

**“Interdyscyplinarne studium porównawcze zwyczajów funeralnych  
ludności kultury pomorskiej, oksywskiej i przeworskiej”**

**Abstract**

In the last centuries BC, significant social and economic transformations occurred across vast areas of Central Europe, including the territories of present-day Poland. The factors that triggered these changes remain unclear, but it is widely believed that they were influenced by the spread of new technologies, innovations and traditions of La Tène culture societies, facilitated by increasingly active trade routes.

These events resulted in cultural transitions. By the end of the 3rd century BC, new groups associated with the Oksywie and Przeworsk cultures emerged in place of the former settlements of Pomeranian culture societies. These new communities differed from their predecessors not only in settlement and economic strategies, but possibly also in their beliefs, as evidenced by substantial differences observed in funerary practices. While cremation of the dead was continued, noticeable changes appeared in the forms of graves and in grave goods, which have received considerable attention in the archaeological literature. Significantly less attention has been paid to the mortuary behaviors that preceded the burial of the deceased.

The aim of the research was to determine whether the changes in funerary rites that took place in the 3rd century BC were limited solely to burial practices, or whether they also encompassed customs preceding the deposition of burned human remains in graves. A comparative analysis was performed for three stages of the funeral ceremony: 1) pre-cremation practices, 2) cremation practices, and 3) post-cremation practices. The study also aimed to identify diagenetic processes potentially occurring in human bones subjected to high temperatures, that could alter the osteological evidence of mortuary customs.

Additionally, the goal of the research was to assess whether the cultural transformations might have been driven by people migrations. This issue has been widely debated, with many archaeologists emphasizing the significant influence of La Tène and/or Jastorf people on local communities, which gradually adopted specific traditions, including funeral practices. The study specifically aimed to investigate whether the early phases of the younger Pre-Roman Period – coinciding with the emergence of groups associated with the Oksywie and Przeworsk cultures – experienced intensified migrations that could have triggered these cultural shifts.

The research was carried out on burned human remains from nine archaeological sites: Czarnówko 5 (Lębork County), Miłoszewo 1 (Wejherowo County), Sychowo 2 (Wejherowo County), Władysławowo-Chłapowo 32 (Puck County), Podwiesk 2 (Chełmno County), Pruszcz Gdański 10 (Gdańsk County), Piotrków Kujawski 1 (Radziejów County), Świerkówiec 1 (Mogilno County), and Zadowice 1 (Kalisz County). In most cases, the sites were excavated in the 20<sup>th</sup> century, and the uncovered osteological materials were archived in museums. The study on diagenetic history of heated bones was conducted on the mechanically undisturbed infills of urns from Czarnówko and Miłoszewo, both on the burned bones and the soil/sediments filling the vessels.

The burned remains were subjected to osteological analysis, focusing on: 1) biological profiling, including the minimum number of individuals (MNI), sex, and age-at-death estimation; 2) the estimation of skeletal completeness by comparing the total mass of the burned bones with the minimal reference mass obtained from modern cremations, followed by the application of the linear regression method proposed by Gonçalves et al. (2016; 2018a); 3) the assessment of skeletal representation using the linear regression method proposed by Gonçalves et al. (2015); and 4) the determination of the degree of bone fragmentation.

Moreover, the analysis included the identification of heat-induced changes in the bones. The burned bones were categorized into three color groups, which typically reflect the efficacy of the cremation process. The proportion of each group relative to the total skeletal mass was recorded. Thermal changes in the bones were further evaluated using Fourier Transform Infrared Spectroscopy (FTIR) with Attenuated Total Reflectance (ATR). To determine whether there were differences in cremation intensity among the studied communities, three chemometric indices – CI, C/C, and OH/P – were tested. To exclude the possibility that the observed differences were caused by factors other than cremation intensity, theoretical expected variation (TEV%) was calculated for each indicator within the studied groups (cultures). The analysis also included observations of biomechanical fractures and bone warping.

Additionally, selected burned human remains from Oksywie and Przeworsk culture communities were subjected to strontium isotope ( $^{87}\text{Sr}/^{86}\text{Sr}$ ) analysis. Depending on the chronology of the burial site, samples were primarily taken from remains found in graves dated to phase A1 or phase A2 of the Pre-Roman Period. Efforts were made to collect two samples from the burned remains for analysis: 1) a pyramid and, 2) a fragment of a long bone diaphysis.

The mechanically intact urns were excavated in 2 cm layers. The recovered burned bones were subjected to osteological analysis described above, whereas the loose sediment samples were analyzed for their physico-chemical properties, including: organic carbon content, total nitrogen content, pH, exchangeable base cation content (Ca, P, Mg, K) and, heavy metal content (Zn, Pb, Cu, Mn).

The research demonstrated that a minimum of 211 individuals were buried in the 199 studied graves belonging to the Pomeranian, Oksywie, and Przeworsk culture communities. Most of them died in adulthood. The sex was estimated for only 18 adult individuals, while for another 60, only single sexually dimorphic features were identified.

No differences were observed in pre-cremation practices among the studied communities. Cremation was likely their 'primary rite', as evidenced by thumbnail fractures and warping of bones, as well as the presence of bones from all regions of the skeleton, particularly the short bones with labile joints, found in most of the studied material. This is further supported by the presence of clothing elements, bearing traces of fire patina and/or melting. However, the exact time between the individual's death and cremation remains undetermined.

Although pre-cremation practices were possibly consistent across the studied communities, the cremation traditions exhibited clear distinctions. While all likely aimed to reduce the body to 'ashes', variations in bone color suggest different cremation techniques. The remains from the Pomeranian and Oksywian cultures were typically burned heterogeneously – the former often exhibiting charring on the skull and lower limbs, while the latter were incompletely calcined on the femur, tibia, and foot bones. In contrast, the Przeworsk culture remains showed consistent and complete oxidation.

The FTIR analysis revealed further differences in burning intensity between the studied communities. No statistically significant difference was found between the Pomeranian and Oksywian cultures in infrared spectra. However, differences were observed between Oksywian and Przeworsk cultures, though these were not fully explained by the theoretical expected variation (TEV%). Significant statistical differences were found between Pomeranian and Przeworsk cultures, likely due to factors other than TEV%. Comparing the chemometric indices with FTIR data for bones burned under controlled conditions, showed that Przeworsk remains were likely burned at slightly higher temperatures than those of the Pomeranian culture. The average CI and OH/P values for Przeworsk were close to those of bones experimentally burned at 800-1000°C, while the Pomeranian bones averaged around 700°C. Standard deviations further indicate that the temperature range for Pomeranian bones was more varied than for Przeworsk remains. The Oksywian culture's average values also centered around 700°C, but were burned more homogeneously than the Pomeranian bones. The average C/C values for all three cultures were significantly higher than those of experimental bones, though discrepancies between the communities align with the previously observed trend.

Identifying the factors directly responsible for differences in burning intensity remains challenging. The temperatures reached during cremation are influenced by variables such as the quality of the wood (e.g., fresh or seasoned) and/or the method of tending the pyre. Additionally, differences in the duration of the combustion process and the position of the body on the pyre cannot be entirely ruled out as contributing factors.

Moreover, the study revealed that the majority of analyzed burned remains, regardless of cultural affiliation or grave preservation, were anatomically incomplete. Graves associated with the Przeworsk culture generally contained fewer bones compared to those of the Pomeranian and Oksywie cultures. This insufficient quantity of bones in cremation burials, compared to reference values, is a widely noticed phenomenon in the literature, irrespective of location or chronology. Five main explanations can be proposed for this observation: 1) only a portion of the cremated bones was selected from the pyre and placed in the grave, 2) the burned remains were divided among multiple burials, 3) a portion of the bones was retained by relatives, 4) some of the bones were deposited in non-burial contexts, 5) the burned remains underwent post-depositional degradation. It is not possible to determine which of these factors contributed to the incompleteness of remains observed in the graves of Pomeranian, Oksywie, and Przeworsk cultures societies.

Furthermore, the research showed that most graves contained bones from all four skeletal regions: skull, trunk, upper limbs, and lower limbs, though their proportions were often disrupted, even in intact graves. The frequent overrepresentation of skull fragments in nearly half of the graves likely reflects a more deliberate selection of this region, often at the expense of trunk and upper limb bones. This could be due to cultural practices emphasizing the symbolic importance of the head (skull) or practical factors, as cranial bones are more robust and usually easier to recover after cremation. However, methodological biases in identifying and recording bones might also explain this pattern.

The analysis also revealed that there are statistically significant differences among the Pomeranian, Oksywie, and Przeworsk culture communities in terms of bone fragmentation. However, it remains unclear whether these differences can be related to the deliberate crushing of bones – practices observed in some prehistoric communities – since their state of preservation may have been influenced by various factors, such as pyre management, burning intensity, deliberate bone selection, post-depositional processes, excavation methods, transport, storage, and analysis techniques. Given that the research was carried out on archived osteological materials, there was no possibility to separate primary from secondary fragmentation, and draw a definitive conclusion about past mortuary behaviors.

The study on mechanically intact urns showed that vessel 70/3 (covered with a partially broken lid) likely experienced episodes of wetting and drying. This is suggested by the elevated levels of manganese ions in its lower layers, as well as the increasing concentrations of calcium, phosphate, and magnesium ions deeper into the vessel. In contrast, such elemental distributions were not observed in the two remaining urns that were tightly sealed with lids, however were present in the urn that lacked a lid. Nevertheless, periodic water saturation likely had a limited impact on the macroscopic and physico-chemical composition of the burned bones present in the 70/3 urn, as the water flow must have been negligible, and the burial environment had only slightly acidic pH, which is insufficient to drastically alter the heat-induced bioapatite.

The strontium isotope ratios obtained for the selected individuals showed that over 34% of them (24 out of 70) were likely non-local. However, determining their place of origin was challenging, as many may have come from nearby regions. At the same time, the presence of certain grave goods suggests that some individuals may have migrated over long distances. The newcomers varied in biological sex and age at death, and undertook their journeys at different stages of life. Their graves were interspersed among those of local individuals and did not stand out, suggesting mutual respect and acceptance of possible cultural differences. Notably, a high proportion of non-locals was recorded for the A1 phase of the Younger Pre-Roman Period, supporting the hypothesis that the cultural transformation during the 3rd century BC might have been driven by people migration.

The dissertation significantly enhances the understanding of funerary practices of Pomeranian, Oksywie, and Przeworsk culture communities. The results demonstrate that changes in mortuary behaviors during the 3rd century BC were not limited to burial practices, but also involved cremation traditions, i.e. how the corpse was burned. Pre-cremation and post-cremation practices remained largely consistent throughout this period. Additionally, strontium ( $^{87}\text{Sr}/^{86}\text{Sr}$ ) isotope analysis suggests that intensified interregional contacts may have played a crucial role in accelerating cultural transformations during this time. Preliminary research on diagenetic processes affecting burned human remains indicates that the extent of chemical weathering primarily depends on moisture conditions within urn vessels. Nonetheless, more research is needed to better understand and refine these observations.