Could Squirrel trade have contributed to England's medieval leprosy outbreak?

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Leprosy is likely to have had a severe impact on the Woman' from Hoxne's life. The visible damage to her skull provides evidence that she would have had

extensive facial lesions and is likely to have suffered nerve damage to her extremities. Credit: Dr Sarah Inskip

Genetic analysis of a pre-Norman skull unearthed in a garden in Hoxne, Suffolk, has added to a growing body of evidence that East Anglia may have been the epicentre of an epidemic of leprosy that spread through medieval England. A strain of the disease may have been brought to East Anglia's coast line through contact with Scandinavia via Anglo-Saxon movement or possibly the later sustained trade in squirrel fur, the new study suggests.

The research, reported in *The Journal of Medical Microbiology*, identified evidence of a strain of *Mycobacterium Leprae* (*M.leprae*), the bacteria that causes leprosy, in ancient DNA extracted from a female skull discovered in Suffolk. "The Woman from Hoxne" is one of a growing number of medieval leprosy cases identified in human remains found in or around East Anglia in the early medieval and Norman period. The researchers suggest that an explanation for the prevalence of leprosy in the area may be found in medieval trade, possibly in fur, which would have included that of squirrels - an animal known to carry the disease.

Working in collaboration with The Friends of Diss Museum and the University of Surrey, the study examined genetic information from a skull held in the collections of the Diss museum in Norfolk since its accidental discovery in the late 20th century. On account of its size and shape, researchers suspected the woman had lived between the 5th to 11th centuries, but their interest was piqued by abnormalities visible on her skull - such as destruction to the nasal spine -which had the hallmarks of leprosy.

Through radiocarbon dating, a team of researchers confirmed that the woman, who probably lived on a diet of wheat, barley and pottage with a small amount of animal protein, is likely to have lived between 885-1015AD. Taking shavings of bone from the skull in order to extract ancient DNA, they also detected traces of the bacteria M.leprae.

The disfiguring disease is likely to have had a severe impact on the woman's life. The visible damage to her skull provides evidence that she would have had extensive facial lesions and is likely to have suffered nerve damage to her extremities.

Analysis of the bacteria revealed that the "Woman from Hoxne" had been infected with the same strain of leprosy already identified in skeletal remains found in East Anglia. The strain had previously been found in the skeleton of a man from Great Chesterford who lived as early as 415-545 AD, suggesting that it persisted for hundreds of years in the South East of Britain.

Sarah Inskip, Research Associate at St John's College, Cambridge, and lead author of the paper, said: "This new evidence coupled with the prevalence of leper hospitals in East Anglia from the 11th century onwards adds weight to the idea that the disease was endemic in this region earlier than in other parts of the country.

"It is possible that apparent clustering of leprosy cases in the East Anglia region could be attributed to chance - perhaps more medieval human remains have simply been uncovered in the region and the discoveries have been better conserved by a soil type containing high levels of bone-preserving chalk. However, the same conditions are also found in areas such as Hampshire and Dorset, where many early Anglo-Saxon cemeteries have been excavated, but no cases of leprosy have yet been reported."

The same strain of leprosy has also been identified in skeletal remains in Medieval Denmark and Sweden and the study's authors suggest that North Sea trade links with Scandinavia may offer an explanation for the apparent prevalence of the disease in East Anglia. "It is possible that this strain of leprosy was proliferated in the South East of England by contact with highly-prized squirrel pelt and meat which was traded by the Vikings at the time this woman was alive. Strong trade connections with Denmark and Sweden were in full flow in the medieval period, with Kings Lynn and Yarmouth becoming significant ports for fur imports" added Dr Inskip.

The last case of human leprosy in the British Isles was over 200 years ago, but a recent study demonstrated leprosy infection in red squirrels on Brownsea Island in Dorset. The disease affects the squirrels in much the same way as humans - resulting in lesions on their muzzles, ears and paws. Sequencing of the *M.leprae* strain in modern red squirrel showed it to be closely related to that detected in the woman from Hoxne. The same strain infects the only other animal based source known to exist, the nine-banded armadillo, which has caused some human cases of leprosy in Florida.

"Research has already established that leprosy can be passed from armadillos to humans, so that it may also come from squirrels is an interesting idea," said Inskip. "It is questionable how long the bacteria could have survived on fur or meat, but it's notable that squirrels were also sometimes kept as pets."

"Perhaps it's the movement of people and prolonged connection between East Anglia and Scandinavia that's important to our understanding of the history of leprosy in the UK, but further research refuting or confirming the role of the fur trade could be highly enlightening and exciting".

The research paper, Leprosy in Pre-Noman Suffolk, UK: Biomolecular

and Geochemical Analysis of the Woman from Hoxne is published in the *Journal of Medical Microbiology*.

More information: Sarah Inskip et al, Leprosy in pre-Norman Suffolk, UK: biomolecular and geochemical analysis of the woman from Hoxne, *Journal of Medical Microbiology* (2017). DOI: 10.1099/jmm.0.000606

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