

Dangerous pathogens were lurking around every corner in an early medieval settlement

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Skull from grave 83 in Lauchheim "Mittelhofen". On this individual, the team was able to detect three infections. Credit: Isabelle Jasch-Boley

The analysis of DNA from 1,300-year-old skeletons allowed the reconstruction of the health status of the Merovingian community in in Lauchheim "Mittelhofen" in today's Baden-Württemberg.

The study, published today in the journal *Genome Biology*, shows a high

prevalence of [infection](#) with various pathogens. The results also allow general conclusions to be drawn about susceptibility to infection in times of climatic change.

Lack of personal hygiene, [disease](#)-carrying rats and general unsanitary living conditions—the Middle Ages are commonly regarded as an age of ubiquitous disease. However, most of our knowledge about medieval epidemics relates to the late Middle Ages after the 12th century CE. In contrast, the incidence of infection in the early Middle Ages and the pathogens responsible for disease outbreaks during this period are still largely unexplored.

An interdisciplinary research team led by scientists from Kiel University (CAU) has now found evidence for a high prevalence of infectious diseases in the early medieval settlement of Lauchheim "Mittelhofen" (Baden-Württemberg) using the latest analysis techniques for ancient DNA.

Analysis reveals various pathogens in the skeletons

For this study of the early medieval settlement Lauchheim "Mittelhofen," researchers isolated DNA from 70 human skeletons excavated within its borders. The graves could be associated with distinguishable farmsteads and dated to the late Merovingian period (7th–8th century CE).

"The DNA data showed that the Lauchheim inhabitants suffered from infections with various pathogens, such as *Mycobacterium leprae*, the hepatitis B virus HBV, the parvovirus B19 and the variola virus VARV," says Professor Ben Krause Kyora from the Institute for Clinical Molecular Biology of the CAU and member of the Cluster of Excellence ROOTS, who led the research team.

The infectious agents detected in Lauchheim cause both chronic and acute diseases of varying severity. Infection with *M. leprae* can lead to the development of persistent and highly debilitating leprosy. Symptoms of HBV infection range from mild abdominal pain and fever to liver fibrosis and even liver cancer. B19 is seemingly less dangerous as the infection is usually asymptomatic and severe complications are rare. In contrast, before its eradication in 1980, variola virus caused smallpox—an acute disease of high mortality.

"However, due to the [genetic differences](#) between the modern and medieval VARV, we cannot tell what the symptoms of the infection were in the Middle Ages and whether the pathogen was as dangerous as the modern variola," explains Prof. Krause-Kyora.

Many people even suffered from multiple infections

The authors noted a substantial number of co-infections with two or even three different [infectious agents](#). Overall, 31% of the community died with a molecular trace of infection with at least one pathogen. "Although this number is very high, it does not reflect a disease burden at one moment in time. Dating of the graves suggests that the burial ground was used for approximately one century, so between three to four generations. It is important to keep that in mind," says one of the lead authors of the study Joanna Bonczarowska from the Institute for Clinical Molecular Biology of the CAU.

Nevertheless, the researchers believe that their reports are likely underestimating the true prevalence of infection in early medieval Lauchheim. Krause-Kyora remarks that "Once all soft tissue is deteriorated, only blood-borne pathogens can be reliably identified in the bones. When considering this limitation together with the degradation of DNA molecules that occurs over time, some infections were probably undetected."

Overall poor health and climatic change

The Lauchheim inhabitants were generally of poor health, as their skeletons showed signs of infections and/or an inadequate diet. One of the senior authors Prof. Almut Nebel from CAU's Institute of Molecular Biology, says that "At the time, Europe experienced a rapid climate decline, known as the Late Antique Little Ice Age. Climate change can drive crop failures, eventually leading to famine."

Malnutrition possibly increased the physiological stress of the people. "In theory, famine would weaken the undernourished population and allow for an easier spread of the pathogens among the community. Those people were in very [poor health](#) and the conditions seemed to be favorable for disease spread and evolution of the pathogens," adds Nebel.

The study provides a new, temporal perspective on the infectious disease burden in a community living in a period characterized by high exposure to pathogens, rapid cultural transition and major climate changes. These conditions, to an extent, one can relate to today—in times of emerging and re-emerging infectious diseases and climate change.

"This study is also a good example of the collaboration between different disciplines at the CAU. Expertise and resources from the Collaborative Research Center 1266, the Cluster of Excellence ROOTS and the Cluster of Excellence Precision Medicine have come together to learn more about the history of human diseases and to draw possible lessons for us today," Ben Krause-Kyora says.

More information: Joanna H. Bonczarowska et al, Pathogen genomics study of an early medieval community in Germany reveals extensive co-infections, *Genome Biology* (2022). [DOI: 10.1186/s13059-022-02806-8](https://doi.org/10.1186/s13059-022-02806-8)

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