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Health, disease and medicine in Crete from the Neolithic to ca. 500 BC

ABSTRACT

This paper presents an overview of the state of health and medicine in Crete from the Neolithic to 500 BC. There are four basic types of sources available for the period in question, most of them obtained by means of archaeology: anthropological; iconographical; literary; other finds. The preserved human skeletal remains are the most important category, of course. There are 53 different burial places (cemeteries or individual tombs) at 48 different sites (including the small islands of Pseira and Mochlos close to the Cretan shore) with at least partially processed and published human skeletal remains from the period in question. The most important skeletal assemblages come from Aposelemis (Neolithic), Agios Charalambos (FN-MM II), Moni Odigitria (EM I-MM IB), Knossos (Lower Gypsades, Ailias and North Cemetery; MM I/II-LM I and ca. 1050-630 BC), Chania (LM II-III B1), Armeni (LM IIIA-B) and Kavousi (LM IIIC-7th century BC). Methodologically, the prevalence of both skeletal and dental pathologies in three main chronological eras (the Neolithic, the Bronze Age, and the sc. Archaic period) are examined. As supplemental indicators reflecting the overall health status of populations, changes in the mean stature of both sexes in the Bronze Age were observed (there is a considerable lack of such data for the Archaic period). The preserved anthropological material reveals six major types of skeletal pathologies and eight major types of dental pathologies. Also, signs of therapeutic or surgical interventions were recorded. The human skeletal material from Crete shows some very interesting examples of pathologies and medical interventions, such as several trepanations (surgical openings of the skull) and a possible dental intervention (a sign of tooth extraction). Beyond disease and state of health, the issue of healing personnel (active healers and caring or supporting persons), their medical or anatomical knowledge and skills, remedies used, and medical (surgical) instruments are also discussed.

KEYWORDS: medicine, state of health, pathology, demography, stature, healer, remedy, Minoan period, Archaic period

This paper deals with the medicine and health state of the population in prehistoric and Archaic Crete. It is a regional overview, based on the author's research on population health in Greece from the Neolithic period to ca. 500 BC. The prevalence of both skeletal and dental pathologies is examined in three main chronological eras – the Neolithic, the Bronze Age, and the Archaic period – to determine the population's state of health. As supplemental indicators reflecting overall health, changes in the mean stature of both sexes in the Bronze Age were observed

(there is a considerable lack of such data for the Archaic period). The issue of healing personnel (active healers and caring or supporting persons), their medical or anatomical knowledge and skills, remedies used, medical (surgical) instruments are also discussed.

I. SOURCES

For the period in question, four basic types of sources are available, most obtained by means of archaeology: (1) anthropological; (2) iconographical; (3) literary; and (4) other finds.

I.1 HUMAN SKELETAL REMAINS

Anthropological sources are human remains, preserved in an archaeological context as skeletal material (resulting from inhumation) or bone ashes with preserved fragments of burnt bone (resulting from cremation). Of course, the anthropological material provides the greater part of information on the health state of the population, as well as clues to the level of contemporary medicine, because besides demographic characteristics and various pathologies it also reveals some medical and surgical interventions.

There are 53 different burial places (cemeteries or individual tombs) at 48 different sites all over Crete (including the small islands of Pseira and Mochlos close to the Cretan shore) with at least partially processed and published human skeletal remains from the period in question. For this paper, having studied the published reports on the anthropological material from 46 sites and actually investigated the preserved human remains from two more sites (Porti and Miamou), the author collated at least some of the basic anthropological characteristics (including information on the state of health) of the buried individuals. At these 48 sites, the anthropological remains of at least 3,253 individuals were uncovered.

The oldest preserved human remains included in the examined anthropological array are dated to the Neolithic period, and were found at four sites: Aposelemis (the most important anthropological set for this period in terms of its evidential value and state of preservation: Agelarakis 2019); Katsambas (Nafplioti and Serpetsidaki 2016); Knossos (Triantaphyllou 2008); and Gerani cave (only stable isotopic analyses for the determination of the prevailing diet were performed: Tzedakis and Martlew (eds) 1999, 216-17). Skeletal remains (mostly) dating to the Minoan period were discovered at 41 sites. Unfortunately, a large proportion of skeletal remains from the EM and early MM phases were deposited as secondary burials in large collective tombs (especially so-called Messara tholoi, e.g. Moni Odigitria: Triantaphyllou 2010) or burial caves/rock shelters (e.g. Agios Charalambos: McGeorge 2008 or Kefala Petras Rock Shelter: Triantaphyllou 2012), but most often as incomplete, fragmentary and disarticulated groups of bones. Distinguishing specific individuals in terms of complete skeletons is therefore not possible in these cases. The demography of such assemblages can only be traced as regards the main features, such as the (minimum) number of individuals and the basic distinction of their age (subadults vs. adults); in the case of better preservation of pelvic bones and/or skull, biological sex determination is also possible. The most important anthropological assemblages in terms of significance and state of preservation are therefore those from the cemeteries of Ailias and Lower Gypsades at Knossos (MM I/II-LM I: Nafplioti 2015), Armeni (LM IIIA-B: McGeorge

1983; McGeorge 1988) and Chania-Odos Palama (LM IIIA2-B1: Hallager and McGeorge 1992). A few specific individual burials from the Minoan period tend to be referred to as evidence of human sacrifice, at Archanes-Anemospilia (Musgrave et al. 1994), Chania (McGeorge 2015) and Knossos-North House (Wall et al. 1986). The anthropological material from four sites dates to the post-Minoan periods: the Knossos-Lower Gypsades chamber tomb (Coldstream et al. 1981); Knossos-North Cemetery (Musgrave 1996); Eleutherna (Agelarakis 2005); and most of the tombs at Kavousi (Liston 1993). The youngest burials at all these sites come from the 7th century BC. The latter three are indeed numerous anthropological assemblages, but mostly contain cremated human remains, so their evidential/interpretative value is, unfortunately, very limited.

I.2 LITERARY SOURCES

Literary sources preserved from the studied period are regrettably scarce. Moreover, they are restricted to administrative and economic records. Information can be drawn from records on clay tablets covered with writing in syllabic Linear B script – for example, some tablets from Knossos bear names of plants, including proven medicinal ones (e.g. mint, saffron, cumin or sage: Arnott 2014, 48, tab. 6.1).

I.3 ICONOGRAPHICAL SOURCES

By iconographical sources we mean images of ill bodies or their parts, medical and/or surgical interventions, as well as probable medicinal deities. Such images are especially common in small sculpture (e.g. terracotta statuettes or just anatomical votives). There are terracotta statuettes that depict priestesses or medicinal deities (e.g. the well-known statuette called the Poppy Goddess from Gazi, dated to LM IIIC: Sakellarakis et al. 1994, 157, fig. 23), and whole figures or body parts often depicting limbs affected by disease. The latter are found on Crete from the Protopalatial period, mostly from the so-called peak sanctuaries (Morris and Peatfield 2014; but see Murphy in this volume).

I.4 OTHER SOURCES

The other sources, archaeological in the narrower sense, include other categories of archaeological finds apart from those mentioned above. These are, above all, medical and surgical instruments and pottery that served as vessels for holding medicinal preparations and/or ingredients, or as utensils for their application. One exceptional find is that of potsherds with preserved organic residues from the turn of the Early and Middle Bronze Ages, found at the remains of a hut in Chrysokamino metallurgy workshop in eastern Crete (Betancourt 2006). Analysis of these residues proved that medicinal preparations were produced from medicinal plants (Betancourt 2006, 413-428; Arnott 2008). This category of sources also includes relics of buildings with rooms most probably used in treatment, and sites where the earliest healing cult was most probably also practised, the so-called peak sanctuaries, dated especially to the MM and LM periods (Arnott 1999; Morris and Peatfield 2014).

I.5 METHODOLOGY

Methodologically, this research employed a combination of multiple procedures and aspects, above all (but not limited to) those of palaeopathology, archaeology, classical philology and history, corresponding to the four categories of sources mentioned above. Primary evidence on the history of medicine and its level is, however, only provided by archaeological and – to some extent – anthropological sources, while the evidence drawn from other categories is merely secondary.

The overall development (and achievements) of medicine and the prevalence of skeletal and dental pathologies were traced over three main chronological eras: the Neolithic, the Bronze Age or Minoan period (subdivided into the three basic phases: Early, Middle and Late), and the so-called Archaic period (ca. 1050 BC until ca. 500 BC); due to simplification, this term includes more chronological phases (Subminoan (1075/1050-1050/1025 BC), Protogeometric (1050/1025-900 BC), Geometric (900-700 BC), Orientalizing (700-640/630 BC) and the “proper” Archaic period (640/630 to ca. 500 BC (in this paper)).

II. DISEASE

It is, of course, the preserved anthropological material that best informs us about the population's health state and some therapeutic interventions in prehistoric and Archaic Crete. This material reveals six major types of skeletal pathologies and eight major kinds of dental pathologies. However, it must be stressed that the remains of many individuals showed several types of skeletal, or skeletal and dental, pathologies at the same time. Considering the enormous extent of the anthropological material and the bulk of resources, unfortunately these pathologies cannot be dealt with here in detail.

II.1 SKELETAL PATHOLOGIES

Skeletal pathologies evident from the anthropological material are the following:

- signs of degenerative disorders and other rheumatic diseases (above all, arthrosis: Aufderheide and Rodríguez-Martín 2011, 93-99);
- signs of (physiological) stress, reflecting anaemia and various episodes of malnutrition or of growth arrest (or possibly other diseases), most often in the form of porotic hyperostosis and cribra orbitalia (Aufderheide and Rodríguez-Martín 2011, 345-351);
- traumatic injuries, above all fractures, some of which resulted from interpersonal violence (Aufderheide and Rodríguez-Martín 2011, 19-45);
- signs of non-specific inflammations, which are defence responses of the organism to loss of internal balance due to attack by various pathogens, most frequently including general bone inflammations, mostly post-traumatic in nature (Aufderheide and Rodríguez-Martín 2011, 172-81);
- musculo-skeletal markers of physical load, i.e. the pathological effects of physical load and long-term exertion or overexertion of certain muscles and their groups, or injury to them, all

usually resulting in ossification of muscles and ligaments (Aufderheide and Rodríguez-Martín 2011, 26-27);

- other skeletal pathologies, such as neoplastic activity (tumours: Aufderheide and Rodríguez-Martín 2011, 371-392), signs of internal diseases (Aufderheide and Rodríguez-Martín 2011, 247-304), congenital defects/disorders (Aufderheide and Rodríguez-Martín 2011, 51-76) etc., including impacts of therapeutic interventions (Aufderheide and Rodríguez-Martín 2011, 31-34).

By and large, signs of degenerative arthrosis (and other rheumatic diseases) and traumatic injuries are the most common type of skeletal pathologies within the anthropological material under research. Both categories were proved at as many as 19 archaeological sites. The second most frequent pathology involves skeletal manifestations of physiological stress, found at 17 sites, followed by non-specific inflammation (15 sites). Musculo-skeletal markers of physical exertion or load were proven at 10 sites. Interestingly, other types of skeletal pathologies – some intriguing cases of congenital defects, neoplastic activity (meaning tumours), bacterial infections or internal diseases – were recorded at 13 sites.

Some very interesting cases of pathologies or diseases were detected in the skeletal material under study. There is e.g. one case of a probable early stage of Bechterew's disease (ankylosing spondylitis – chronic inflammatory systemic connective tissue disease of unclear aetiology; Individual 15C (male 30-35 years old) from Chania-Odos Palaima: Hallager and McGeorge 1992, 41), evidence of bacterial infections – tuberculosis or brucellosis, cases of congenital disorders (Fig. 1) and neoplastic activity, and some other internal diseases.

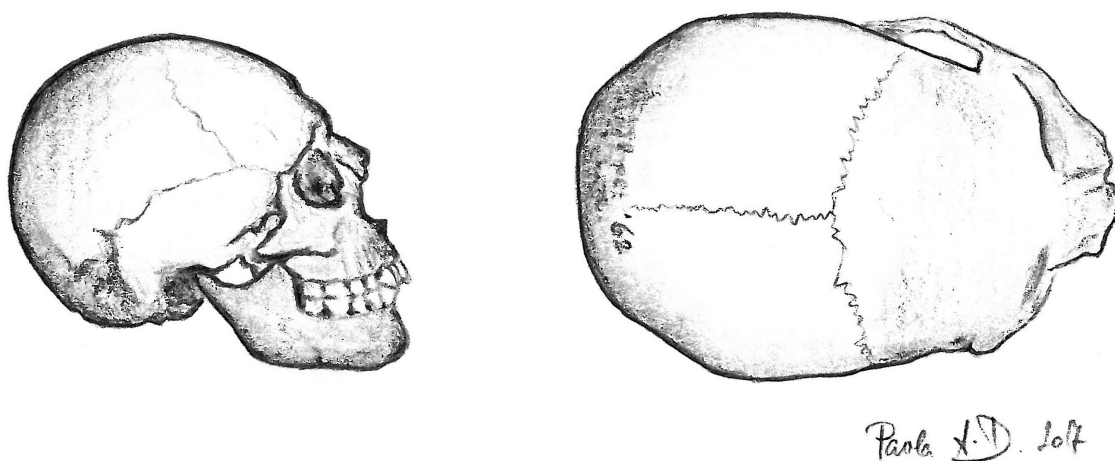


Fig. 1. Microcephalic skull from Kato Zakros (east Crete). Presumably prehistoric period.

Drawing by Pavla Alusikova Dostalikova.

II.2 DENTAL PATHOLOGIES

Dental pathologies are the following:

- dental caries (Aufderheide and Rodríguez-Martín 2011, 402-405);
- dental calculus (Horáčková et al. 2004, 185);

- ante-mortem tooth loss;
- periodontitis (Aufderheide and Rodríguez-Martín 2011, 400-402);
- periapical abscesses (Horáčková et al. 2004, 183-184);
- dental wear (enamel attrition) (Aufderheide and Rodríguez-Martín 2011, 398-399);
- dental (enamel) hypoplasia (Aufderheide and Rodríguez-Martín 2011, 405-407);
- dental and orthodontic anomalies (Horáčková et al. 2004, 186-187).

The most common type of dental pathology is, naturally, dental caries (proved at 19 sites), followed in the standing by ante-mortem tooth loss (18 sites) and periapical abscesses (15 sites). Less common (in terms of incidence) are dental enamel hypoplasia (recorded at 13 sites), dental calculus (11 sites), dental wear (enamel attrition; documented at 9 sites), and periodontitis (8 sites). Dental or orthodontic anomalies were only proven at one site.

II.3 SOFT TISSUE DISEASES AND PATHOLOGIES

To a somewhat lesser extent, evidence of pathologies is also provided by iconographical and literary sources, which may complement the picture outlined by skeletal remains and supply missing information. Iconographical sources – especially terracotta statuettes and so-called votive limbs from peak sanctuaries – often show diseases and pathologies of soft tissues as well, which is rarely reflected in skeletal material.

One example of an internally or neurologically ill person is the MM terracotta statuette of a sitting woman from Traostalos peak sanctuary (Geroulanos 2014, 24-25, fig. 3.1), with her left leg markedly thick and her right leg rather thin. This asymmetry between the two extremities is most often interpreted as elephantiasis or lymphoedema of the thick left leg, though it might be some impairment – atrophy or paresis? – of the thin right one (Arnott 1999, 4; Morris and Peatfield 2014, 59-60, fig. 7.7).

Probably the best representation of a neurological condition is a terracotta statuette from Gortyn (dated either to the 7th or 6th century BC; Pirsig et al. 1995) (Fig. 2). It depicts a standing mature woman with marked one-sided asymmetry in her face and upper extremities, most probably showing a person with clear consequences of a stroke with one-sided impairment.

III. DEMOGRAPHIC CHARACTERISTICS

Demographic categories, especially average life expectancy and stature, are important parameters reflecting a given population's state of health. Obviously, high sickness rate significantly reduces life expectancy and contributes to significant mortality in some age groups,

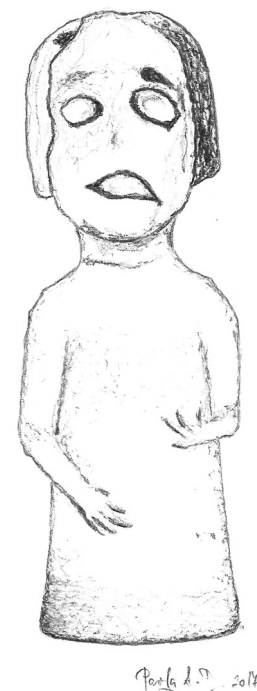


Fig. 2. Terracotta statuette of a woman with facial distortion and asymmetry of the upper limbs. 7th or 6th century BC. Herakleion Museum. Drawing by Pavla Alusikova Dostalíkova.

e.g. subadult individuals. Disease, malnutrition and physiological stress in general can in turn slow an individual's growth.

The determination of average stature and age/life expectancy depends, of course, on the good state of preservation of the anthropological material. Therefore, these data are only available for some sites/regions and periods. In Crete, during the period under study, average population stature for both sexes was determined at only seven sites from the Minoan period, with total average population stature being calculated at one further site (Kefala Petras Rock Shelter – 162.5 cm). Due to the highly fragmentary state of preservation and significant prevalence of cremated remains, average stature could not be determined for the Archaic period.

In the EM period, average stature was determined at only two sites: Agios Charalambos and Moni Odigitria. The overall average values for this period are 165.805 cm for males and 155.2125 cm for females.

In the MM period, average stature was determined at two sites: Myrtos-Pyrgos (here only the range of highest and lowest heights was given: Musgrave 2015) and Pezoules Kephala (in Kato Zakros: Becker 1975). During this period, the overall average height was 166.4025 cm for males and 157.08 cm for females.

For the LM period, average stature was established for three sites: Armeni, Mochlos-Limenaria (Triantaphyllou 2011) and Chania-Odos Palama. In the last of these, the greatest difference between the average stature of the two sexes within a single site was also recorded (164.5 cm for males and 148.8 cm for females). Normally, this difference is 5-8% in favour of males, but here it amounts to as much as 9.5%. In this period, the overall average stature is 166.7833 cm for males and 153.7967 cm for females.

For the population from Chania-Odos Palama – as the only Cretan Bronze Age site – the average age was determined at 34.14 years for males and 25.6 years for females. Several Greek populations from the study period show high subadult mortality and/or a high proportion of young adults. A good example in Crete is the population from Armeni, where 114 of the 364 buried individuals studied and published so far are subadults. This large number indicates a high infant mortality rate (31.3%), with 34% of local children not surviving their 2nd year of age and 57% being younger than 5 years.

IV. HEALING PERSONS

Healing persons are only indirectly documented in Crete during the prehistoric and Archaic periods, mainly based on traces of therapeutic or invasive (surgical) interventions preserved in the skeletal material. These interventions have been conclusively proven in the anthropological material under research. It is known that they were performed both directly (as surgical and dental interventions) and indirectly (as various aspects of caring).

Of surgical procedures, the most well-known and most sophisticated are trepanations (surgical openings of the skull), through incisions in bones of the skull adjacent to traumatic lesions, probably performed with surgical instruments, but there is also evidence of several cases of other interventions (simple as well as sophisticated). In the set of anthropological material

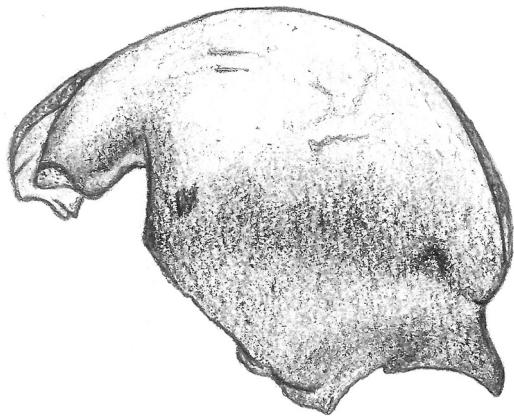


Fig. 3. Skull fragment with trepanation on the right side of the frontal bone. Individual 8083, Agios Charalambos (Crete). FN-MM II. Drawing by Pavla Alusikova Dostalikova.

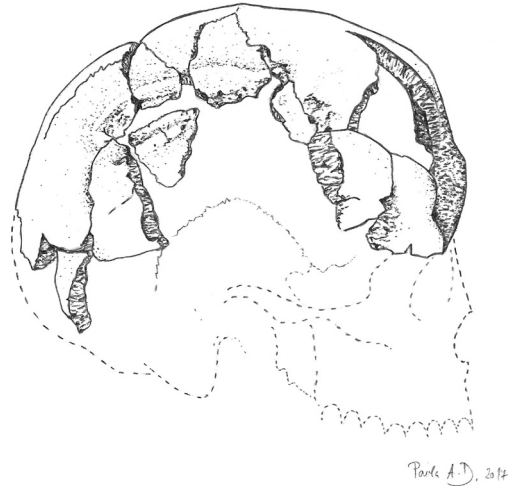


Fig. 4. Fragmented skull with trepanation on the right side. Kavousi Vronta (east Crete), grave 5, burial 1. 8th century BC. Drawing by Pavla Alusikova Dostalikova.

under study, two trepanations are fully proven and up to five more cases are probable, as the trepanation opening is often only partially preserved.

The two fully proven trepanations can be found on the skull of individuals 8083 (Fig. 3) and 8123 from Agios Charalambos (dated to FN-MM II: McGeorge 2011); both were successful. The five probable cases of trepanations can be found in the skeletal remains of individuals 1012 and 8124 from Agios Charalambos (dated to the same period as the previous cases), an individual from Apesokari (dated to EM I-MM III: Vavouranakis and Bourbou 2015), so-called skull C from the North House at Knossos (dated to LM IB) and Individual 1 from Grave 5 in Kavousi Vronta (8th century BC: Liston and Preston Day 2009) (Fig. 4).

At four sites, the preserved skeletal evidence also suggests performance of dental interventions or hygiene (at Agios Charalambos, Knossos-Ailias, Armeni, and Chania-Odos Palama), although the evidence for three of them is only indirect. Within the entire set of anthropological material included in this study, the only direct evidence of a dental intervention – a tooth extraction – is the broken root of a 1st molar in the left maxilla of a female individual (c. 21-22 years old) from Tomb 2 in Chania-Odos Palama, dated to LM IIIA2-B1 (Hallager and McGeorge 1992, 29, 40, pl. 3).

In Knossos-North House and on the islet of Pseira (Arnott 2003), very strange and controversial lesions, so-called cut marks, were documented. These are most probably traces of cuts made by sharp metal or obsidian instruments. Unfortunately, the purpose and origin of these marks are not clear. Though they may be traces of surgical instruments, they are more likely to represent evidence of the preparation of corpses for burial, when their muscles and/or ligaments were cut or severed to enable the arranging of the deceased in the often limited space of the tombs (Hughes 1991, 18-24).

At least in some communities or regions, it is highly likely that certain persons were already practicing the medical/healing professions significantly earlier, at least in the Bronze Age. This



Fig. 5. Terracotta statuettes and models from the sacred cave of Eileithyia at Inatos (Crete), representing pregnant women or scenes of childbirth. Mid-9th–end of 8th century BC. Herakleion Museum.
Photo by Pavla Alusikova Dostalíkova.

is confirmed by preserved human remains with traces of sophisticated medical procedures and well-healed traumas. It is also logical to assume that surgical interventions and trauma treatment were carried out by people who practised medicine more or less regularly. McGeorge (2008, 578-594) even believes that the large set of well-healed traumas and several surgical operations recorded within the human skeletal remains from EM and early phases of the MM period, including those from Agios Charalambos, testify among other things to the gradual formation and establishment of the medical profession on the cusp of the Early and Middle Bronze Ages.

In addition to healers, the sources also document the existence of medical support staff – midwives. A very interesting collection of terracotta statuettes and models from the sacred cave of Eileithyia, the goddess of childbirth, at Inatos (from the second half of 9th to the end of 8th century BC), depicts standing figures of women and groups, including a woman and her assistant (midwife) in childbirth (Kanta and Davaras (eds) 2011) (Fig. 5). Among others, these statuettes and models provide evidence of the emphasis placed on the issues of obstetrics and gynaecology, and assistance in childbirth (i.e., some gynaecological-obstetrical tradition). Although midwives are only documented in the Cretan sources in the Archaic period, it is reasonable to assume that a certain group of women acquired (and passed on) the knowledge of caring for women in labour and their newborns in a much earlier, i.e. prehistoric period.

It must be also stated that even in prehistoric times, the healers in Crete in the period under study had a good knowledge of human anatomy, which is also demonstrated in the fine arts. As for general medical knowledge and skill, some sites mainly from the MM and LM periods show a high number of successfully healed traumas, and some of them even trepanations or other sophisticated therapeutic interventions (surgical as well as dental). On the other hand, at some

other sites there is a high number of unhealed or poorly healed traumas, which permits us to conclude that medical knowledge, skill and staff were scant, resulting in few or no therapeutic interventions and procedures.

V. REMEDIES AND MEDICAL INSTRUMENTS

Regarding remedies used, the best evidence was found at the abovementioned small copper smelting site of Chrysokamino. Twelve pottery sherds of vessels from a hut or shelter, dated to the EM III to MM IA, were analysed for organic residues. Gas chromatography and mass spectrometry revealed a number of plant compounds and animal fats, including ones that strongly suggest the presence and use of specific medicinal plants. Of these, nine herbs native to Crete or the Eastern Mediterranean have clear medicinal effects and use, such as anise, coriander, cumin, fennel, harmal, licorice, rue, saffron and verbena (Arnott 2008; Beeston et al. 2008). It thus appears that the vessels in question were used in the making and storing of quite complex herbal concoctions, including resinated wine to make the medicine more palatable. Such remedies were most probably used to cure injuries or symptoms connected with the metal industry.

Regarding medical instruments, stone or obsidian blades may have been used for surgical interventions since the Neolithic period. Various bronze utensils – knives, scrapers, tweezers, ear picks etc. – could have served both common household and medical purposes. In the Early Iron Age, such tools also began to be made of iron. However, only one collection of tools in Crete from the period under study can be interpreted with a high degree of certainty as medicinal or surgical instruments: three iron knives, four stick-probes, three specific chisels or scrapers and one pair of tweezers. These tools were found in grave nos. 5 and 9 in Kavousi-Vronda and are dated to the 8th century BC (Liston and Preston Day 2009, 67-70, fig. 4.4-4.8).

CONCLUSIONS

From the evidence preserved, it is obvious that an important characteristic of Cretan medicine was its combination or close connection with religious and practical (empiric) aspects, especially in the prehistoric period, though also in Archaic times. This was reflected in the therapeutic procedures used. On the one hand, the physicians/healers of the time were able to prepare remedies from plants in liquid and ointment form (thereby practicing phytotherapy), and perform sophisticated therapeutic interventions such as trepanations or management of fractures and other injuries, but on the other, above all in the general population and in folk medicine, faith healing through a healing cult was very common. So, in prehistoric medicine, both purely empiric and purely religious therapeutic procedures were used, in many cases – or in many patients – probably in combination.

The surviving anthropological material testifies to the harsh living conditions of Cretan populations during the period in question – they were clearly exposed to many pathogens and had to work physically hard to scrape a living. All these aspects are naturally reflected in the health status and sickness rate, represented by the proven skeletal and dental pathologies, as well as in the low body height and life expectancy of individuals (compared to later periods in

human history) and high neonatal and subadult mortality. The health status of most populations in urban centres also shows the adverse influence of city life (such as loss of resistance to disease, higher mortality at a young age and the reduced average body height of the population).

Based on the sources presented here and the evidence they yield, it is obvious that medicine in Crete developed to a rather high professional level as early on as in prehistoric times, supported by thorough knowledge of human anatomy and a combination of empiric and religious components. By the turn of the Early and Middle Bronze Ages, at the latest, Cretan physicians or healers were able to perform sophisticated therapeutic (surgical) interventions, for example trepanations, on a somewhat large scale, and to prepare drugs from medicinal plants which were reasonably efficient in treating certain types of symptoms. This basic knowledge and skill eventually survived the end of the Bronze Age civilization and entered “Homeric” or Archaic medicine. We should definitely not forget the considerable foundational contribution made by prehistoric physicians and healers, including those from Crete.

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