THE PALEOEPIDEMIOLOGY OF INFECTIOUS DISEASES AS ELUCIDATED BY MICROBIAL BIOMARKERS

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Paleoepidemiology of infectious diseases includes studying populations of human remains and estimating the frequency and distribution of disease. Using specimens from the Dakhleh Oasis, Egypt, the pre-pottery Neolithic Atlit Yam in the Eastern Mediterranean, and the Sudanese Nubian remains of Kulubnarti, we sought ancient DNA (aDNA) of Mycobacterium tuberculosis and/or Mycobacterium leprae, and their specific cell wall lipid biomarkers. Disease can be identified in specimens with limited if any paleopathological lesions. This is not surprising as only ~5% of active tuberculosis cases result in bony involvement. Detection of MTB biomarkers in bones indicates a generalized infection and cannot be confused with latent infection. In leprosy, typical paleopathology occurs in multi-bacillary disease so microbial
biomarkers can detect other clinical presentations and dispersed infections. We have reported co-infections of tuberculosis and leprosy in specimens from the Dakhleh Oasis and elsewhere. Therefore microbial biomarkers can significantly change estimates of prevalence and frequency of disease. Paleoepidemiology also includes understanding the origin of infectious diseases, changes in the host/pathogen relationship over time, reservoirs of infection, latency and transmission. For example, microbial biomarkers have illustrated the establishment and spread of leishmaniasis from Nubia into ancient Egypt. Linking molecular fingerprinting with phylogenetics shows that M. tuberculosis has co-evolved with humans over millennia and the lineages that infect humans are more ancestral than Mycobacterium bovis. Similarly, our understanding of the origins and spread of leprosy around the globe have been elucidated by characterizing the aDNA of M. leprae extinct strains from Egypt and Europe.