Palaeodemographic Analysis of a Byzantine-Medieval Neighbourhood in Nicosia-*Palaion Demarcheion* ('Old Municipality') 2002-2004

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Cyprus, being located at the convergence of Asia, Africa and Europe, has diachronically been an important crossroads for commerce, cultural and religious interactions, military ventures and politics. Traditionally, this complex interaction between the various foreign groups and the local Cypriot populations has been studied, to the extent possible, through material culture (composition, shape and form of movable artefacts and architectural structures), written historical sources and to a lesser degree through the evolution of language. The aim of this research is to investigate the demography of past populations by integrating the available data obtained from archaeological and historical sources with information derived from anthropological and genetic analyses. In particular, this paper discusses the site of Nicosia-Palaion Demarheion, which is located within the Venetian fortification walls of Nicosia, and is associated with two churches (conventionally named Church A΄ and B΄ respectively) and their cemetery populations that date between the late 11th to 15th centuries AD. Historically, this era has been associated with a widespread movement of people both in Europe and the East, while in Cyprus this is mainly associated with the Frankish rule.

The present study involves the anthropological analysis of a minimum number of 209 individuals excavated during the 2002-2004 excavation seasons.[1] *The cemetery population associated with Church A΄ appears to have been dominated by infants and children, while a large percentage of young individuals is also present in the cemetery associated with Church B΄. The palaeodemographic profiles of these two population groups were compared with the palaeodemographic profiles of three other contemporary European cemeteries. In addition,*

[1] This paper was presented at the lecture series organized by the Association of Cypriot Archaeologists in January 2010, Nicosia, Cyprus.

skeletal samples from 47 individuals were submitted for genetic analyses. The preliminary results of this interdisciplinary study indicate that the large percentage of infants in the cemetery population most likely represents an increase in population rather than an increase in mortality rates, as further supported by the historical and genetic data.

This is the first time that anthropological and genetic data have been incorporated in the study of past migration in Cyprus. In view of these findings, future research is encouraged to include the study of human skeletal collections when examining the social structure in Cyprus during the Byzantine and Medieval periods.

Introduction

Cyprus is the third largest island in the Mediterranean Sea and throughout history its most distinctive feature has been its geographical location, at the convergence of Europe, Asia and Africa. The island, owing to this strategic position, interacted with most of the influential powers in the region. The Greeks have been the dominant population group in Cyprus from early historic times to the present. The long-lasting presence, however, of the many incoming foreign groups that were gradually integrated into the pre-existing populations formed complex demographic parameters that are not so easily discernible in the archaeological record.

The chronological framework of the present study focuses on the late 11th-15th century AD, which in Cyprus corresponds to the Middle Byzantine (965-1191 AD) and Frankish (1191-1489 AD) periods. According to historical and archaeological records, Cyprus was conquered by King Richard the Lionheart of England in 1191 AD and was subsequently sold to the Knights Templar. The Knights Templar in turn sold the island to the King of the crusader state of Jerusalem Guy de Lusignan, who took possession of the island in May 1192 AD.

During the preceding Byzantine period, the population composition of Cyprus consisted mainly of Greek Christians. Historical sources indicate that during the Frankish period, the capital of the island, Nicosia, was the centre of the Latin rulers and the residence of the majority of the Frankish nobility.[2] The populations that moved to the island during the Frankish rule included Latins (both from Western

[2] Violaris (2014: Appendix I) gives an account of the population structure of byzantine-medieval Cyprus and the population transformations that took place during the Frankish period mainly as recorded in historical sources.

Europe and the East) and refugees from Syria and Palestine, who migrated to Cyprus during the last decades of the crusader states, and especially in 1291 AD further to the Mamluk conquest of Latin possessions in the coastal areas of these lands.[3] These groups were well integrated into the local society, and a prime example demonstrating this integration was the fact that by the 15th century AD the Pope was obliged to approve intermarriages between the Greeks and the Latins.[4] Other interacting groups mentioned in historical sources during this timeframe included various Western European traders, such as the Italian and Provençal merchants, Maronites, Armenians, Greeks, Lombard and Bulgarian mercenaries, as well as other smaller groups.[5] According to Nicolaou-Konnari,[6] the Latin population of Cyprus was less than one-fourth of the total island population, with the Maronites and Syrians becoming the largest groups following the Greeks and Latins. In addition, the Armenian population increased, while Jews were present in small numbers in the towns of Nicosia, Famagusta and Paphos.

Demographic research documents that the Cypriot population experienced growth from the beginning of the 13th century until the mid-14th century AD,[7] when the plague epidemics killed approximately 30-50% of the European population.[8] The present research focuses on the palaeodemographic and genetic profiles of a byzantine-medieval human skeletal collection excavated at the site of Nicosia-*Palaion Demarcheion*, in order to examine whether the socio-political changes in the Frankish Cyprus were indeed reflected in the demographic structure of these cemetery populations. This research is particularly important since it is the first palaeodemographic study in Cyprus for this period, while the cemetery populations from Churches A′ and B′ represent one of the largest archaeological skeletal collection on the island.

Introduction to demography

Demography is essentially the study of human populations especially with reference to their size, structure and growth, and provides statistical analysis of living populations

3 Nicolaou-Konnari 2005.

4 Violaris 2014.

5 Nicolaou-Konnari 2005: 15; Violaris 2014.

6 Nicolaou-Konnari 2005: 15.

7 Nicolaou-Konnari 2005: 15; Violaris 2014.

8 DeWitte 2014: 1.

by examining spatial or temporal changes in response to migration, fertility, life expectancy, and mortality. Palaeodemography is primarily differentiated in that the population parameters under study belong to past societies.[9] The palaeodemographic reconstruction of a population is one of the most important aspects in anthropological studies, as it is a key tool for better understanding the dynamic parameters between the biological and social factors influencing a population change, and for examining other factors related to health and standard of living.

One of the first researchers in the field of palaeodemography was John Lawrence Angel, who can perhaps be considered the founding father of European palaeodemography with his writings on life expectancy in the ancient world.[10] In the 1970s, palaeodemographic studies had thrived in the archaeological literature, with researchers applying the demographic theory to ancient populations and using abridged life tables[11] as a tool to aid interpretations of age-at-death profiles from cemetery samples. In the following decade, however, a great debate arose over the merits of palaeodemography with disputes on the accuracy of the age-at-death profiles and the low correlation between skeletal and chronological age, and on the assumption that age-related changes in the human skeleton were constant through time.[12] One of the main problems was the age representational bias due to differential preservation, or the age estimation of the skeletal remains of certain age classes, such as the elderly adults.[13] Therefore, the advance of palaeodemographic research subsided due to the reported series of limitations constraining the methodological procedures.

Attempts were made to defend the use of palaeodemography by testing the accuracy and bias of the ageing techniques, introducing age cohorts into the model and considering other inferential sources, such as settlement size and distribution, subsistence data, census returns, or - in questioning the utility of skeletally-based reconstruc-

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[9] Chamberlain 2000: 101.

[10] See Ortner and Kelley (1988: 146-148) for a list of J. Lawrence Angel's select bibliography; see also: Harper 2008.

[11] Life tables are undoubtedly the oldest and most powerful tool in demographic studies. Life tables present the mortality history of a hypothetical group (or life table cohort), where through time-successive intervals the cohort loses a certain proportion of its members - in other words, they present the extent to which a group of people die with age. Abridged life tables are based on wider age categories, in contrast to the complete life tables that use one-year age intervals.

[12] Bocquet-Appel and Masset 1982.

[13] Walker et al. 1988; Bermúdez de Castro and Nicolás 1997.

tions - proposing the alternative use of historical and contemporary populations.[14] Different approaches taken included the introduction of sophisticated mathematical models to compensate for age-at-death biases,[15] and the use of paleoclimatic proxies and genetic data to infer demographic behaviours based on the principle that gene differences (genetic drift, mutation, flow, natural selection) correlate to the demographic performances of populations, such as structure, size, population growth and migration waves.[16] Despite all the controversies in palaeodemographic techniques and assumptions, the demographic studies remain one of the principal means for investigating large-scale socio-political, biological and adaptive changes in past populations.

Demography of modern Nicosia

The first systematic census of the Cypriot population was undertaken in 1881, while Cyprus was under British administration.[17] According to this census data, the Municipality of Nicosia had 11.536 inhabitants, while the Omerie Quarter, where the site of Nicosia-*Palaion Demarheion* is located, had 713 inhabitants, represented by 335 men and 378 women. The population structure of the Nicosia District (56.312 inhabitants) assumed a normal distribution and was undergoing a period of natural growth with a relatively small number of incoming foreign population. In particular, a total of 704 individuals had a reported birthplace outside Cyprus in 1881, the majority originating from Turkey, Syria, and Arabia.[18] Approximately two-thirds of the foreign population were males.

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[14] See: Hassan 1981; Nelson 1981; Buikstra and Konigsberg 1985; Marcus 1989; Milner et al. 1989; Saunders et al. 1993; Bagnall and Frier 1994; Brewis 1995; Hoppa and Vaupel 2002.

[15] Gage 1989; Konigsberg and Frankenberg 1992; Müller et al. 2002; Gowland and Chamberlain 2005.

[16] Lutz et al. 2001; Dean et al. 2002; Hey 2005; Shennan et al. 2013.

[17] Colonial Office 1884: 19-20. In 1878 Cyprus became a British protectorate under Ottoman suzerainty until 1914 when Britain annexed the island. In 1925 Cyprus was proclaimed a Crown Colony and retained that status until its independence in 1960.

[18] Colonial Office 1884: 42. 156 persons (105 males) originated from Turkey, 120 (81 males) from Syria, 107 (44 males) from Arabia, 65 (41 males) from the British Isles, 62 (41 males) from Asia Minor, 35 (27 males) from Greece, 31 (17 males) from Egypt, 84 (57 males) from various other European countries, 27 (17 males) from other Asian countries, 12 (3 males) from African countries, 4 (1 male) from Australia, and 1 female from Mexico.

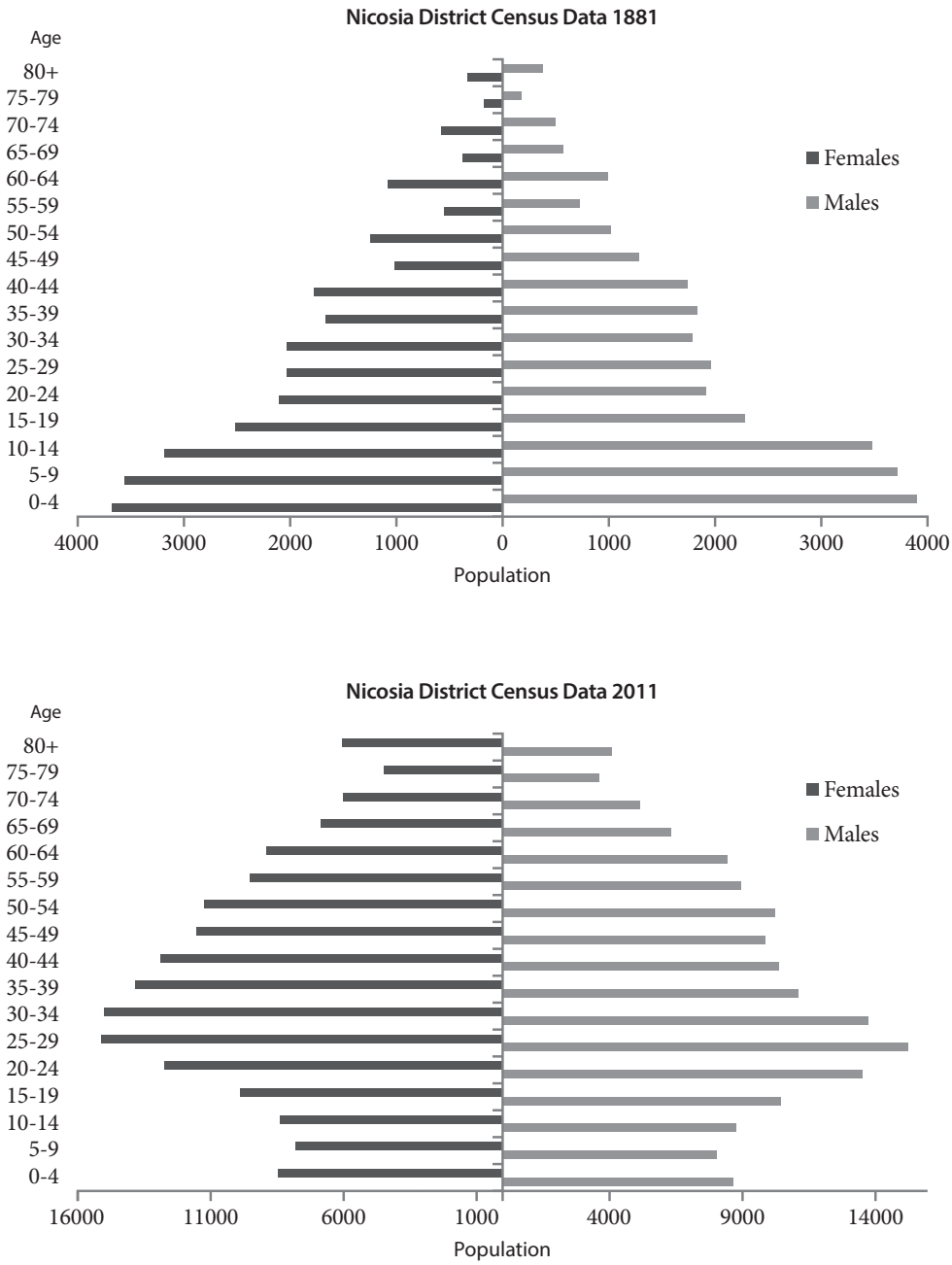

Figure 1: *Population structure (by sex and age) of the District of Nicosia in 1881 and 2011.*

During the following decades of British colonial rule, the population of Nicosia District increased by almost four times reaching a total of 204.283 inhabitants in 1960.[19] The 2011 population census reports that the population of Nicosia District enumerated 326.980 individuals.[20] A comparison of the structure of the population after an interval of 130 years shows that the normal distribution of the population exhibited at the end of the 19th century was skewed by a gradual decrease in fertility rates (Fig. 1). In addition, the number of individuals with a reported birthplace outside Cyprus in 2011 formed 21.9% of the total inhabitants of the Nicosia District in contrast to the 1.3% in 1881. Approximately half of these individuals originate from a European Union country, whereas the vast majority of the remaining individuals originate from the Philippines, Georgia, Sri Lanka, Russia, and Vietnam.[21]

Although each era is characterized by its own unique demographic parameters, the above example shows that the palaeodemographic assumptions of a stationary population with a normal distribution may oftentimes be erroneous. In fact, the assumption of static populations does not typically fit any real population, and, therefore, its use involves a certain amount of abstraction.[22] This by no means refutes palaeodemographic techniques, but merely emphasizes the need to consider not only the birth and death rates of a given population, but also immigration and emigration effects, especially in contexts, where there are inferences of such population movements.

The site of Nicosia-*Palaion Demarheion*

The present study involves the analysis of the skeletal remains excavated from Nicosia-*Palaion Demarheion* ('Old Municipality'). The site is located within the Venetian fortification walls (Fig. 2) and was accidentally discovered during construction works for the new Nicosia City Hall. Rescue excavations were conducted by the Department of Antiquities, under the direction of Yiannis Violaris, from June 2002 to October 2006. The excavated areas brought to light antiquities dating from the Byzantine period to the British rule testifying to a continuous use of the site from the 11th to the 20th century AD.[23]

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[19] Statistical Service 2014a: 30.

[20] Statistical Service 2014b: C1. In 2011 the Omerie Quarter had a population of 105 males and 101 females.

[21] Statistical Service 2014b: A1b.

[22] Larsen 1997.

[23] Violaris 2004; Chrysostomou and Violaris 2014.

Figure 2: *Location of the site of Palaion Demarheion within the fortified walls of Nicosia.*

The architectural remains of two churches, each associated with a cemetery, are perhaps amongst the most important findings of the excavations. The first church, conventionally named Church A′, represents a complex of two small single-aisle churches; the northern part dates to the 12th century AD, while the southern part has two architectural phases that date to the second half of the 12th century or the beginning of the 13th century AD. Unfortunately, damage caused during construction works precludes much information related to the history of these buildings. The burials associated with Church A′ date from the 12th to the 13th century AD.

The second church, conventionally named Church B′, is associated with an architectural phase that dates towards the end of the 11th or early 12th century AD, and burials surrounding the church date at least from the 12th century. During the early 13th century AD, Church B′ was destroyed by fire, it was rebuilt, but was subsequently destroyed again. After the latter destruction, the area of the church was used as a cemetery until the 15th century.

The skeletal remains of over 400 individuals were recovered from the two cemeteries, which resulted in the establishment of one of the largest archaeological skeletal collection in Cyprus. The burials were associated with shallow graves not typically exceeding 50 cm in depth. Three main types of graves were documented: (a) simple pits with or without a wooden coffin, (b) simple pits covered with stone slabs with

or without a wooden coffin, and (c) cist tombs built with rectangular limestone and covered with stone slabs. In general, the graves were orderly aligned in an east-west orientation peripheral to the churches. Although burials involved single inhumations, many graves were partly or entirely disturbed either by later burials or other architectural features resulting in the presence of disarticulated and commingled remains within the cemeteries. Such disturbance of burials is more evident in the later periods, and was most probably due to the lack of space from the increasing cemetery population. During the 14th and 15th centuries AD, rectangular headstones demarcated the burials.[24]

In both church cemeteries, there were no clear patterns between male and female burial locations, although the infants and children were clustered closer to the churches. The position of the arms varied, with the most typical occurrence being both arms folded over the abdominal region. Other positions included one hand on the abdominal area and the other on the mid- or proximal end of the opposite humerus, both forearms crossed over the chest region, or both arms fully extended alongside the body. With regards to the analysed dataset, there was no pattern between arm position and gender, age or type of burial. The burials dated to the 14th and 15th century AD exhibited a greater diversity in arm positioning.[25] Personal belongings associated with the skeletons included jewellery (rings, earrings, crosses), coins and clothing remnants (belt buckles, buttons). Traces of cloth bands suggest that most of the skeletons were wrapped in shrouds. Finally, the grave fills almost always included eggshells, broken glass vessels and pottery sherds.[26]

Methodology

The present study was partly funded by the Cyprus Research Promotion Foundation further to a research grant application submitted in the beginning of 2005, and therefore only relates to the skeletal remains that were excavated during the 2002, 2003 and 2004 seasons. The project involved the analysis of a minimum number of 209 individuals. A total of 113 individuals were recovered in anatomical position, whereas the remaining skeletons originated from 57 secondary or disturbed deposits.

[24] Chrysostomou and Violaris 2014.

[25] The arm position has been reported to provide an accurate dating method in medieval Danish cemeteries (Kieffer-Olsen 1993 qtd: DeWitte 2006: 46-47).

[26] Chrysostomou and Violaris 2014.

Adult sex determinations were conducted using the recommendations suggested by Bass.[27] Determination of sex was not attempted for the immature skeletons, due to the lack of reliable anthropological techniques at the time of study.[28]

One of the fundamental aspects of the project was the estimation of the age at death. A number of macroscopic osteological techniques were employed that are commonly used to address age-at-death estimations in both mature and immature individuals. These include dental development and eruption, long bone length, bone ossification and epiphyseal fusion for the immature individuals,[29] as well as pubic symphysis, auricular surface and sternal rib end metamorphosis for the adult individuals.[30] Each skeleton was placed into an age cohort representing infants (up to 2 years old), children (up to 10 years old), subadults (up to 20 years old), young adults (up to 30 years old), middle adults (up to 60 years old) and senile individuals (over 60 years old). In cases where an age interval overlapped between two age cohorts, the individual was accounted for only in the category that included the mean age, and thus the greater part of the age range.[31] In both cemeteries, several mature individuals could not be assigned to a specific age cohort and these were omitted from the palaeodemographic analysis. The exclusion of these individuals may have had some effect on the profiles, but is unlikely to have affected the overall trends discussed in the present paper.

Due to limitations concerning adult age estimations, this study focuses on the demographic profiles of the immature individuals (under 10 years old). Although the use of model prior probabilities and other semiparametric or fully parametric models produce promising results in terms of overcoming some of the problems faced by the palaeodemographic studies, these were not applied in the present research. Any attempts to make inferences on the adult population would be undermined by two major limitations: (1) the small number of adults in each age cohort that is more likely to change in a currently unpredictable manner once the entire cemetery popu-

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[27] Bass 1987.

[28] Sex determinations for immature individuals were traditionally considered problematic due to the apparent lack of sexual dimorphism. This notion, however, may change based on more recent methodological advances (e.g. Stull 2013).

[29] Moorees *et al.* 1963; Fazekas and Kosa 1978; Ubelaker 1989; Scheuer and Black 2000.

[30] İşcan *et al.* 1984, 1985; Lovejoy *et al.* 1985; Brooks and Suchey 1990.

[31] For example, if an individual was aged 19±2 years (age interval 17-21 years, range = 4) that individual would be categorized within the subadult (11-20 years) age cohort since both the mean (19) and the greater part of the range (3 versus 1) fell within the subadult age cohort.

lation is analyzed and, (2) the lack of breakdown of burials according to chronology, as this was not completed at the time of this study. The latter is especially important since we anticipate that some of the 14th century burials may have been associated with the Black Death epidemics.

The aggregate infants/children mortality data from the cemeteries related to Church A′ (12th-13th century AD) and Church B′ (11th-15th century AD) were compared to the cemetery populations of other European archaeological sites: two Hungarian 12th-13th century cemeteries, namely Hajdúdorog-*Katidülö* (n = 679) and Hajdúdorog-*Szállásföld* (n = 1074),[32] and one Croatian 14th-18th century site from Nova Rača (n = 104).[33] The selection of cemeteries for comparison purposes was based on the following: (1) on the availability of published resources (both in terms of access and published language), (2) chronological timeframe of cemetery use (i.e. contemporary to the cemetery samples under review), (3) representation of a single European geographical local (in contrast to the combination of data from several cemeteries), and (4) similarity in the reported age cohorts.

Skeletal samples representing 47 individuals originating from the two cemeteries at Nicosia-*Palaion Demarheion* were submitted to the Cyprus Institute of Neurology and Genetics (CING) for genetic analyses. During the excavation, standard protective measures were taken against potential contamination. Elements submitted for genetic analysis were excavated/processed by select personnel whose DNA profiles were recorded for exclusion purposes. Mitochondrial DNA (mtDNA) testing was conducted for both hypervariable regions I (HVR-I: 16024-16365) and II (HVR-II: 073-263).

Results

The current research focuses on childhood mortality through abridged life tables.[34] The aim is to investigate whether the demographic profiles of the young age groups

[32] János *et al.* 2014: 311. In the original research data were compared to an Italian 7th century AD in La Selvicciola (Salvadei *et al.* 2001: 712). These were herewith replaced by the Hungarian datasets as these cemeteries are contemporary to the ones in Nicosia-*Palaion Demarheion*. The data on La Selvicciola were similar to the Croatian data (n=123; 10.6% 0-3 years, 6.5% 3-6 years, 9.8% 6-12 years, 8.1% 12-18 years, 36.6% 18-40 years and 28.5% 40+ years).

[33] Šlaus 2000: 197.

[34] The mortality rates were estimated on the assumption that the population was static strictly for convenience, since the scope of the research is not to discuss the problem of non-stationarity, but rather to focus on the effects of migration.

corroborate the historical sources in relation to a population growth during the beginning of the Frankish period, primarily due to the presence of an incoming foreign population.

Table 1: *Distribution of mortality rates in five European cemeteries.*

	P. Demarh. Church A′		P. Demarh. Church B′		Hajdúdorog-*Katidu*		Hajdúdorog-*Szállásföld*		Nova Rača	
x	d_x	q_x	d_x	q_x	d_x	q_x	d_x	q_x	d_x[‡]	q_x
Infants	30.12	0.3	25.49	0.25	8.91	0.09	8.24	0.08	9.62	0.1
Children	22.89	0.33	7.84	0.11	17.65	0.19	19.37	0.21	19.23	0.21
Subadults	6.02	0.13	7.84	0.12	9.77	0.13	16.26	0.22	10.58	0.15
Young adults	16.87	0.41	11.76	0.2	8.91	0.14	4.27	0.08	27.88	0.46
Adults	15.66	0.65	41.18	0.87	40.38	0.74	35.68	0.69	30.77	0.94
Senile	8.44	1	5.88	1	14.38	1	15.89	1	1.92	1

[‡] Reported age categories involve birth-1 year for infants and 2-10 years for children.

The basic function for the creation of life tables is the number of individuals in each age category, which is described as D_x. The function d_x represents the percentage of people who died in each age interval and is determined as $d_x = \frac{D_x}{\sum D_x}(100)$. The percentage of the total survivors at the start of the next age interval x can then be calculated as, $l_x = l_x - d_x$. The value of l_0 is the radix (or the standard number of births) of the life table and is presently set at 100. The probability of death (q_x) can be computed from d_x and l_x by, $q_x = d_x / l_x$ (Tbl 1).

In addition to the palaeodemographic data collected, DNA was successfully extracted from 32 out of the 47 submitted samples. Out of these 32 samples, 4 samples matched the excavator's genetic profile and were excluded from further analysis, while 12 samples gave partial mtDNA data (Tbl 2).[35]

[35] The DNA extraction and typing was conducted by Dr. Marios Cariolou and Mr. Panayiotis Manoli at the Laboratory of Forensic Sciences, Cyprus Institute of Neurology and Genetics, Nicosia, Cyprus. Haplogroup assignment and interpretation was conducted by the first author.

Table 2: Mitochondrial DNA results related to sampled skeletal elements.

Skeleton Code	HVR1* (16024-16231)	(16164-16365)	HVR2 (073-265)
Church A′			
ΣK 18	173T, 223T	173T, 223T, 292T, 325C, 352C	073G, 189G, 195C, 263G
ΣK 19	129A, 183C, 189C	183C, 189C, 265C, 311C, 325C	152C, 263G
ΣK 20	(no data)	304C, 311C	263G
ΣK 21	CRS**	311C	263G
ΣK 25	069T, 126C, 145A, 162G, 222T	(no data)	073G, 153G, 162T, 258T, 263G
ΣK 39	126C, 142T, 163G, 186T, 189C	CRS	073G, 263G
ΣK 41	093C, 145A	362C	239C, 263G
ΣK 43	(no data)	185T, 186T, 343G	(no data)
ΣK 46	218T	218T, 320T, 354T	073G, 153G, 195C, 225A, 226C
ΣK 55	CRS	311C	263G
ΣK 56	162G	CRS	073G, 263G
ΣT 10B	069T, 126C, 193T	CRS	093G, 185A, 189G, 200G, 247A, 263G
ΣT 23	126C, 163G, 186T, 189C	186T, 189C, 294T	073G, 263G
Church B′			
ΣK 7	(no data)	(no data)	152C, 263G
ΣK 8	092C, 173T, 223T	(no data)	(no data)
ΣK 48	067T, 223T	(no data)	(no data)
ΣK 49	(no data)	(no data)	144T, 145T, 263G
ΣK 50	069T, 126C	362C	(no data)
ΣK 60	CRS	CRS	143A, 204C, 207A, 258T, 263G
ΣK 61	CRS	294T, 296T, 304C	073G, 263G
ΣK 66	193T	193T	095G, 152C, 263G
ΣK 75	108T, 134T, 159T	239T, 311C, 320T	152C, 253T, 263G
ΣK 149	169T, 224C	224C, 257T, 287T, 311C	073G, 263G
ΣK 154	CRS	288C, 311C	073G, 263G
ΣT 12	(no data)	192T, 256T, 270T, 294T, 309G, 350G	(no data)
ΣT 31	(no data)	(no data)	239C, 263G
ΣT 33	(no data)	320T	(no data)
ΣT 46	086C, 182C, 183C, 193T, 223T	(no data)	(no data)

* Numbers represent nps minus 16000. ** CRS = Cambridge Reference Sequence.

Discussion

The presence of migration in ancient populations has been investigated through a wide range of methodological approaches. Studies describing population movements and cultural interactions involve written records, archaeological indicators, such as changes in movable and immovable assemblages, or biological and genetic indicators, such as isotopic compositions in skeletal/dental remains, presence and spread of diseases, and other phylogenetic approaches. Research in Cyprus has traditionally focused on the study of architectural remains, movable antiquities and burial practices,[36] historical sources,[37] while scant studies have been published involving linguistic evidence,[38] biological affinities[39] and hereditary diseases.[40] The study of the cemetery populations at Nicosia-*Palaion Demarheion* offers new insights on this research area. Although the present paper discusses the preliminary results of the study and involves only half of the excavated skeletal remains the outcome remains of paramount importance.

The palaeodemographic analysis shows that the aggregate percentage of infant/child death rates is significantly higher for Church A′ and accounts for more than half of the total associated cemetery population (53.01%). Church B′ shows the second highest percentage (33.33%), but is closer to the aggregate infant/child rates of the other three European cemeteries (26.56%, 27.61% and 28.85%) (Fig. 3).

In palaeodemographic studies a frequent phenomenon for differential past population mortality curves relates to sampling errors. This may be due to a biased excavation recovery strategy, biased sampling during the anthropological analysis, past destruction of a cemetery section and so forth.

The excavation at Nicosia-*Palaion Demarheion* was a rescue excavation, and prior to the Department of Antiquities' involvement, construction works destroyed the upper layers of Church A′. Unfortunately, there is no information on whether the layers that were destroyed contained any burials. However, the foundations of the church and all layers surrounding the church at this level (church floor and below) were preserved. Therefore, we assume that all 12th-13th century burials remained intact from this destruction. Due to the rescue nature of the excavation and the physical limitations of

[36] Frankel and Webb 2001; von Wartburg and Violaris 2009.

[37] Παπαδόπουλλος 1965.

[38] Karageorghis and Masson 1988.

[39] Parras 2004.

[40] Δέλτας 2004.

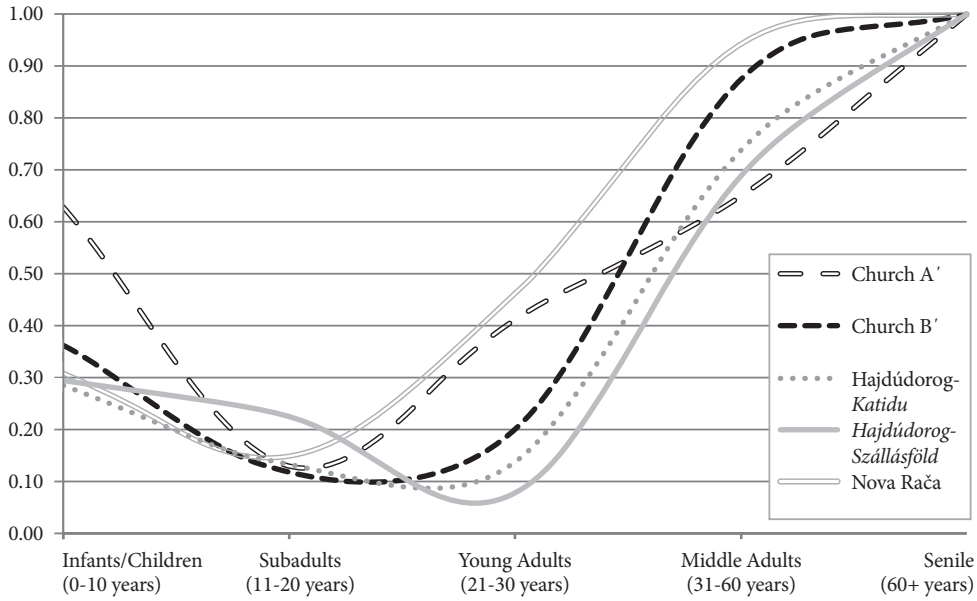

Figure 3: *Mortality curves related to five European cemetery populations.*

the site, not all areas of the plot were excavated. In particular, the northern parts of the cemeteries were not fully excavated as they expanded under a modern road. The east, west and south limits of the cemeteries were excavated, although some of the adult cist tombs associated with Church A′ were preserved *in situ*. In the northern part of the cemeteries there are infant burials, as documented by more recent archaeological work conducted for the construction planning. It is therefore anticipated that if this section of the cemeteries were to be fully excavated, this would result in an even greater percentage of infants/children within the cemetery populations. The same applies for the anthropological analysis. A preliminary review of the skeletal material excavated during the 2005-2006 seasons showed that more infant than adult skeletons were present, therefore analysis of all recovered skeletal material would also increase the percentage of the younger individuals.

Another aspect to be considered in palaeodemographic studies are factors associated with catastrophic mortality profiles or selective death. The bubonic plague, also known as the "Black Death", is one such example of catastrophic mortality.[41] Cyprus was struck by the Black Death in 1347-48 and the fatalities were as hard as in the rest

[41] Gowland and Chamberlain 2005.

of Europe and the Mediterranean, thus reducing the Cypriot population between one-third and one-fifth.[42] Plague epidemics continued to break out, especially in 1362-63, 1438 and 1470 AD. Nonetheless, the high prevalence of infant deaths is witnessed in the cemetery of Church A′ that dates to the 12th-13th century AD - that is, prior to the bubonic plague epidemics in Cyprus.

The second factor to be considered that relates to diseases is selective death. Selective death can affect individuals with the highest frailty,[43] whereas high infant mortality could have been caused, for example, by a high incidence of water- or food-borne infections from artificial feeding,[44] or by other outbreaks of diseases such as smallpox, that occurred for instance as often as every three to four years in York during the 16th and 17th centuries AD.[45]

Indeed, a large percentage of the younger individuals exhibit pathological lesions which are consistent with anaemic lesions. These lesions affect almost all regions of the skeleton and are observed on 67% of the younger individuals associated with Church A′ and 54% of the infants/children associated with Church B′. The skeletal remains demonstrating such lesions are associated with all cemetery layers thus spanning for more than four centuries. Prior to a screening program in the early 1970s, the Cypriot population exhibited high prevalence of thalassaemia: 1 in 7 Cypriots was a carrier of β-thalassaemia, both members of 1 in 49 couples were heterozygotes, while 1 in 158 newborns was expected to be a homozygote.[46] Therefore, a small number of skeletal samples demonstrating such pathological lesions was genetically tested for the presence of the most common thalassaemic mutation in the modern Cypriot population (80.6%, IVS 1-110 G/A), however, the results were inconclusive.[47]

Although selective death affecting only younger individuals cannot be excluded, another hypothesis for an increased infant mortality rate, more rarely documented in the archaeological record, is the introduction of an incoming foreign population. This hypothesis is not only supported by the historical records, but it could also justify

[42] Nicolaou-Konnari 2005: 16.

[43] DeWitte and Wood 2008: 1436.

[44] Landers (1993: 139-148) suggests this was the cause for the high infant mortality in London during the 17th and 18th centuries AD.

[45] Galley 1998: 104-108.

[46] Angastiniotis *et al.* 1986: 291.

[47] These genetic analyses were conducted by Dr Marina Kleanthous and Mr George Christopoulos at the Molecular Genetics Thalassaemia Department, Cyprus Institute of Neurology and Genetics, in collaboration with Dr Michalis Angastiniotis.

the high infant percentages in the cemeteries which are mainly associated with the beginning of the Frankish period in Cyprus. In such a scenario, the high number of infants/children would not correspond to a high mortality rate, but rather to a larger population producing a larger number of offsprings. In simpler terms, in a hypothetical population with annual crude births of 100 infants, a 20% infant mortality rate would result in the death of 20 infants. If this population increased resulting in the crude birth of 150 infants, the actual number of infant fatalities will increase to 30 even though the mortality rate would continue to be the same (20%). That is, the infant cemetery population will have a substantial increase with this population change. On the other hand, the adult cemetery population during this initial period (first generation) will be less affected since typically the incoming population involves young or middle-aged adults that are associated with much lower mortality rates.

If we support the hypothesis of an incoming population, then the cemetery population of Church B′ should correspond to a mixture of the initial incoming group and all subsequent generations. Therefore, this could justify the somewhat reduced infant/child percentages, as they could be masked by the later generations resuming a normal distribution or perhaps by the catastrophic mortality profiles. Future analysis involving the grouping of skeletal remains chronologically should provide further clarifications on this matter.

One powerful method presented in the last decades, for the study of population movements is the application of molecular methods. There is a vast literature on this topic through the study of both modern and past population groups. No previous studies have been published on ancient Cypriot populations, however small samples of the modern Cypriot population have been evaluated.[48] Phylogenetic research has dramatically advanced during the past years, and more recent works are routinely based on combined HVS-I and high-resolution restriction typing, to include Bayesian estimations for mitogenomes in relation to age estimates and phylogeographic distributions.[49]

A study of the available genetic data shows that haplogroups T and J are present in both church cemeteries.[50] Haplogroup T represents almost 10% of mtDNAs in Europe and around 8% in the Near East, and it most likely originated in the Near East. ΣΤ 23

[48] Rosser *et al.* 2000 ; Capelli *et al.* 2006; Irwin *et al.* 2008.

[49] Thomas *et al.* 2008.

[50] Haplogroup data and mtDNA frequencies for T and J are taken from Pala *et al.* 2012.

(16126, 16163, 16186, 16189, 16294), which is associated with Church A′, falls under the T1a subclade and is found in a widespread area covering northwestern Africa, throughout Europe, the Near East and central Asia. Haplogroup T2, represented by ΣK 61 (16294, 16296, 16304; T2b) and associated with Church B′, is however mainly found in Western Europe. The T2b lineages are predominantly European with considerable gene flow into the Near East.

The second haplogroup observed in both church cemeteries is J. In Church A′, two individuals are associated with this haplogroup: ΣK 25 (16069, 16126, 16145, 16162, 16222), that represents subclade J1b, and ΣT 10B (16069, 16126, 16193), that represents subclade J1d. Both of these subclades are found predominantly in the Near East. In Church B′, ΣK 50 (16069, 16126, 16362) is associated with subclade J1c2. This subclade is primarily found in Europe and especially central Europe, the Balkans and the Ukraine. Although it is found in the Near East at low frequencies, this is believed to be the result of back-migration from Europe.

Two subclades of haplogroup U are also noted in the cemeteries. Subclade U3 is associated with ΣK 43 (16185, 16186, 16343; Church A′) and subclade U5a2a is associated with ΣT12 (16192, 16256, 16270, 16294, 16309, 16350; Church B′). Haplogroup U3 has low frequencies in Europe and slightly higher frequencies in the Near East and Caucasus, while its highest prevalence is in Middle East.[51] Haplogroup U5 on the other hand is a European haplogroup that is relatively frequent in central and eastern Europe, as well as in Mediterranean populations such as the Italians and Tunisians.[52]

Haplogroup W is recorded only in an individual associated with Church A′. ΣK 18 (16173, 16223, 16292, 16325) represents subclade W6 which is most frequent in the Levant and the Caucasus and is widespread within Europe.[53] Haplogroup K is associated with Church B′ and in particular with ΣK 149 (16169, 16224, 16257, 16287, 16311; subclade K1a4a1g). K1a4 is found across Europe and the Near East, while K1a4a1 is mainly a European subclade.[54] Finally, several individuals in both cemeteries are associated with haplogroup H (as well as other haplogroups). These individuals fall under various subclades that are more poorly defined

[51] Gómez-Carballa *et al.* 2013.

[52] Malyarchuk *et al.* 2010.

[53] Olivieri *et al.* 2013.

[54] Behar *et al.* 2012.

using the HVS-I and/or HVS-II, therefore no further analysis was attempted.[55] The presentation of the preliminary anthropological and genetic results of this study is not exhaustive. It does, however, provide important evidence to support the introduction of a new population in Nicosia. These findings are consistent with historical sources, but for the first time are supported by the past population itself. The introduction of a substantial in numbers new population could also explain the high prevalence of infants/children in the cemeteries, especially in the late 12th/13th century AD and the presence of new haplogroups in the cemetery that span until the 15th century AD. In addition, Coureas[56] while investigating the interaction of the Latins and Christians states that Christian noblemen were placed in their tombs with their hands crossed - a byzantine position denoting death - while the Latins were buried with their hands united - a position denoting prayer. If arm positioning was indeed related to the ethnic/religious beliefs at an individual level, then a more diverse population could provide additional explanations for the diversity in arm positioning in the upper layers of the cemeteries. The final merge of data deriving from the anthropological and archaeological analyses should provide further clarifications on these matters.

Conclusions

Limited historical information is available on the population of Cyprus during the Byzantine-Medieval periods, however data on the demographic mechanisms of population replacement, to include migration, mortality and fertility, remains scarce. Migration in medieval times both in Europe and the East is an undisputable fact, driven either by military endeavours, religious persecutions, slavery, commerce, socio-cultural or even environmental factors. To shed some light on the population dynamics, especially during the 12th-13th century Cyprus, this study synthesizes historical, archaeological, palaeodemographic and genetic data derived from two cemetery groups in Nicosia. We anticipate that upon completion of the anthropological, archaeological and genetic analyses the preliminary outcomes of this study will be further supported.

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[55] The identification of RFLP markers for the remaining samples will be more diagnostic for the assignment of haplogroups.

[56] Coureas 2000.

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Περίληψη

Η Κύπρος διαχρονικά υπήρξε σημαντικό σταυροδρόμι για το εμπόριο, τις πολιτισμικές και θρησκευτικές αλληλεπιδράσεις, στρατιωτικές εκστρατείες και την πολιτική. Παραδοσιακά, οι πολύπλοκες διαδράσεις μεταξύ ποικίλων ξένων πληθυσμιακών ομάδων και των γηγενών Κυπριακών πληθυσμών έχουν μελετηθεί κυρίως μέσα από τον υλικό πολιτισμό, τις γραπτές ιστορικές πηγές και σε μικρότερο βαθμό μέσα από τις εξελίξεις της γλώσσας. Σε αντίθεση προς την παραδοσιακή προσέγγιση, η παρούσα μελέτη εξερευνά τη δημογραφία παρελθοντικών πληθυσμών ενσωματώνοντας στα αρχαιολογικά δεδομένα και στις ιστορικές πηγές, πληροφορίες που έχουν εξαχθεί από ανθρωπολογικές και γενετικές αναλύσεις. Πιο συγκεκριμένα, η παρούσα μελέτη εξερευνά ταφικό πληθυσμό από την εντός των Ενετικών τειχών θέση Λευκωσία-*Παλαιό Δημαρχείο*, όπου εντοπίστηκαν δύο εκκλησίες (συμβατικά ονομάστηκαν Εκκλησίες Α΄ και Β΄) και νεκροταφεία που χρονολογούνται από τον ύστερο 11ο μέχρι τον 15ο αιώνα μ.Χ. Ιστορικά, αυτή η περίοδο έχει συσχετισθεί με τη μετακίνηση ανθρώπων τόσο στην Ευρώπη, όσο και στην Εγγύς Ανατολή, ενώ η Κύπρος βρισκόταν υπό Φραγκική κυριαρχία. Οι ταφικοί πληθυσμοί που μελετήθηκαν εντοπίστηκαν κατά τις ανασκαφές μεταξύ των ετών 2002-2004 και ανέρχονται στα 209 άτομα κατ' ελάχιστον. Ο ταφικός πληθυσμός που σχετίζεται με την Εκκλησία Α΄ φαίνεται να κυριαρχείται από βρέφη και παιδιά, ενώ μεγάλο ποσοστό νεαρών προσώπων υπάρχει και στο κοιμητήριο της Εκκλησίας Β΄. Γενικά, τα παλαιοδημογραφικά προφίλ των δύο ταφικών πληθυσμών δεικνύουν ότι το μεγάλο ποσοστό βρεφών μάλλον αντιπροσωπεύει αύξηση του πληθυσμού παρά αύξηση του ρυθμού θνησιμότητας, όπως υποστηρίζουν και οι γραπτές πηγές. Η παρούσα μελέτη αποτελεί την πρωιμότερη προσπάθεια διασύνδεσης ανθρωπολογικών και γενετικών δεδομένων για την μελέτη παρελθοντικών φαινομένων μετανάστευσης στην Κύπρο.