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Infectious disease in the ancient Aegean: Intestinal parasitic worms in the Neolithic to Roman Period inhabitants of Kea, Greece

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ABSTRACT

Little is known about infectious disease and parasites in the prehistoric inhabitants of the islands of the Aegean, in contrast to later time periods. It is only with the development of Greek medical texts in the 5th and 4th centuries BCE we start to find evidence for the diseases that affected the population of region. Foremost amongst these authors was the medical practitioner Hippocrates, who lived on the island of Kos. The descriptions of the many diseases he and his students encountered were recorded in their medical texts in the 4th and 3rd centuries BCE, known as the Hippocratic Corpus. These important texts provided the core philosophy underpinning medical theories in Europe and the Arab world for the following 2,000 years. Past research to determine which species of intestinal parasitic worms were described in the Hippocratic Corpus has suggested they indicate roundworm, pinworm and *Taenia* tapeworm. However, until now, there has been no archaeological evidence for which species of helminths were present in ancient Greece. In this study, we analysed soil sediment adherent to the sacrum and iliac bones of the pelvis of 25 burials dating from the Neolithic to Byzantine period on the Greek island of Kea, not far from Kos. Four individuals (16%) were positive for the eggs of intestinal helminths, dating from the Neolithic (4th millennium BCE), Late Bronze Age, and the Roman Period. The species identified were whipworm (*Trichuris trichiura*) and roundworm (*Ascaris lumbricoides*). We consider reasons as to why fewer species of parasite appear to have been present on Kea than was the case for northern Europe at the same time period. This study of ancient parasites shows how we can combine archaeology with history of medicine to better understand the discoveries of key early scientists and medical practitioners.

1. Introduction

Hippocrates was a medical practitioner who lived in the 5th–4th century BCE on the Greek island of Kos, in the Aegean Sea. The medical texts of Hippocrates and his students are important as they described humoural theory to explain the cause of disease for the first time. It was thought that when the four humours (black bile, yellow bile, blood and phlegm) were in balance a person would be healthy, but when out of balance or corrupted then sickness would result (Horden and Hsu, 2013; Nutton, 2013). These texts, known as the Hippocratic Corpus, were passed on and translated by the Romans, Arabs and the people of medieval Europe. Indeed, humoural theory became the accepted explanation for ill health and influenced medicine for the next two thousand years in Europe and the Mediterranean region (Cantor, 2001; Mann, 2012; Totelin, 2011).

Modern researchers have studied the descriptions of many different diseases recorded in the Hippocratic Corpus to try and identify which conditions Hippocrates and his students encountered (Pappas et al., 2007; Sajadi et al., 2011; Tefekli and Cezayirli, 2013). A number of these descriptions were those of intestinal parasitic worms. The Greek texts used three terms when describing helminths. *Helmins strongyle* was a large round worm, *Helmins plateia* was a flat worm, while *Ascaris* was a small round worm. These three terms have been interpreted as referring to roundworm (*Ascaris lumbricoides*), tapeworm segments (perhaps *Taenia* sp.), and pinworm (*Enterobius vermicularis*) (Trompoukis et al., 2007). However, it is known that interpreting ancient medical texts to make a modern diagnosis is not a simple process, as there are many confounding factors that may potentially lead to an error in interpretation (Mitchell, 2011).

Until now there has been no archaeological study of the intestinal helminths present in the Greek islands at the time of Hippocrates, with which we might compare this written evidence. This is in contrast with

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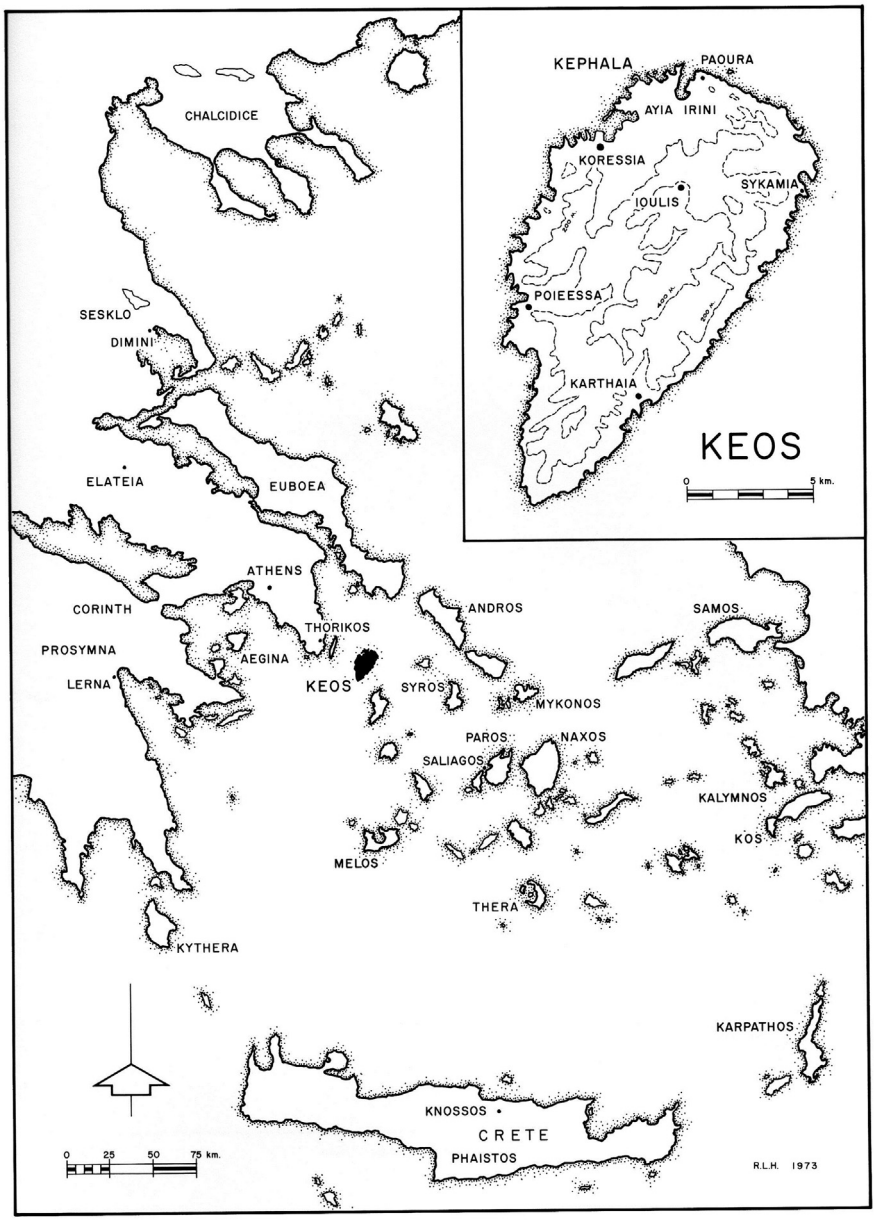

Fig. 1. Map showing location of the island of Kea (Keos), and the sites of Kephala and Ayia Irini.
Image: Department of Classics, University of Cincinnati.

the evidence that is available for disease found in human skeletal remains in Greece from the Neolithic onwards (Bourbou, 2003; Charlier and Tsigonaki, 2011; Papathanasiou et al., 2000). Such a study of intestinal helminths would allow us to be much more confident as to the species described by Hippocrates 2500 years ago. It could also potentially give us an indication of when intestinal parasites were first brought to the islands, and how the species of parasite infecting the population might have changed over the millennia following settlement of the islands.

2. Material and methods

The samples under study originate from the island of Kea, which is situated in the Cyclades Islands in the Aegean Sea. Human skeletal remains were excavated from two sites on the island, namely Kephala and Ayia Irini (Fig. 1). Both excavations started in 1960 and ended in the early 1970s.

The Neolithic settlement of Kephala was situated on a promontory of the north-western coast of the island. Forty graves were excavated. The material culture of the occupation levels at Kephala can be dated to the 4th millennium BCE. Kephala was inhabited for less than two centuries and was never re-inhabited after its abandonment in the Neolithic (Coleman, 1977).

Ayia Irini is situated north of the port of Ayios Nikolaos in the north-west coast of the island. Most graves (25 individuals) in Ayia Irini date from the Middle Bronze Age (2000/1900–1550 BCE), but graves dating from the later Bronze Age (1550–1100 BCE), Roman period (146 BCE–330 CE), and Byzantine period (330 CE–1207 CE) were also excavated (Caskey, 1962; Overbeck, 1989; Wilson, 1999).

For this study sediment was collected from the anterior aspect of unwashed sacral bones and internal aspect of the iliac bones of the pelvis from the skeletal remains, along with control samples from the unwashed crania and/or feet (Reinhard et al., 1986; Fugassa et al., 2008). Nine Neolithic burials from Kephala were sampled, as were sixteen individuals from Ayia Irini dating from the Chalcolithic (n = 1), Bronze Age (n = 2), Roman (n = 10) and Byzantine (n = 3) periods.

Each sample was processed by disaggregation in 0.5% trisodium phosphate, and the solution then passed through a series of microsieves with mesh sizes 300, 160, and 20 μm. Sediment particles trapped on the 20 μm mesh will contain any parasite eggs present. This sediment was