

## Chapter 2 Case Study (2.5.1, 2.5.3): Urban-Rural Differences in Markers of Stress

-Tracy K. Betsinger

Skeletal and dental markers of stress can be used to assess mortality risk in a population in addition to reflecting episodic or ongoing stress. The question of who is at risk of death can be answered by comparing frequencies of stress indicators—such as porotic hyperostosis, cribra orbitalia, and enamel hypoplasias—between different cohorts or populations based on age, sex, status, or other factors. Rebecca C. Redfern and collaborators (2015) sought to determine whether urban or rural populations in Roman-period England (1<sup>st</sup>-5<sup>th</sup> centuries AD) were more at risk of death by comparing the prevalence of these stress markers as well as markers of specific and nonspecific infection and oral health. They tested the hypothesis that rural populations had better health and a lower mortality risk than urban populations.

Following the Roman conquest, there was a ranked system of urban settlements that included *civitas*, an administrative and political center, which was below the higher status *municipium* and *colonia*. *Civitas* were walled settlements with well-organized street plans. They were also associated with small-scale horticulture and cemeteries located within the fortifications. The rural landscape of post-conquest Britain also changed due to the establishment of large estates and the introduction of new agricultural technology. Despite these changes, urban areas are thought to have still had poorer overall health due to lack of sanitation and high population density of humans and animals. Bioarchaeological, historical, and clinical data all suggest higher levels of disease, including both metabolic and infectious conditions, for urban inhabitants than for those who lived in rural sites.

Redfern and colleagues examined skeletal assemblages from the county of Dorset in southern England. During the Roman period, this region included both rural settlements as well as a *civitas*. A sample of 150 skeletons from eight rural sites and 194 skeletons from 10 urban sites were examined for the presence of cribra orbitalia, porotic hyperostosis, nonspecific periostitis, enamel hypoplasias, rickets, scurvy, tuberculosis, carious lesions, and calculus. Subadult age-at-death was determined based on dental eruption, diaphyseal length, and epiphyseal fusion, and adult age-at-death was estimated based on the pubic symphysis, auricular surface, and sternal rib ends. Sex was determined according to pelvic and cranial morphology. Rates of each health indicator and the risk of mortality were compared between the collective rural and urban sites. Because the mortuary patterning of the Poundbury sites differed substantially from other Dorset cemeteries, rural-urban comparisons were also conducted excluding these sites. To assess whether differences in risk of mortality existed between rural and urban populations, the researchers used the Siler statistical model, which estimates the hazard of dying at a particular age. There are three components to the Siler model, representing juvenile mortality, deaths unrelated to age, and a typical senescent pattern of mortality (i.e., risk of death increases with age once adulthood is reached). These components are independent from one another in that surviving one component does not impact the risk of death from

another. For example, surviving through subadult years (component 1) does not increase or decrease the risk of dying from an accident (component 2).

The results their study demonstrate that although there are no statistical differences in mortality risk between rural and urban when the entire sample is used (all sites and all individuals), there is a statistically greater mortality for urban subadults than for rural subadults. Comparing age-at-death distributions also demonstrated that urban cemeteries had significantly more 0-10 year olds and adults >35 years of age than rural cemeteries. Additionally, significantly higher rates of enamel hypoplasias, carious lesions, and rickets were found in urban cemeteries than in rural ones. When the Poundbury sites are excluded, there were significantly higher rates of enamel hypoplasias, carious lesions, and calculus in urban sites, while rural cemeteries had significantly higher rates of porotic hyperostosis, cribra orbitalia, and nonspecific periostitis. Again, when considering subadults alone, there was a significantly higher mortality for urban subadults than rural subadults. By contrast, urban adults had significantly lower mortality risk than rural adults. When comparing urban cemeteries from Poundbury with urban cemeteries of other settlements, researchers found a higher risk of adult mortality at Poundbury. Additionally, there was significantly higher adult survivorship at the non-Poundbury urban cemeteries. The Poundbury sites also had significantly higher rates of porotic hyperostosis, cribra orbitalia, and nonspecific periostitis, whereas non-Poundbury cemeteries had higher rates of caries and calculus. Comparisons of male versus female survivorship and risk of mortality yielded no statistically significant results.

From these results, the researchers concluded that rural Dorset populations had lower levels of stress, dental disease, and metabolic disease compared to urban populations in the region. This was, however, dependent on whether Poundbury samples were included in the analyses. This study demonstrated that the comparison risk of death between urban and rural populations is more complex than what one might assume, and it is age-dependent. In particular, urban subadults had a significantly higher mortality than rural subadults, which may be related to urban-rural differences in child-rearing practices. The researchers also argue that the increased survivorship and greater presence of older adults in the urban cemeteries reflects the less hazardous nature of living in *civitas*, which did not have the large population size and high housing density of much larger urban settlements, and, thus, did not have the same health impacts that are commonly associated with urban living. The Poundbury sites are unique among the sample, as individuals from these cemeteries demonstrated poorer health, higher subadult mortality, and higher adult mortality risk. The researchers suggest that these results may reflect different childcare practices at these settlements, including different patterns of breastfeeding and weaning. Researchers argue that the Poundbury sites were inhabited by a larger proportion of migrants than other sites in Dorset, which would account for such differences.

This study is an excellent example of how stress indicator data can be used to help investigate who is at risk of dying in a population as well as collective health of the population. Overall, this study shows that there are significant differences in patterns of health and mortality between urban and rural populations in Roman Britain. Urban adult

populations in Dorset had lower mortality risk than rural adult populations. Additionally, this study demonstrated that the Poundbury sites were unique to the region. Future studies examining mobility, such as based on stable isotope analysis, may help to determine whether or not this is true.

Reference:

Redfern RC, DeWitte SN, Pearce J, Hamlin C, Egging Dinwiddy K. 2015. Urban-rural differences in Roman Dorset, England: A bioarchaeological perspective on Roman settlements. *American Journal of Physical Anthropology* 157:107-120.