

7000 year-old tuberculosis cases from Hungary – Osteological and biomolecular evidence



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S U M M A R Y

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This study derives from the macroscopic analysis of a Late Neolithic population from Hungary. Remains were recovered from a tell settlement at Hódmezővásárhely–Gorzsa from graves within the settlement as well as pits, ditches, houses and as stray finds. One of the most important discoveries from these remains was evidence of tuberculosis. Pathological analysis of the seventy-one individuals revealed numerous cases of infections and non-specific stress indicators on juveniles and adults, metabolic diseases on juveniles, and evidence of trauma and mechanical changes on adults. Several cases showed potential signs of tuberculosis and further analyses were undertaken, including biomolecular studies. The five individuals were all very young adults and included a striking case of Hypertrophic Pulmonary Osteopathy (HPO) with rib changes, one case with resorptive lesions on the vertebrae, two cases with hyper-vascularisation on the vertebrae and periosteal remodelling on the ribs, and one case with abnormal blood vessel impressions and a possible lesion on the endocranial surface of the skull. The initial macroscopic diagnosis of these five cases was confirmed by lipid biomarker analyses, and three of them were corroborated by DNA analysis. At present, these 7000-year-old individuals are among the oldest palaeopathological and palaeomicrobiological cases of tuberculosis worldwide.

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1. Introduction

This research is based on the analysis of human skeletal remains recovered from the Late Neolithic tell settlement of Hódmezővásárhely–Gorzsa in the South of Hungary. This site, located about 15 miles North East of Szeged and 9 miles South West of Hódmezővásárhely, was occupied through six settlement phases

starting from the Early Tisza culture. The naturally elevated settlement was surrounded by streams and marshes.

The Tisza Culture occupation of the settlement occurred during the first half of the fifth millennium BC, with a time span of at least 300 years. Twenty samples from the site provided a calibrated range of 4970–4594 BC [1], recalibrated most recently by Masson to 4932 to 4602 BC with a 95.4% confidence interval using the calibration curve IntCal04 for Northern Hemisphere in the dating programme OxCal 4.1 [2]. Bone fragments of HGO-53, one of the individuals presented in this study, were also analysed most recently at the Hertelendi AMS C-14 Lab in Debrecen, Hungary (AMS Lab code DeA-2485.1.1), and confirmed that this individual dated back to the start of the fifth millennium BC, with a calibrated age range of 4780–4715 BC with 1 sigma, based on HGO-53 radiocarbon age of 5872 ± 32 BP and the intcal09.14c calibration data set [3].

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Only two percent of the site has been investigated to date, first by Gazdapusztai in the 1950s [4], and then by Horváth in the 1970s, 1980s and 1990s [5]. Unfortunately, there are no published maps of the site, and there is no information currently available on the location of the graves and other remains in relation to the settlement and to each other. Seventy-one individuals dating from the Tisza Culture were recovered from Hódmezővásárhely-Gorzsa, including 56 who had been buried in graves within the settlement and the partial remains of a further possible fifteen recovered from pits, ditches, houses and as stray finds. Their remains are housed in the collection of the Biological Anthropology Department of the University of Szeged, on loan from the Móra Ferenc Múzeum in Szeged.

Macroscopic analysis revealed that juveniles accounted for a third of the Late Neolithic remains, while two-thirds of the adult remains where sex could be determined were female. This population appeared to have been mostly non-violent, leading a physically stressful life, prone to infections and with a high rate of dental disease [6]. The pathological analysis revealed a case of Hypertrophic Pulmonary Osteopathy (HPO). Although its most common causes nowadays are intrathoracic cancer and chronic intrathoracic infection [7], tuberculosis would have been a more likely cause in the past. Tuberculosis has already been successfully identified as a possible primary cause of HPO in the archaeological record [8], and was found to strongly correlate to HPO in a historic population from a pre-antibiotic era [9]. In modern cases, HPO has also been associated with severe and untreated pulmonary

tuberculosis [10]. Based on the strong link between HPO and tuberculosis, aDNA and lipid biomarker analyses were carried out on this individual to confirm the presence of tuberculosis among this ancient population. The biomolecular results confirmed that tuberculosis had been present at this Late Neolithic site, and this case was published in full [11]. Four further probable cases of tuberculosis were discovered through macroscopic analysis and were similarly tested for *Mycobacterium tuberculosis* aDNA, and mycolic and mycocerosic acid cell wall lipid biomarkers.

2. Materials and methods

2.1. Morphological analysis

All examinations were carried out macroscopically at the Biological Anthropology Department of Szeged University. All remains were damaged and fragmentary. Sex was estimated based on several morphological methods principally concentrating on the morphological traits of the skull and the pelvis, while also giving some consideration to bone dimensions [12,13]. Age was estimated from skeletal and dental development, particularly concentrating on state of epiphyseal fusion in addition to tooth wear, and giving some consideration to the morphology of the pubis and the auricular surface [14,15]. The palaeopathological analysis, based on macromorphological observations (Figure 1), was undertaken at the same laboratory [16].

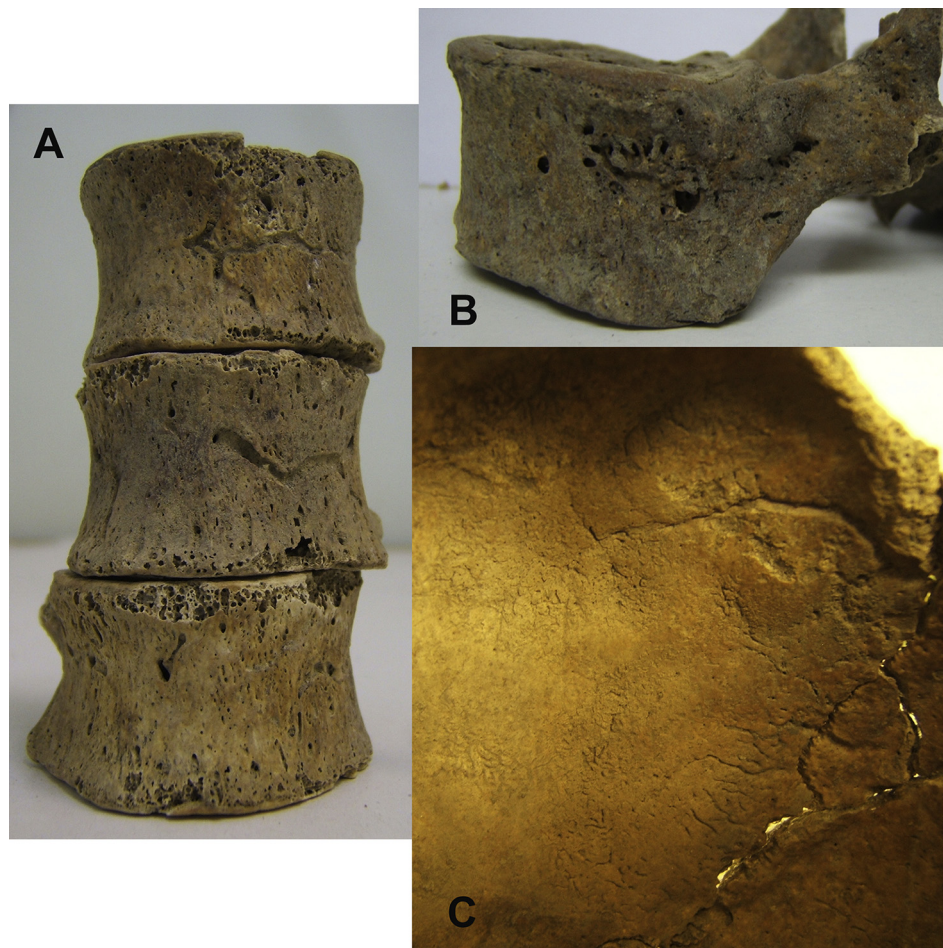


Figure 1. Atypical osteological evidence of tuberculosis A. Hypervascularisation of the vertebrae of HGO-10; B. Resorptive lesion on vertebra of HGO-21; C. Abnormal blood vessel impressions (abvi) with SES-like pattern (*Serpens endocrania symmetrica*) on the endocranial surface of HGO-48.

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