

## Chapter 10 (10.2) Case Study: Pre-Black Death Trends in Survival and Mortality

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The Black Death was one of the deadliest epidemics in human history and led to a variety of sociocultural and demographic shifts. Scholars in a variety of fields, including anthropology, have studied the Black Death, but there remain a number of unanswered questions, including why mortality rates were so extremely high during the outbreak compared to modern mortality rates. Sharon DeWitte (2015) addresses this question in her study of pre-Black Death populations. Utilizing paleodemography, DeWitte tests the hypothesis that survivorship decreased and mortality increased immediately preceding the Black Death, which made the population especially vulnerable to an outbreak.

The question of why the Black Death had such a high mortality rate has been considered for some time. Recent comparisons of the genome of *Yersinia pestis* (the bacteria that causes the plague) from fourteenth-century samples and from modern samples have yielded no significant changes in the DNA controlling virulence, which excludes genetic change as a possible explanation for why the fourteenth-century plague resulted in dramatically higher death rates. Paleodemography is especially well suited to addressing this question, as it considers the entire population, including males and females, a full range of ages, and a variety of social classes, something which is not true about historical documents, which often reflect the perspective and experience of adult males of higher status. By examining survivorship and risk of mortality, the overall health of the population can be estimated. Climatological and historical data from the period just before the epidemic suggests that famines were becoming more common as crops failed, and there was an increasing disparity between socioeconomic classes. Previous bioarchaeological studies indicate that various infectious diseases were particularly problematic as well. The combination of food shortages and disease stress would make a population, especially those of the lowest social classes, more susceptible to a large outbreak and result in a higher death rate.

To test the hypothesis, DeWitte utilized a sample of 597 skeletal remains from London, representing two pre-Black Death time periods: early pre-Black Death (eleventh–twelfth centuries) and late pre-Black Death (thirteenth century). Adult ages were estimated using transition analysis of the pubic symphysis, auricular surface, and cranial suture closure (see Boldsen et al., 2002). Subadult age estimates were based on epiphyseal fusion, dental eruption, and dental development. Statistical analyses employed included the Gompertz–Makeham hazard model for assessing differences in mortality risks between the two periods, Kaplan–Meier survival analysis to determine the effect of time period on survival, and the fertility proxy ( $D_{30+}/D_{5+}$ ), as changes in fertility rate affect age-at-death distributions.

Statistical results indicate that there were significantly different age distributions between the early pre-Black Death period and the late pre-Black Death period. The later period had fewer subadults under the age of 10 years and fewer adults over the age of 65 years. Conversely, the later period had more adults between 15 and 35 years of age than

the earlier period. Hazard analysis reveals higher mortality risks for the late pre-Black Death sample than in the earlier period, while the survival analysis indicates lower survivorship in the later period. The fertility proxy suggests a higher birth rate in the thirteenth century compared to the eleventh–twelfth centuries, but there is no statistically significant difference between the two periods.

Collectively, these results indicate that there was a decline in health prior to the outbreak of the plague due to reduced survivorship and higher adult mortality in the late pre-Black Death period. This may, then, explain why the Black Death resulted in a markedly high mortality rate, as poor health would make the population extremely vulnerable. If the Black Death had occurred in a more robust population, without declining survivorship and increasing adult mortality, then the outcomes would have likely been quite different. The lack of difference in the fertility proxy between the two periods indicates that changes in birth rate do not account for the demographic changes observed in the age-at-death distributions. One possible drawback of this study is the 100-year lag time between the latest date of the late pre-Black Death sample and the actual start of the epidemic. However, historical and climatological data do not indicate that health, survivorship, and/or adult mortality improved in the intervening years. In fact, these data reflect a decline in population growth and size as well as an increase in mortality during the thirteenth and fourteenth centuries, which suggests a continuation of the pattern found by DeWitte.

This study is an excellent example of the utility of bioarchaeology in general and paleodemography in particular for addressing questions of historical significance. By combining paleodemographic data with historical and climatological data, DeWitte makes a strong argument for a decline in health as the explanation for why the Black Death was so deadly in the fourteenth century. Additionally, this study emphasizes the importance of considering the human context of disease, including the sociopolitical, economic, biological, and environmental factors that explain the morbidity and mortality patterns of a disease. This is essential whether the disease in question is occurring in the past or is a current outbreak. By contextualizing the disease, more can be understood about the transmission of the disease, its severity, and its persistence, which may enable researchers to manage an outbreak more effectively.

#### Reference

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