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**COMPARATIVE BIOLOGICAL ANTHROPOLOGICAL ANALYSIS OF NON-  
ADULTS FROM HISTORICAL POPULATIONS**

SUMMARY OF THE PHD THESIS

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SZEGED  
2018

## **INTRODUCTION**

The process of biological adaptation to a certain environment can be studied by human remains both from a socio-cultural and a biological perspective. From a biological point of view, the skeletal remains of non-adults similarly to adult remains are suitable for acquiring such data which, if they are interpreted in depth, can provide a more complete picture of past lives (Halcrow and Tayles, 2011). To recognize this, significant changes were needed in the approaches of different fields of social and natural sciences during the last decades, while at the same time the role of children in physical anthropological researches also emerged (Lewis, 2007). The study of children and childhood can provide a very important basis to a complex analysis of human populations, which can be approached from two different directions: the child as a social being, his/her role in a certain society; and the child as a biological identity, who reacts to the effects of the surrounding environment on a physical level.

## **AIMS AND OBJECTIVES**

The analysis of non-adult skeletal remains within Hungarian anthropological studies has also been neglected for a long time mainly because of their underrepresentation in the cemeteries. The remains of children have not been involved in any other studies than the description of pathological cases or demographical analyses. This dissertation is the first which would like to attempt to interpret data of children from the Carpathian Basin in order to draw conclusions regarding the life quality of past populations.

My aims and objectives are the following:

1. From the in depth analyses of the mortality pattern of children and pathological lesions connected to metabolic and infectious diseases, I attempted to make conclusions regarding how children with developing immune systems and higher nutritional needs reacted to the changes of stress factors (eg. the amount and quality of food, sociological and economical changes) in three historical periods.
2. I estimated the extent of the effect of stress factors on different populations with the help of the morphological characteristics and frequency data of their

pathological indicators (porotic hyperostosis, subperiosteal new bone formation and endocranial lesion).

3. I tried to detect and interpret the effect of economical and environmental changes of certain historical periods with the comparison of the examined populations.

## **MATERIALS AND METHODS**

The examined time scale involves the Avar Age (7<sup>th</sup>-8<sup>th</sup> c.), the Arpadian Age (12<sup>th</sup>-14<sup>th</sup> c.) and the Late Medieval Period (14<sup>th</sup>-16<sup>th</sup> c.). The three periods are characterized by different historical and environmental processes; therefore it can be suspected that the examined population met with different types of challenges on various levels.

The population dynamics processes during the formation of the Avar Empire were accompanied by significant cultural and lifestyle changes, which changes could appear also in the customs of child rearing and in the society's view of the role of children. Among others, the survey of the pathological lesions was also important in order to detect the effects due to these changes in the life circumstances.

This period is represented by the Kölked-Feketekapu Avar Age site. The excavation was conducted in two different areas and on the "A" site 681 graves had been found between 1970-71.

The burials can be dated from the last decade of the 6<sup>th</sup> century to the mid-8<sup>th</sup> century. The particular significance of the cemetery is that according to the archaeological material the presence and survival of Germanic tribes can be suggested until the beginning of the Avar Period, which later gradually assimilated into the nearer and wider environment of the settlement (Kiss, 1988). During the anthropological analysis, moderately preserved skeletal remains of 466 individuals could be identified, from which 150 were infants.

The Arpadian Age was also characterized by important changes, since this is the time when the Hungarians converted to Christianity, while the settling and resettling of populations also happened during this period. From this era, I have examined the cemetery around the church of the 12<sup>th</sup>-13<sup>th</sup> century Kána village which had been excavated prior to the construction works of the Kőérberék-Tóváros housing estate from 2003 to 2005. Not only the cemetery but also the village belonging to it was almost entirely excavated. According to the archaeological material, the Kána population was a relatively wealthy agriculturalist society (Terei, 2006; Daróczi-Szabó, 2013). The depopulation of the village had started most

probably due to the growing area of vineyards. The anthropological analysis started straight after the excavations in 2005, when I recorded the basic data of the skeletons (sex, age and metrical data). The analysis could identify the moderately preserved skeletons of 1044 individuals from the 1077 graves. The number of non-adults is 274 individuals. I had previously conducted pathological analysis on the children of the first phase of the cemetery (László, 2008), which database has been extended with new data by this present study. The previous research was based on the two phases in the cemetery structure, which allowed me to make a comparative growth study between the two areas. I also included in the analysis another contemporary cemetery (Zsámbék, Norbertine monastery and church; Hajdu, 2006), and one belonging to the Turkish period (Fonyód-Bézsénypuszta; Bernert and Évinger, 2006). According to the growth analysis, children in the Late Medieval Period were probably under larger stress effects, which caused retardation in the growth of the long bones in their first 10 years (László, 2012).

Both for archaeology and anthropology, one of the youngest research fields are the Late Medieval and the Turkish Periods, which will provide several new possibilities in the future for us. The population movements, the changes in economical, political and sociological circumstances probably meant a significant psychological and physical pressure on both the local and the immigrant populations. The everyday presence of interpersonal conflicts can also be detected in several of the skeletal materials, which do not only refer to certain major military events but also point out local minor fights (László et al., 2015). The cemetery around the church of Paks-Cseresznyés can be dated to this period as well, excavated between April of 2008 and 2009. According to the buildings and to the archaeological material of the village it can be dated to the 14<sup>th</sup>-16<sup>th</sup> centuries, which probably became deserted due to the expansion of the Ottoman Empire. I conducted the anthropological analysis between 2009 and 2010, during which I could examine a very well preserved material of 504 individuals from the excavated graves. Among these, 263 were infants.

I estimated the extent of stress effects on the different populations with the mortality pattern and the pathological analysis of stress indicators. These stress indicators belong to the categories of metabolic and infectious diseases, namely porotic hyperostosis, subperiosteal new bone formations and endocranial lesions. I analysed the pathological lesions with macroscopical morphological (occasionally by radiological analysis) methods. To compare frequencies of the various lesions I have used the  $\chi^2$  test, considering the varying states of

preservation in the series. In this dissertation, among others, it was also an aim not only to give the crude prevalence of the affected individuals with subperiosteal new bone formations according to the total number of examined individuals but also to calculate the ratio both of the affected bone elements and the diaphyseal segments with bone appositions. We could calculate the true prevalence of affected bones and diaphyseal segments in this way. By this approach the extent and severity of subperiosteal lesions could be examined more accurately which gave an opportunity to signify the frequency of mild and more severe forms of pathological lesions within a sample.

## **RESULTS**

### **Mortality**

The Kána sample showed the lowest child mortality rate (26%). The ratio of non-adults was average in the Avar Kőlked “A” cemetery (32%). The highest mortality rate appeared in the early childhood but mortality started to decline significantly in later years, contrary to the two other samples. The reasons for a higher death rate in the early years could be the negative effects of the weaning period, which could be combined with a weaker immune system leading to lower resistance to infectious diseases.

The most disadvantageous mortality rate could be experienced in the Late Medieval Paks-Cseresznyés sample, which was indicated by an outstanding 52% rate. In this cemetery, the mortality of children did not decline even after the sixth year.

### **Non-specific stress indicators**

The endocranial lesions showed lower frequency in the Paks series, contrary to the other two, and the subperiosteal lesions were also represented by milder forms. These suggest that diseases leading to such alterations were briefer and probably because of the low resistance of the deceased the symptoms were less severe. Regarding porotic hyperostosis, Paks cemetery was the most affected sample. Nevertheless, scurvy was also present in the Kána sample, which suggests a significant physiological load. This probably can be traced back rather to seasonal negative effects, since according to the archaeological context long-lasting distressed periods could not be presumed.

In terms of age distribution both differences and similarities can be ascertained among the populations from the three historical periods. The frequency of cribra orbitalia and endocranial lesions was the highest between 2–6.5 years. However, in the case of Paks and Kölked, the frequency of cribra orbitalia increased with age. The proportion of endocranial lesions declines with age at Kölked similarly to Kána; while in the case of Paks major differences between age groups could not be detected. The Arpadian Kána village represents probably a more balanced population with a lower mortality of children (26%); however, I experienced the highest frequency of lesions with non-specific infectious origin in this sample. Besides their high rate, severe forms of the lesions were more frequent. It can be concluded that the children with severe lesions had better immune systems; therefore, they lived much longer with the disease to develop pronounced and frequent bone alterations. These observations essentially testify to the so-called osteological paradox; that is, bony reactions of diseases can determine a strong immune system. The adequate immune response can allow the individual to live longer and thus be able to fight with the pathogen to survive the first phase of an infectious process, which eventually leads to traces on the bone as well (Wood et al., 1992).

It can be also detected that the effect of negative extrinsic factors had come up in late childhood, which was indicated by the dominance of the co-occurrence of metabolic and infectious non-specific bone lesions. The higher frequency of periostitis was most characteristic at the end of childhood in all three of the cemeteries; further, the severer forms were also more frequent in the older age groups.

The most outstanding characteristics in these populations were that children with bony signs of non-specific infections amounted to a higher number within the Kána group; and also the frequency of the more severe and extensive bone appositions were higher than in the two other series. These results and the absence of other metabolic stress indicators suggest that the variance can be due to differences in the environment and lifestyle and/or contraction with different pathogens. This latter is supported by the more dominant presence of tuberculous lesions with also its very severe forms in the Kána sample, which suggests the slower, chronic process of the disease. The relative low frequency of endocranial lesions in the Paks population also implies the presence of pathogen(s) that caused rapid and severe infections leading to high mortality rates.

## DISCUSSION AND FUTURE PROSPECTS

In summary, during the accomplishment of the tasks referred to in the aims and objectives above I reached the following conclusions:

1. Differences in life circumstances and in the nature of diseases in the three populations can be suggested based on the varying of mortality patterns and frequencies of non-specific stress indicators.
2. The extent of stress effect could be estimated, which testified also to the osteological paradox, which is:
  - 2.1 The more severe forms of subperiosteal new bone formations were higher in number among the older children who had more developed immune systems.
  - 2.2 Contrary to the higher child mortality in Kána, the lesions of non-specific infections were more severe and higher than in Paks, where the mortality rate of children was extremely high.
  - 2.3 The frequency values of the non-specific indicators of infections on their own did not demonstrate the nature and severity of the lesions; thus, they did not imply the level of stress in the populations either.
  - 2.4 Nonetheless, the interpretation of frequency values with the morphological characters of the new bone formations, allowed one to infer the nature of the disease processes; namely, one can conclude the dominance of chronic or acute conditions.
  - 2.5 Therefore the differences of the manifestations of non-specific infectious lesions illustrated the varying resistance of children in the three populations.
3. The economical, environmental and historical effects of certain periods could be demonstrated and interpreted to a certain extent:
  - 3.1 Based on the mortality data, at the Avar Kólked site, apart from the high mortality rate at an early age, other significant stress factors cannot be discerned in comparison to the other two populations. The variation perhaps can be sought in the different customs of child rearing; however, this proposition could not be answered based on the methods employed in the doctoral thesis.

- 3.2 Judging by the mortality rates and the above mentioned pathological characteristics of the children of Kána, the Arpadian Age can be regarded as a more balanced period.
- 3.3 At the same time, by observing the symptoms of the lack of vitamin C, it could also be determined that temporary effects can also be observed within a population despite the generally good living circumstances.
- 3.4 The results of the Late Medieval child remains from Paks reflect perfectly well the difficult living circumstances defined by the negative social and political relations characteristic of the age, which may have resulted in the lower resistance of children.

The future analysis of child remains holds in itself the potential for various further studies. Apart from the pathological lesions discussed in this study, the more in depth analysis of teeth and traumatic lesions can carry additional possibilities as well. The early stage/atypical tuberculous lesions in the series can also be examined further, which can later be supplemented by molecular studies. Extending the molecular analyses to the child remains of other cemeteries of the period may present data on the origins of the infectious agents, as well as the background for the various manifestations of tuberculosis. Following the methodology applied with children, the research can also be extended to the analysis of adult remains.

The complex and reliable interpretation of Hungarian anthropological and archaeological research results can only be obtained if accompanied by regional studies. Since, throughout the country in various historical periods, differences can be discerned between territories due to the varying usage of space, which set off different regional processes. These can reveal themselves in the various lifestyles of populations, or even their ethnic structures. With this study, I wanted to present how the living circumstances and environmental challenges characterizing a population can be examined through children as well; thus, the analysis of the remains of children can be the perfect basis for comparison in future bioarchaeological research.



## PAPERS PROVIDING THE BASIS FOR THE THESIS

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