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The Osteological Evidence of Neolithic Populations from the Southern Great Plain of Hungary

An Insight into the Potential of Macroscopic Observations for the Demographic and Pathological Analyses of Past Populations

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Ph.D. Thesis

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Summary

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INTRODUCTION

Archaeological Background

The debate on the origins of agriculture among archaeologists has been ongoing "for most of the discipline's history" (Barker 2006:382). In Europe, two main possibilities have been considered: the movement of people originally from the Levant bringing a new culture with them, or the adoption of this culture and way of life by indigenous Mesolithic populations following contact with these early agrarian societies (also referred to as the diffusionist vs indigenist model by Makkay 1996; or as the colonisation vs acculturation hypothesis by Whittle 1996). In Hungary, the halt in the first wave of neolithisation with the Körös Culture in the Carpathian basin for several centuries before its spread north- and westwards, together with the recent Mesolithic archaeological evidence from this area has led to the conclusion that the local indigenous populations had resisted the adoption of this new culture (Kertész 1996; Makkay 1996; Kertész & Sümegi 2001). It is unknown if the uncovered sites were occupied occasionally or on a permanent basis. The Körös Culture marked the arrival of the first domestic animals in the Carpathian basin, mostly with sheep and goat although cattle and pig also played a smaller role. These were parts of a complex economy involving cereal cultivation, animal husbandry, fishing, hunting and gathering (Paluch & Tóth 2005, Bonsall *et al.* 2007). Insistence on concentrating their livestock on sheep and goats of southeastern origins not well suited to the local climate has been highlighted as probable evidence that this population had newly immigrated to the area (Bartosiewicz 2005). Körös individuals were buried in simple individual graves on the edges of settlements (Whittle 2003).

It is thought that after the colonisation of the Southern Great Plain by the Körös population in the Early Neolithic, indigenous Mesolithic hunter-gatherer groups adopted this new way of life in the Middle Neolithic as demonstrated by the Alföld Linear Pottery (AVK) Culture (Paluch & Tóth 2005). A complex system of tell settlements and smaller farmsteads followed with the Tisza Culture of the Late Neolithic (Kalicz & Raczky 1987). In complete opposition to the Körös Culture, the Tisza population utilised their local resources with an intensive exploitation of wild animals, such as the large aurochs, reflecting the "culturally different attitude to animals and the wild in general" (Bartosiewicz 2005:61). Tisza individuals were buried within the settlement, and could be found between or under houses (Whittle 2003).

The tell-settlement of Hódmezővásárhely-Gorzsa spread over five hectares and accumulated a 180-200cm thick occupation layer during the Tisza Culture topped by subsequent strata from the following periods of occupation up to the Middle Ages. The site included a large, burnt, six-room house, the largest building from this period in Hungary. Tisza burials at this site were reported as small family grave groups in temporarily unoccupied parts of the settlements (Horváth 2005), with an earlier publication mentioning serological analyses indicating that these represented "four successive generations of one genetic unit" (Horváth 1987). An extensive range of contacts with surrounding cultures was observed in the lithic raw materials and the use of flax in textiles, while a rudimentary form of writing was also noted on finds (Horváth 2005). The nearby site of Hódmezővásárhely-Kökénydomb was a less densely inhabited "tell-like settlement within a single-layer settlement" (Kalicz & Raczky 1987). Horváth (2005) described the shift to a pastoral economy as the cause for the disintegration of these large villages during the subsequent Copper Age with a "breakdown of the earlier socio-economic system" which may have otherwise led to urbanisation as seen in the Near East.

Anthropological Background

Since the 1980s, distance analyses have been utilised to find anthropological evidence of the transition from hunting-gathering to farming, particularly trying to establish if colonisation or acculturation had taken place. In a pan-European analysis of 286 Mesolithic individuals (including 62 from the Iron Gates on the Danube River between Romania and Serbia) and 280 Early and Middle Neolithic individuals (twenty from the Iron Gates), a decrease in robusticity with the first farmers was established, together with the cohabitation of two distinctive morphological types in the Mesolithic-Neolithic transition (Menk & Nemeskéri 1989). This was understood to prove the coexistence of local and newly arrived populations for an extended period, with the Neolithic populations eventually (and only progressively) replacing the original Mesolithic locals.

Such gracilisation was also demonstrated in Early and Middle Neolithic Hungary in a similar study (Zoffmann 1994), albeit on populations from the Neolithic onwards only as Mesolithic skeletal remains have yet to be uncovered in this area. Results of this and several other Penrose distance analyses showed continuity in the indigenous populations of the Carpathian Basin throughout Prehistory (Zoffmann 1980, 1984, 1992, 2000). The most recent analyses indicated that the Early Neolithic Körös populations originated from the South and the South-East, which would support the theory that early farmers had colonised the area, while the AVK Middle Neolithic populations of the Northern Great Plain had stronger links with North-Eastern Europe, which would confirm the later adoption of a Neolithic way of life by indigenous late hunter-gatherers (Zoffmann 2005). The Late Neolithic Tisza population appeared to be strongly linked genetically to the AVK Middle Neolithic population, although also introducing a new anthropological variant with a broader face not seen in the region previously.

RESEARCH AIMS AND OBJECTIVES

This research aimed to provide a unique contribution to our knowledge of the First Farmers of Europe in general and the Neolithic populations from the Southern Great Plain of Hungary in particular, while demonstrating the potential of macroscopic observations for the demographic and pathological analyses of past populations.

After decades of new and continually improving technology, macroscopic analyses of human bones often take a back seat, losing priority over more specialised scientific and mostly microscopic techniques. Nevertheless, a great deal of information may still be obtained in this manner. The main objective of this thesis was therefore to validate the potential of macromorphological analyses, even in worst-case scenarios reminiscent of this sample with ancient and severely fragmented or damaged remains lacking any contextual data, by providing crucial new palaeodemographic and palaeopathological information to help further our understanding of the First Farmers of Europe and more specifically of the Early and Late Neolithic Populations of the Southern Great Plain of Hungary.

The first part of this research focussed on establishing the palaeodemographic characteristics of these populations, including age, sex and growth/stature. In particular, methods available for macroscopic demographic analyses were reviewed extensively to establish their suitability for

the study of such archaeological remains, and to ensure that as much accurate information as possible could be retrieved from such material. The most appropriate methods were then utilised on this Neolithic sample, providing a comparison of results based on different methodologies when applicable.

The second part of the thesis presented the palaeopathological analysis of the individuals identified in part one together with the significance of the results for the palaeopathological record, demonstrating that even the most fragmentary remains could offer a considerable amount of information when analysed thoroughly and systematically. These boxes of damaged fragments and incomplete bones could provide us with a better understanding of Neolithic populations, proving the potential of macromorphological studies at least as a first major step before undertaking complementary or more refined analyses, while providing new evidence of the transition to farming and the impact of the adoption of agriculture on Central European populations.

MATERIALS

A sample of 100 individuals from the Southern Great Plain of Hungary close to the Romanian Border was gathered for macroscopic analysis, mostly from the small geographical area between Szeged and Hódmezővásárhely, with a few individuals close to Békés slightly further North-East. This osteological sample, comprising all the remains currently available from this region, was unique in size for such a small geographical area in such a remote period, and at a time of particular archaeological and anthropological importance. The Early Neolithic sample comprised of twelve individuals from the Körös culture (5950 to 5400 BC), ten of whom were represented by their skull only. The Late Neolithic sample included 86 individuals of the Tisza Culture (4970 to 4410 BC), with most of the remains excavated from the tell settlement of Hódmezővásárhely-Gorzsa (4970 to 4594 BC).

METHODS

Current macroscopic methods for osteological analysis were critically reviewed, and several methods for ageing, sexing and stature estimation were compared.

Juveniles

Gustafson and Koch's (1974) diagram was particularly useful for macroscopic dental age estimation of ancient and fragmentary remains. Ubelaker (1978) and Schour & Massler (1941) charts, MFH (Moorrees *et al.* 1963)/Smith (1991) stages, and Gustafson and Koch diagram all produced concurring dental age estimates.

Black, Scheuer and Schaefer's work (Schafer *et al.* 2009) was demonstrated to be the most up-to-date source of skeletal developmental age estimates for juveniles at present, with the added research of Fazekas and Kósa (1978) for fetuses and neonates. Rissech and Black's (2007) scapular functions were unsuccessful in this population. As age estimates based on diaphyseal

lengths suffered from the effect of population variability, population-specific data should always be preferred. However, for ancient archaeological remains with no other suitable baseline sample, the ranges of measurements provided by Stloukal and Hanáková (1978) from their historic sample were found to be the most appropriate to use as a guideline for age estimates.

Juvenile sexing estimates were deemed unsuccessful in this study based on the wide variation of their results. However, morphological sexing traits were easy to record, including chin protrusion, shape of the anterior dental arcade, gonial eversion and ramus angle for the skull (Schutkowski 1993; Loth & Henneberg 2001), as well as angle and depth of the greater sciatic notch, arch criterion, iliac crest curvature, and auricular elevation for the pelvis (Weaver 1980; Schutkowski 1993). It would therefore remain useful to note these traits in the hope that further research on documented samples will help refine these methods to eventually afford sexing of juvenile remains. The combined facial score method (Molleson *et al.* 1998) and Mays' (1998) plotting method were also found to offer great potential for archaeological remains, although they could not be applied to this particular sample due to the limited number of juveniles and the lack of undamaged orbits.

The best method to estimate fetal stature available remained Fazekas and Kósa's (1978) formulae based on various bone dimensions, while Visser's (1998) calculations utilising diaphyseal lengths were found to be particularly useful for postnatal juvenile stature estimates of archaeological remains. Percentage of attained growth could also be utilised for comparison with other populations, as long as the same methodologies were used on all samples.

Adults

Skeletal and dental development as described above could be utilised to estimate the age of adult remains before full maturation. Once the individuals were fully mature, broad age-ranges were presented instead of merely giving the mean estimate, utilising as many age indicators as could possibly be observed. These age classes should also always be specified and no assumption made on the age ranges covered when those were not detailed. Although these age categories limited severely any analysis of the demography and health status of past populations, even the broad definition of infant, child, adolescent, young adult and mature or old adult could provide essential information on the life and death of those former communities. Dental wear based on Smith (1984) and Brothwell (1963, 1968, 1989) methods was shown to have significant potential in ageing adults in such ancient populations within broad age categories while cranial sutures and ribs were demonstrated not to be suitable age indicators for the macroscopic analyses of such ancient archaeological remains.

Adult sex estimation based on commonly used morphological traits of the skull (including the nuchal crest, mastoid process, supra-orbital margin, glabella, and mental eminence) and the pelvis (greater sciatic notch, pre-auricular sulcus, overall pelvis shape, and shape of the pubis) was shown to benefit from the addition of the mandibular ramus flexure trait (Loth & Henneberg 1996), while Bruzek's (2002) pelvic traits and those from the distal humerus (Falys *et al.* 2005) did not prove useful. Osteometric analyses also yielded valuable additional information, including foot and hand bones dimensions which provided a useful alternative solution for sex estimation of ancient remains. As population-specific baselines were shown to be essential due to population variability, a baseline dataset was created for this Tisza

population based on the author's analysis.

Anatomical statures (ideally from length *in situ* in the grave or if not available utilising an anatomical method such as Fully's technique) remained the most appropriate source of stature estimates in archaeological populations. However, for damaged and incomplete "bones in a box" as in this Neolithic sample, Sjøvold's (1990) weighted lines of correlation offered the best system currently available to estimate maximum adult height of archaeological populations from their long bone lengths, utilising the average of all estimations available.

RESULTS

The results of the demographic analysis indicated that the Early Neolithic sample included five female and seven male adults, without any juveniles. The Late Neolithic population was represented by a third of juveniles, 23 males and 31 females, nearly all the females coming from the site of Gorzsa. Stature estimations based on a third of the adults indicated an average height of 167 cm for males and 154 cm for females.

Ten juveniles showed signs of pathology, including two cases of scurvy, four cases of infection, and six presenting non-specific stress indicators. Pathological analyses of the adult population revealed that mechanical changes (osteoarthritis, degenerative bony changes and musculoskeletal stress markers) were common in old adults and also in young females. Eleven individuals showed non-specific stress indicators. Evidence of trauma was found in eleven individuals, presenting mainly as well-healed fractures and one case of spondylolysis. Ten individuals displayed signs of infection, including mastoiditis, chronic rhinitis, sacroiliitis, and four possible cases of meningitis of unknown aetiology. One case of tuberculosis with secondary hypertrophic pulmonary osteopathy and four further cases of tuberculosis were also confirmed. In addition, a potential case of leprosy and one of cancer were also discovered. Finally, dental disease including caries, calculus and tooth loss was widespread.

DISCUSSION

The potential of macroscopic analysis

The skeletal remains of the populations under study were damaged and very fragmented, lacking contextual data, and their analyses restricted to macromorphological observations. Despite these severe limitations, remarkable information on the health status of these early farmers were revealed thanks to a very careful and painstakingly time-consuming macroscopic pathological analysis. Cases of particular interest could then be referred to specialists for further analyses in an attempt to confirm macromorphological diagnosis while limiting costs as well as sample destruction to the bare minimum. For example, the detailed macromorphological analysis of the thousands of bone fragments of HGO-53 led to the diagnosis of a case HPO secondary to tuberculosis (Masson *et al.* 2013), which in turn helped to identify four other probable cases in the same sample. The five tuberculosis cases were then confirmed by microbiological analyses, providing evidence of the presence of this infection in Europe seven

millennia ago. Without the initial macroscopic study of these thousands of fragments, this major discovery would not have taken place.

Early Farmers of Europe

One year before the start of this doctoral research, the author's dissertation based on the published osteological evidence available at the time had to conclude that the health status of European populations was not radically changed by the transition to farming, with a steady evolution and progressive transformation from hunting-gathering to farming. Violence seemed to be present both in the Mesolithic and the Neolithic, and at that time there were no signs of diseases linked to agriculture and domestication such as tuberculosis with the first farmers of Europe (Masson 2002). However, the osteological evidence presented in this thesis has greatly improved our knowledge, both specifically for the Neolithic populations of the Southern Great Plain of Hungary, but also for the Early Farmers of Europe in general.

Origins

No Mesolithic human remains were available in Hungary and a direct comparison with preceding hunting-gathering populations could therefore not be undertaken. The gracility of the skeletal remains would appear compatible with a reported loss of robusticity between the Mesolithic and the Neolithic, attributed to the arrival of a new population (Menk & Nemeskéri 1989). Osteometric sexual dimorphism in this small geographical study area seemed to remain the same throughout the Neolithic with little change in robusticity compared to the following two periods of prehistory, although cranial morphometrics appeared to show some differences between the Early and Late Neolithic. This would agree with the results of Zoffmann's distance analyses mostly concentrating on the taxonomy of Hungarian ancient populations, and which reported a continuity overall with a new type added during the Late Neolithic (Zoffmann 2000, 2005). It would also agree with the evidence based on Neolithic faunal remains (Bartosiewicz 2005), and the excavations of Mesolithic and Early Neolithic sites in the region (Kertész 1996; Makkay 1996; Kertész & Sümegi 2001; Sümegi *et al.* 2003), with the neolithisation of former Mesolithic indigenous groups and the slow assimilation of both populations. Differences in mean male stature between different sites of the same period also demonstrated that intra-population variations were present within contemporary populations.

Health status

Growth in the Tisza population demonstrated the same prolonged growth compared to modern populations as historic samples, although the Late Neolithic growth rate was closer to contemporary populations than historic populations. The calculated average height of nearly 168cm for males and slightly above 153 cm for females living at the heart of the Carpathian Basin during the Neolithic was only slightly shorter than that of their modern Hungarian counterparts. Comparison with other prehistoric and historic samples worldwide also showed little difference between those geographically and chronologically distant populations. There was also very little incidence of enamel hypoplasia among these individuals, particularly in adult remains. The adoption of farming did not seem to have had a negative impact on these indicators of health.

However, the rate of dental disease in these populations was very high and similar to other published Neolithic individuals from Hungary, illustrating the negative impact of their diet on their oral health. Metabolic diseases also seemed to be present, with several probable cases of scurvy noted on juveniles, denoting a severe lack of vitamin C in the diet of these farmers, on some occasions at least.

While the rates of accidental trauma and of infection reported for Northeastern Hungary were low (Ubelaker *et al.* 2006), the analyses of this substantial sample from a small geographical area in Southeastern Hungary revealed a high rate of accidental trauma and mechanical changes, indicating that the way of life of these Early Farmers was physically very stressful. The incidence of infections in the Tisza population was also very high, with a fifth of the population affected, including adults and juveniles. Most importantly, five cases of tuberculosis were confirmed following the author's initial macromorphological diagnosis, and more possible cases have been highlighted. As detailed in the introduction, the Tisza Culture had a complex socio-economic system, centred on densely occupied tell-settlements with smaller farmsteads in the vicinity. In particular, the site of Gorzsa, from where all five cases of tuberculosis were recovered, also produced the largest Neolithic house in the country with six separate rooms. Such changes in settlement system may have precipitated the rise of infection, and would certainly have facilitated the spread of infections among these Early Farmers.

Violence

Interestingly, there were little signs of inter-personal violence in this relatively large sample of one hundred Neolithic individuals from South-eastern Hungary, in contradiction with findings from the same period reported in the North-eastern part of the country (Ubelaker *et al.* 2006), and more generally across Europe (Guilaine & Zammit 2005). This could be linked to sample bias, with individuals having suffered (and particularly died from) violence not necessarily buried in the same place as the rest of the community (Smith & Brickley 2009), as well as the fragmented and incomplete nature of the remains. Nevertheless, the osteological evidence of this population would agree with the theory that violence during the Neolithic may not have been common (Barker 2006).

AREAS FOR FUTURE RESEARCH

Further microscopic, histological and biomolecular analyses will be undertaken to confirm the additional possible cases of tuberculosis, the probable scurvy cases, the unique case of possible leprosy and that of potential cancer.

Contextual data for the site of Gorzsa would be of crucial importance. A plan of the burials would allow for more advanced palaeoepidemiologic studies to try establishing the chronological occurrences of these contagious infections, as well as their effect on burial practices. Numerous anomalies and anatomical variations already recorded during this doctoral research could also be used to assess potential connections between individuals.

Radiocarbon dating of the pathological skeletal remains would also be invaluable, while isotopic analyses could also provide key information to accompany the pathological results.

More skeletal remains from the Körös Culture would greatly improve the comparison of Early and Late Neolithic populations of the Southern Great Plain of Hungary, and it is still hoped that Mesolithic human remains will one day be recovered. The investigations of additional Tisza individuals from other sites yet to be uncovered would also provide a helpful comparison for the findings of this thesis and increase the data available for further statistical studies.

CONCLUSION

This doctoral research provides a unique contribution to our knowledge of the Early Farmers of Europe in general and the Neolithic populations from the Southern Great Plain of Hungary in particular. The potential of macroscopic observations for the demographic and pathological analyses of past populations was demonstrated on this exceptional Neolithic sample, revealing despite the lack of contextual data, the damaged and fragmentary skeletal remains, and the restriction to morphological analyses, a mostly non-violent population prone to infections, with a physically stressful way of life and a diet leading to a high rate of dental disease and (at least occasionally) lack of vitamin C. In particular, the palaeopathological analysis uncovered the oldest cases of tuberculosis in Europe so far, as well as the probable oldest cases of scurvy. In addition, a potential case of leprosy and one of cancer were also discovered, which would be of great significance for the palaeopathological record if these can be confirmed by further studies.

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