

AT THE CROSSROADS OF CONTINENTS: ANCIENT DNA INSIGHTS INTO THE MATERNAL AND PATERNAL POPULATION HISTORY OF CROATIA

Jelena Sarac^{1,2}, Dubravka Havas Augustin¹, Natalija Novokmet¹, Dragan Primorac³⁻¹¹
and Damir Marjanovic^{1,2,12}

¹Institute for Anthropological Research, Centre for Applied Bioanthropology, 10 000 Zagreb, Croatia;

²University of Rijeka, Faculty of Biotechnology and Drug Development, Rijeka, Croatia; ³St. Catherine
Specialty Hospital, Croatia; ⁴Josip Juraj Strossmayer University, Faculty of Dental Medicine and Health,
Osijek, Croatia; ⁵Josip Juraj Strossmayer University of Osijek, School of Medicine, Osijek, Croatia;

⁶University of Split, Medical School, Split, Croatia; ⁷Pennsylvania State University, Department of
Biochemistry and Molecular Biology, PA, USA; ⁸University of New Haven, Henry C. Lee College of
Criminal Justice and Forensic Sciences, West Haven, CT, USA; ⁹Sana Medical School, Coburg, Germany;

¹⁰University of Rijeka, Medical School, Rijeka, Croatia; ¹¹National Forensic Sciences University,
Gandhinagar, India; ¹²International Burch University, Sarajevo, Bosnia and Herzegovina

Background: South-Eastern Europe, and Croatia in particular, has served as a genetic crossroads between the Near East and Europe since prehistoric times, shaped by numerous and recurrent migration events. Mitochondrial DNA (mtDNA) and Y-chromosomal markers are especially valuable in this context due to their uniparental inheritance and limited recombination. Their analysis in ancient genomes provides an exceptional framework for tracing migration processes and demographic changes through time.

Objective: The aim of this study was to investigate patterns and trends in Croatian maternal and paternal genetic landscapes from the Neolithic, Bronze, and Iron Ages through Antiquity and the medieval period to the modern era.

Subjects and methods: A database comprising 304 published ancient genomes from Croatia was compiled. The ISOGG Y-DNA Haplogroup Tree 2019–2020 and mtDNA Tree Build 17 (PhyloTree) were used to determine Y-chromosomal and mitochondrial haplogroups, respectively.

Results: The Croatian mtDNA profile indicates strong continuity of major maternal lineages (H, U, T, J, and K), reflecting enduring Mesolithic ancestry and early Neolithic farming expansions, with only minor changes over time. In contrast, Y-chromosomal data show substantial paternal turnover, shifting from early farmer- and hunter-gatherer-associated haplogroups (G2a, J2b) to a more diverse historic population influenced by R1a, I1, J1a, E1b, and N1a. Compared with historic populations, modern Croatians exhibit a marked increase in I2a, now the dominant paternal lineage.

Keywords: mtDNA; Y chromosome; Ancient DNA; Croatian (pre)history.

Acknowledgement / Funding Source: This research was funded by the project “Applied Bioanthropology in the Study of ancient and contemporary populations in the Republic of Croatia – IA-INT-2024-BioAntroPoP” (Luka Bockor), Institute for Anthropological Research and European Union, NextGenerationEU, Individual scientific career development.