

GEOMETRIC VARIABILITY OF THE LUMBAR SPINE FROM MEDIEVAL TO MODERN TIMES

Marta Gratkowska¹, Marta Krenz-Niedbala¹ and Magdalena Koszewicz²

¹Adam Mickiewicz University, Faculty of Biology, Institute of Human Biology and Evolution, Poznan, Poland; ²Wroclaw Medical University, Clinic of Neurology, Wroclaw, Poland

Background: Low back pain is a global epidemic, affecting over 600 million people worldwide. The condition has been tentatively linked to reduced physical activity in modern sedentary societies, yet the morphological basis of this relationship remains underexplored.

Objective: This study compared the three-dimensional shape of the lumbar vertebrae in historical and contemporary populations to assess whether reduced biomechanical loads on the spine – associated with a decrease in physical activity over time, as commonly reported in the literature – resulted in morphological changes in this most loaded area of the spine.

Subjects and methods: The shape of the fourth lumbar vertebra (L4) of adult individuals was analysed using 3D geometric morphometrics. The contemporary sample (N=100) consists of anonymized CT scans from the Medical University of Wroclaw, Poland, and the historical sample (N=92) originates from a Polish medieval cemetery in Cedynia, dated between 10th to 14th centuries AD. Both cohorts were age-matched to control for age-related bone loss. Landmark-based shape analysis was performed using generalized Procrustes analysis and Principal Component Analysis in the geomorph R package.

Results: Preliminary results reveal significant morphological differences between the two populations. Marked sexual dimorphism is present in the medieval population, demonstrating greater variability in vertebral shape between male and female skeletons compared to the contemporary cohort. Medieval lumbar vertebrae exhibit shorter and less massive transverse processes, while their inferior articular processes are more defined than those of modern vertebrae. A reduced vertebral body diameter is clearly visible in contemporary individuals relative to their medieval counterparts, suggesting gracilization of the lumbar spine under reduced mechanical loading regimes.

Conclusions: The observed shape changes indicate functional adaptation of the lumbar spine to declining physical activity levels over centuries. These findings provide an evolutionary perspective on spinal morphology and may enhance our understanding of low back pain aetiology in modern populations.

Keywords: Lumbar spine; Geometric morphometrics; Low back pain.

Acknowledgement / Funding Source: Adam Mickiewicz University – ID-UB grant no. 190 for “Doctoral research and international training and workshops”.