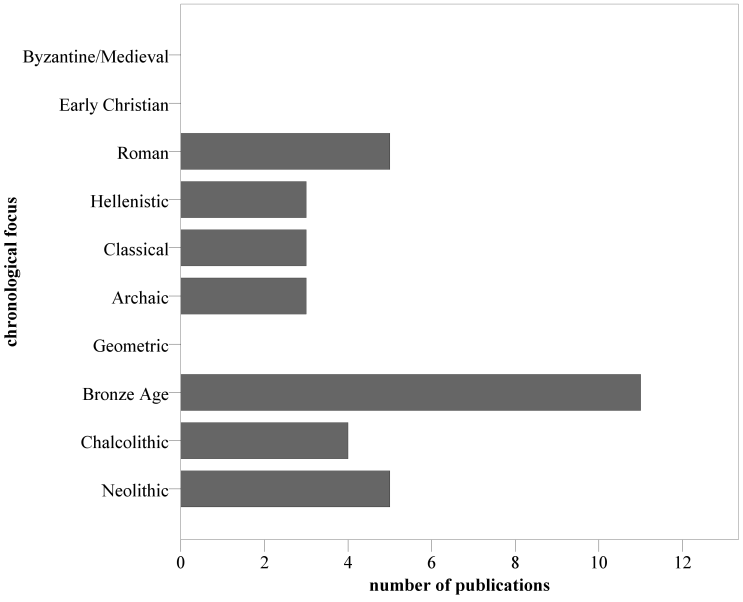

Figure 6. RDAC papers on Cypriot ancient human remains divided by chronological period.

gorized as 'multiregional' as they focus on more than one chronological period. The district of Paphos showed a higher prevalence of studies (n=15, 37.5%) in RDAC.

Discussion

A history of human bioarchaeology in Cyprus

Through this intensive literature survey, we identified 201 works on ancient Cypriot human remains. Research on Cypriot human remains dates back to the late 19th and early 20th century during when analyses of skeletal materials were included in scientific treatises, papers and reports. Several of the early researchers analysing ancient Cypriot human remains were physicians (e.g., Virchow 1884; Hjortsjö 1947), though some were physical anthropologists (Buxton 1920; Schaeffer 1935). During the beginning of physical anthropology and paleopathology in Europe, archaeological human remains were analysed mostly by physical anthropologists (Mackinnon 2007; Buzon 2012) with little or no focus on the archaeological context or key questions for the archaeology of the region—rather, focus was on anatomical variation, anomalies, metric measurements, and at best, population affinity. Following the trends of their time, researchers working with Cypriot material in the late 19th and early 20th centuries display a particular interest on complete crania, metrics and demographics. Such examples include the works of Buxton (1920), Schaeffer (1935), Rix and Buxton (1938) and Hjortsjö (1947), focusing on Neolithic and Bronze Age Cypriot skull measurements, observations on cranial shape, cranial modification and age/sex estimations.

During this early period, osteological reports of skeletal assemblages began to be published, with the majority included in archaeological site reports as appendices. These osteological reports focused mainly on descriptive reporting and analyses (inventories, metrics and sex/age estimations) rather than contributing towards answering archaeological questions. Osteological reports without integrating the archaeological contextual data recovered from excavations were a common trend in research worldwide during the early 20th century (Mackinnon 2007; Buzon 2012).

During the next decades, there was a slight increase, globally, on research on human remains as well as on the number of researchers focusing on ancient human remains. However, a significant change occurred during the mid-20th century when the analysis of human remains in Europe and the USA begun to adopt a more contextual approach.

Researchers in Cyprus also started to include the analysis of osteological materials within a bioarchaeological framework (Larsen 1997; Buzon 2012; Zuckerman et al. 2012), signalling the beginning of the development of the study of Cypriot human remains towards a more systematic and contextualised approach. According to

Buzon (2012), who studied general global trends in the development of bioarchaeological approaches to paleopathology, J. Lawrence Angel, an American physical anthropologist focusing on both Eastern Mediterranean and African-American populations, integrated biological changes in a broader framework along with historical, cultural, environmental, and ecological data into his research. J. Lawrence Angel (1955, 1961) studied Cypriot osteological materials from several archaeological sites and contributed significantly to the development of paleopathology in Cyprus (Harper & Fox 2008; Buikstra & Lagia 2009; Lorentz 2010). Research conducted by Banton (1951) Axmacher and Hjortsjö (1959) and Longmore (1975) are a few more examples of papers with a contextualized approach. These early works, however, mostly focused on the examination of the skull, dental pathologies, measurements of the cranium and cranial pathology associated with particular skeletal lesions such as anaemia. During the following decades, and still today, descriptive osteological reports continue to be published alongside more problem-oriented human bioarchaeological research.

Our study has shown that the development of bioarchaeological research in Cyprus towards an interdisciplinary framework took place relatively recently, from 1980 onwards. There is a clear shift towards more contextual and problem-oriented studies (e.g., Agelarakis 1997; Fox 1997, 2014, 2019; Fox & Tritsaroli 2019; Anastasiou & Mitchell 2013; Baker et al. 2012; Voskos & Vika 2020). While international research institutions and universities have shown great interest in the study of Cypriot human remains, Cyprus has only one regional educational institution with bioarchaeology as a research domain, offering graduate studies and training on the subject. This is the Cyprus Institute (CyI), founded in 2005. The delay in establishing regional educational institutions focusing on bioarchaeology might have contributed to the delay in the development of Cypriot bioarchaeology.

Human bioarchaeology in Cyprus: The literature

A significant number of articles focusing on the analysis of Cypriot human remains has been published in RDAC so far, in contrast to other journals. This pattern is likely linked with the fact that RDAC is the major regional journal in Cypriot archaeology, publishing both excavation reports and research papers. According to the results, the majority of the papers published by RDAC are osteological reports, most often included as appendices of the main archaeological paper, focusing on reporting human osteological material recovered during excavation. These reports include inventories, together with assessments of the minimum number of individuals (MNI), estimation of age and stature, assessment of sex, and description of pathological conditions on bones and teeth. These reports are brief in length and do not explicitly refer to any specific research questions. The publication of reports on excavations in Cyprus is among the primary aims of RDAC, and the large number of osteological reports of

human remains derived from archaeological excavations is in line with this aim. In contrast, as seen through our analysis, articles published in other journals are problem-oriented bioarchaeological studies rather than descriptive reports, applying scientific methodologies and interdisciplinary approaches (e.g., Baker et al. 2012; Anastasiou & Mitchell 2013; Calabrisotto et al. 2017; Calabrisotto 2017; Goude et al. 2018; Voskos & Vika 2020; Lorentz & Casa 2021; Lorentz et al. 2021a).

Overall, published research on human bioarchaeology in Cyprus showed a notable increase through the years. This pattern can be associated with the increase of excavated osteological material and the number of bioarchaeologists interested in Cypriot and Eastern Mediterranean ancient populations, as well as global trends in human bioarchaeology and archaeology in general. Particularly, the increase in papers on Cypriot human bioarchaeology from the 1980s onwards can be associated with the increase of specialization and development of human bioarchaeology during the 1980s worldwide. According to Little and Sussman (2010), a considerably large amount of research and increased training of doctoral students in physical anthropology took place during the period from 1960 to 1980. Indeed, during the 1980s the number of researchers analysing skeletal remains from Cyprus has increased (i.e., Lunt 1980; Domurad 1985; Downs 1982; Schulte-Campbell 1983; Moyer 1984). Osteological reports continue to prevail during this period, within RDAC in particular, from 1980 to 2000. This trend is detected in worldwide human bioarchaeological literature as well. According to Lovejoy et al. (1982) until the 1970s papers classified as descriptive comprised half of the total number of papers in the *American Journal of Physical Anthropology*. From the 1970s onwards, there was a shift in the international literature towards more analytical approaches, with researchers focusing on palaeodemography, biomechanics, growth, skeletal development and more. It seems that Cyprus follows international trends in human bioarchaeology but with some delay. The shift towards problem-oriented studies in Cyprus begins in the 1980s and 1990s. Researchers now focus on the analyses of complete skeletons and commingled remains, conducting comprehensive bioarchaeological research with the application of analytical approaches. While the early stages of analytical approaches where set in the mid-20th century, it is during the last decades of the century that a shift towards a more interdisciplinary framework took place in Cyprus. Synthetic, problem-oriented human bioarchaeological studies reached a peak in the 2010s.

In terms of research foci and trends within RDAC and all other sources, these are in agreement. The majority of the papers published in the early years focused primarily on descriptive analyses, especially of crania, with minimal or no focus on answering archaeological questions. Only towards the last quarter of the 20th century, has there been a significant increase in problem-oriented studies. The focus now falls on the human bioarchaeological investigation of aspects of social identity, social status, lifestyle

and funerary and social practices. The number of palaeopathological studies and of papers on reconstruction of health status has also increased. During the last decades of the 20th century and the new millennium, the trends and research foci have shifted towards a more contextualized approach. The number of researchers interested in ancient populations on Cyprus also increases. Research foci include work that goes beyond traditional descriptive osteology. Problem-oriented bioarchaeological studies increase in number while osteological reporting of skeletal collections continues to be published as well. These studies vary in topics. Researchers are interested in contributing to archaeology and investigate a variety of questions in order to better understand ancient Cypriots, their health and lifeways, through the analyses of human remains by integrating osteological data onto archaeology. A few examples are the work by Harter–Lailheugue (2005), Fox and Marklein (2014), Lorentz (2020), Lorentz et al. (2021b), Le Mort (2007), Harper (2011), Harper and Tung (2011), Parras (2014), Chrisostomou and Violaris (2014), Gamble and Lorentz (2014), Calabrisotto et al. (2020); Lorentz and Casa (2020), Voskos and Vika (2020), Ioannou (2021), and Le Mort et al. (2021). These directions focus on topics such as activity, hygiene, lifestyle, funerary and social practices, diet, demography and demographic changes, kinship, mobility, health status and pathologies.

Our review has shown that while there is a significant development of Cypriot human bioarchaeology, still several gaps exist. Only few papers on Cypriot human bioarchaeology have been published in the most acknowledged journals on bioarchaeology and biological anthropology, such as the *International Journal of Osteoarchaeology*, *American Journal of Physical* (now *Biological*) *Anthropology* and *International Journal of Paleopathology*. The majority of the papers published in these journals dates between the 2010s and the 2020s (e.g., Anastasiou & Mitchell 2013; Lorentz 2020; Lorentz & Casa 2021; Lorentz et al. 2021a; Lorentz et al. 2021b). New directions and applications of novel technologies and state-of-the-art methodologies for extracting new knowledge from Cypriot ancient populations are very likely to lead to papers suitable for leading multidisciplinary peer reviewed journals. These new directions could include the development of new methodological approaches particularly focused on working with commingled and poorly preserved remains, taking into consideration the poor preservation of a large part of Cypriot archaeological human remains (Fox & Marklein 2014).

In regard to the chronological focus, it seems that the Bronze Age (2500–1050 BC) has attracted the most interest. The Neolithic (10th millennium – 3900 BC), the Chalcolithic (3900–2500 BC) and the Roman (58 BC – 395 AD) periods also prevail over the other periods, both within RDAC and within all sources. This pattern could be the result of the initial systematic bioarchaeological analyses of specific collections laying the basis for further studies, the availability of osteological mate-

rial, and the preservation status of bones from specific find locations, which enable further problem-oriented research to be conducted. For instance, the majority of papers on human remains from Kourion, one of the largest urban cities during the Hellenistic-Roman period, focus on descriptive analyses leading to a series of publications (Domurad 1985; Chapman 1988; Parks & Chapman 1999; Harper 2000, 2001). Another factor contributing to the above observation could have been the relative lack of discovered human osteological material dated to other chronological periods. In addition, poor bone preservation often prevents the application of analyses. Investigating human remains dating from all the different chronological periods present in Cyprus is, however, crucial as it contributes to new knowledge and understanding of Cyprus' ancient populations throughout the millennia. In addition, it will enable future comprehensive and comparative bioarchaeological studies to be conducted within Cyprus as well as between Cypriot and neighbouring populations.

Comprehensive and comparative studies on ancient Cypriot human remains are to-date relatively few (e.g., Agelarakis 1997; Fox 1997, Ioannou 2013; Ioannou 2021; Ioannou in preparation). Comparative studies between populations of different chronological and geographical backgrounds are pivotal as they enable new knowledge acquisition, detection and investigation of differences in aspects such as demographic structure, mobility, funerary practices, palaeopathology, diet, prevalence of chronic infectious diseases, activity patterns, and possible interpersonal violence (Knudson & Stojanowski 2008).

Through our results, it is possible to observe that there is some delay in the systematic application of state-of-the-art bioarchaeological methodologies to ancient Cypriot human remains. As presented earlier in this review, this delay has been associated with several factors affecting preservation of human remains, hence limiting the analysis and application of advanced research techniques and state-of-the-art methodologies requiring sufficient bone preservation. Such challenges include climate and environmental factors, excavation procedures and looting activity (Harper & Fox 2008; Calabrisotto et al. 2017). During the last decades, advance state-of-the-art methodologies have increasingly been explored and applied to Cypriot material, but they are considerably few. The application of new methodologies is crucial as it enables the investigation of ancient populations in a way that traditional human bioarchaeology is not able to. Examples of such research conducted on Cypriot osteological materials are paleoparasitology (e.g., Anastasiou & Mitchell 2013; Ioannou & Lorentz in preparation), isotopic analysis (e.g. Calabrisotto 2017; Calabrisotto et al. 2017, 2020; Goude et al. 2018; Voskos & Vika 2020, Nikita et al. 2021) and aDNA (Chrysostomou & Violaris 2018). Studies focusing on paleopathology by applying the latest relevant methods are also few. Such studies contribute towards understanding infectious diseases, hygiene and diet of a population during specific periods of time. Par-

asites found in the burial soil can be detected through microscopic examination and DNA analyses, providing tangible results for gaining deeper insights to past diseases and human biology (Buzon 2012). Bioarchaeological research focusing on activity in order to provide information about occupation lifestyle and exposure to health hazards in the past (Buzon 2012) are also limited in Cyprus (e.g., Monaco 2021). Furthermore, among the most current trends in human bioarchaeology worldwide is the application of stable carbon and nitrogen isotope and strontium isotope analyses for the investigation of paleodiet and mobility (Fontanals-Coll et al. 2015). There is no comprehensive bioarchaeological research focusing on the reconstruction of paleodiet and mobility by applying isotopic analyses in Cyprus. Calabrisotto (2017) and Voskos and Vika (2020) are among the few researchers working on applications of isotopic and radiocarbon analyses to investigate palaeodiet and bone preservation for radiocarbon dating in Cyprus.

Most novel developments include the application of Synchrotron Radiation (SR) enabled approaches to the human bioarchaeology of Cyprus (Lorentz et al. in preparation) in order to answer key questions in Cypriot archaeology and the archaeology of its wider region. Synchrotron radiation approaches include non-destructive/minimally destructive techniques that can reach the level required for extracting data that cannot be obtained using any other conventional method. Applications of SR enabled approaches on ancient human remains include metal element localization in ancient human tissue (hair, bone and teeth) using SR-XRF/XAFS, non-destructive virtual histological analysis of the accentuated lines in dental enamel and micro-analysis of dental calculus using SR-microCT (Ioannou et al. 2018; Ioannou et al. 2019; Lorentz et al. 2020).

Legislation, excavation techniques and methodologies of excavation and recovery of human remains in Cyprus have developed significantly during the last decades on behalf of the Department of Antiquities of Cyprus (Aristotelous 2021). Proper excavation, recording and recovery of human remains is crucial in order to acquire data and information that cannot be recovered once the human remains reach the laboratory. Careful and proper excavation of human remains contributes towards acquiring information about funerary and disposal practices, and taphonomy, as well as enables the retrieval of samples for paleoparasitological analyses (Buzon 2012; Knudson & Stojanowski 2008).

Conclusion

Through this intensive literature review, we brought the review of human bioarchaeology in Cyprus up-to-date, identifying 201 research works with the inclusion of new work conducted over the last thirteen years (2008–2022) since the last review. To date, research on human remains has been identified in journals (n=92), books (n=94)

and postgraduate dissertations (n=15). Using statistical analyses, we have provided a systematic assessment of the content and focus, trends and developments, since the beginning of human bioarcheology in Cyprus. While research on archaeologically recovered human remains has a long history on the island, with over one hundred years of published research activity, it is only during the last decades that more problem-oriented approaches have flourished, aligning with international developments and trends. Interdisciplinary orientations began appearing during the mid to late 20th century, but the full development of these research directions took place during the first two decades of the 21st century, with the 2010s reaching a peak in problem-oriented bioarchaeological studies. The collected data shows that this is a new era for the bioarchaeology of Cyprus, where research undertaken thus far has created a strong base for future research and continues to provide insights to key questions for the archaeology of Cyprus and the region, as well as contributes toward the formulation of new archaeological questions. New and emerging directions inspired by global developments in human bioarchaeology and human remains analysis are currently being explored and applied to Cypriot human remains.

A complete bibliography on Cyprus bioarchaeology can be found in the **Supplementary File**.

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