

The Balts and the Finns in historical perspective: a multidisciplinary approach

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Introduction. Ethnic history of human populations is a too complicated phenomenon to elucidate it on the basis of several gene frequencies. It is obligatory to compile all data on molecular genetics and serology, to add new ones, to request services of paleopopulation comparisons, facts of anthropological odontology, craniology, and anthropology of the modern population of the area as well as linguistic and archaeological information. A multidisciplinary approach to elucidating historical relations between the Balts and the Finns is the goal of the present report. **Materials and methods.** Approx. 800 blood samples from Lithuania were examined in order to investigate Lithuanian population according to different genetic markers. Discrete cranial traits of 6,426 skulls from Lithuania and adjacent territories as well as 3,734 skulls belonging to the Neolithic, Bronze Age, 2,000 YBP and 1,000 YBP were investigated. We disposed of data on the ethnic odontology of 4,993 modern Lithuanians as well as of 1446 skulls dated to 2,000 YBP and 1,000 YBP. **Results.** Two separate clusters consisting consequently of four Baltic and two Finnish groups emerged in the dendrogram (Fig. 1). The mesocranial Mesolithic population in Lithuania might be related to the Middle-European kernel of mesocranes. The Middle-European orientation of the Neolithic and Bronze Age Lithuanian population is evident. The influx from the eastern part of the ancient Baltic area was detected in the 2,000 YBP population. The Lithuanian 1,000 YBP population was more homogeneous than the inhabitants of Latvia (Fig. 2). The Y chromosome haplogroups 1 and 9 show complementary clines from southeast to northwest of Europe, the Baltic peoples (Latvians and Lithuanians) demonstrating a mixture of western and eastern genetic traits (Fig. 3). In Northern Europe, strong geographical, linguistic and cultural barriers can be identified. Three main migration directions could have a real influence on the formation of the Lithuanian gene pool. **Conclusions.** Anthropological, archaeological and linguistic data demonstrate that there was no common ancestry of the Balts and the Finns. Genetic and phenetical similarities might occur due to gene exchange between adjacent populations on the northern and eastern borderlines of the ancient Baltic area that took place from the Mesolithic time. It is impossible to date the emergence of some genetic and anthropological similarities between the Balts and the Finns.

Key words: molecular genetics, paleopopulation genetics, anthropology, the Balts, the Finns

INTRODUCTION

The early stages of inhabitation of the Baltic countries are poorly known. It is possible that the Baltic area had its first inhabitants as early as 35,000–40,000 years ago, at the time when *Homo sapiens* spread over Europe. The origin, language or ethnic

affinity of these Paleolithic people are unknown, since all archaeological evidences were destroyed by the melting continental glacier that covered the whole Northern Eurasia during the last glacial maximum ~25,000 YBP.

There are conflicting anthropological findings regarding the origins of Indo-Europeans and formation of Baltic tribes in Eastern Baltic. The Lithuanians and the Latvians are the only Baltic nations that survived until today, therefore molecular genetic characterization of these populations may help to reconstruct the prehistory and the ethnogenesis of people in this area.

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The Finno-Ugric influence on the Balts is particularly uncertain. In this context, the conclusion by V. Laitinen et al. (1) that Baltic males share a common Finno-Ugric ancestry sounds quite categorically. Firstly, it was made on the basis of determination of only five Y-chromosomal biallelic loci. Secondly, it is unclear which part of Lithuania the investigated persons represent. Thirdly, the question arises what about other Y-chromosomal peculiarities, what about the diversity between Baltic and Finno-Ugric females. Are the materials of the authors enough to speculate on the ethnic history of those peoples, and is it possible to time genetic events in this special case?

In our opinion, ethnic history of human populations is a too complicated phenomenon to elucidate it on the basis of several genetic markers. It is obligatory to compile all data on molecular genetics and serology, to add new ones, to request services of paleopopulation comparisons, facts of anthropological odontology, craniology, anthropology of modern inhabitants in the area, as well as linguistic and archaeological information. A multidisciplinary approach to elucidating the historical relations between the Balts and the Finns is the goal of the present report.

MATERIALS AND METHODS

An investigation of Lithuanian population (more than 800 population samples) was made according to different genetic markers. Such markers include blood groups (A1A2B0, Rh (C, c, D, E, e), MNS, P, Lutheran, Kell, Lewis, Secretor (FUT2), Duffy, Kidd (Jk), Landsteiner-Wiener, (LW) Colton (Co)); serum proteins (TF, Gc, α_1 -antitrypsin); mtDNA RFLPs and direct sequencing of the 1st hypervariable segment (HVI) of the control region of mtDNA; the frequency and distribution of Y-chromosomal haplogroups and the allelic status of different markers; recent Alu insertions (ACE, TPA25, APO, FXIIIIB, A25, B65, PV92, D1, HS4.14, HS4.75, HS4.32, HS4.69, HS4.65, HS4.59, HS3.23, HS2.43), and the frequency distribution of gene mutations in the CFTR gene for cystic fibrosis and *PAH* gene for phenylketonuria.

Discrete cranial traits of 6,426 skulls from Lithuania and adjacent territories dated to the two last millennia were investigated (2). The mean measures of divergence (MMD) among separate cranial samples as well as among pooled diachronous ethnic series were calculated and their matrix was clustered. Multivariate analysis of craniometric traits of Neolithic and Bronze Age series from Lithuania and 70 synchronous reference groups from the Baltics and adjacent territories was carried out. 3734 (2116

male and 1618 female) excavated in Lithuania and belonging to the 1st and 2nd millennia A. D. were measured, factorial analysis was made, Penrose's distances were calculated and their matrix was clustered (2). We dispose the data on the anthropological odontology of 4993 individuals from modern Lithuania, as well as of 1446 skulls dated to the 1st and 2nd millennia A. D. (3–5). Anthropological characteristics of modern inhabitants of the Baltic area were quoted after M. V. Vitov et al. (6). For interpretation of findings, linguistic and archaeological information was used.

RESULTS AND DISCUSSION

Multivariate phenetical comparisons were performed in diachronous populations on the eastern coast of the Baltic Sea and adjacent territories. There, the material of 2,000 YBP from Lithuania, Latvia, and the people of Chernyachov culture, as well as the Lithuanian materials from 1,000 YBP, Latvian, East Slavonic, people from Balto-Slavonic borderline, Estonia and Karelia were examined by the same author. Two clusters consisting of four Baltic and two Finnish groups emerged in the dendrogram (Fig. 1).

The medieval Slavonic skulls fit into the Baltic cluster, too. The clusters are close, nevertheless, they are separate. The Lithuanian skulls (2,000 YBP) are rather close to the two mentioned clusters, and those of Chernyachov people as well as Latvians of the same period stand somewhat sideways.

Unfortunately, Mesolithic materials from Lithuania are not numerous and fragmental. The men from Spiginas, Kretuonas and Duonkalnis are mesocranic, some of them have the somewhat flattened up-

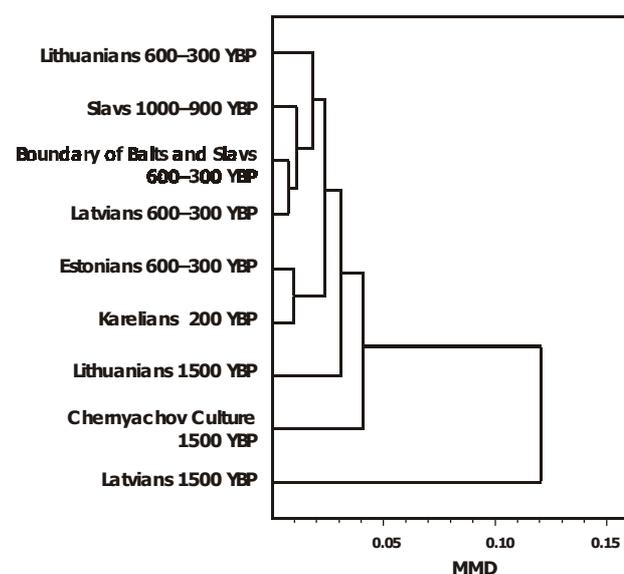


Fig. 1. Divergence of peoples in East Baltic area and adjacent territories according to discrete cranial traits

per part of the face characteristic also of the Stone Age population in Sweden and Denmark, where the Mongoloid admixture is quite dubious. The skulls from Duonkalnis have a sharp horizontal profile of the middle part of the face. Consequently, Mesolithic population of Lithuania might be related to the Middle-European kernel of mesocranes, which was detected by V. V. Bunak as early as 1951.

In the Neolithic and Bronze Age, population in Lithuania and East Prussia, two types (mesomorphic mesocranic clinoprosopic and hypermorphic dolichocranic clinoprosopic) were revealed.

The first type is closely connected with the Globular Amphora people from Poland, the representatives of the Bell Beaker culture from Moravia, the Megalith culture tribes from Germany as well as with the Middle Neolithic population from Denmark. Consequently, its orientation towards Middle Europe is evident. It is possible to suppose that the pre-Indo-European background of the south-eastern part of the Baltic region may have had a constant influx from the focus of the Middle European brachyranes (2).

The second type (massive archaic proto-European) fixed in this area from the Mesolithic started to predominate together with the strengthening of Corded Ware culture and especially with its Boat Axe version. Repercussions of archaemorphic people from the primary motherland of all Indo-Europeans in Europe and overbalance of a local analogous component are supposed to be the two main agents of Indo-Europeanization of the South-East Baltic region. Orientation of this craniological type towards the South-East is evident.

In the material that represents Balts 2,000 YBP the influx of newcomers from the eastern part of the ancient Baltic area (up to the lower reaches of the Oka River) was detected, and it might be a reflection of the great migration of peoples (2). In the later period (1,000 YBP), a mosaic distribution of local anthropological complexes in the territory of Lithuania came to light. It is possible to suppose that the latter phenomenon was a result of unfinished physical consolidation of the Baltic tribe unions during the formation of the Lithuanian nation (10). On the East Baltic scale, the inhabitants of Lithuania were quite homogeneous, while the Latvian territory is quite heterogeneous (Fig. 2).

The teeth of the native inhabitants of all 44 administrative districts in Lithuania were investigated from the odontological point of view (tooth morphology, the picture of masticatory surfaces). Modern Lithuanians represent a homogeneous Middle-European odontological type. The same type was detected in the craniological materials (2,000 and 1,000 YBP), its roots lie even in the Stone Age popula-

tion (4, 5). On the other hand, only one third of Latvian groups represent this type (3–5).

Modern population of Lithuania, Latvia and Estonia was investigated in 1952–1954 by the Baltic United Expedition, and six anthropological types were estimated (6). There are differences of their distribution in the three states. In Lithuania, the Middle-European type prevails, with an insignificant admixture of West-Baltic and Ilmen-Dnieper types. On the contrary, the West-Baltic and East-Baltic types are characteristic of Estonia, a slight Middle-European admixture existing in its central part. Latvians stand between Lithuanians and Estonians: they belong to the West-Baltic type, and the admixture of Middle-European type is more evident than in Estonians.

The first known inhabitants on the eastern coast of the Baltic Sea were Magdalenian hunters and gatherers (12,000 YBP). A new local culture appeared here, intermingling Lingby-Bromme, Ahrensburg and Swiderian cultures (11,000 YBP). In the



Fig. 2. The main anthropological types of medieval inhabitants of the East Baltic region (2)

Mesolithic (10,000–7,000 YBP), Mesolithic Nemunas culture, which continued the Paleolithic tradition and was influenced by Maglemosian and Epipaleolithic cultures, was present in the southern part of the region, while the Kunda culture dominated in the North. Its traces were discovered only in Northern Lithuania.

In Early and Middle Neolithic (6,000–5,000 YBP), Mesolithic Nemunas and Kunda cultures developed correspondingly into Neolithic Nemunas and Narva cultures, however, influences from other neighbouring cultures were also noticeable. Thus, Neolithic Nemunas culture was oriented to Central Europe, while Kunda culture got impulses from the East. The last culture had four variants; its west-southern group was spread in the northern part of Lithuania, mostly as far as the lower reaches of the Nemunas River. To all appearances, the representatives of both cultures belonged to the circle of Old European languages (7).

4,500 YBP, Comb and Pit Ornamented Pottery culture, which was connected with Finno-Ugric-speaking people, invaded the Narva territory. Its fragments reached Lithuania, mostly in its northern and eastern part. At the same time South-Western Lithuania was affected by Funnel Beaker, Globular Amphora and later (4,500–4,000 YBP) by Corded Ware cultures. The latter three cultures made a superstratum on the Neolithic Nemunas and Narva substratum, and they were connected with Indo-European speaking population, the Baltic people being a result of intermingling among the carriers of the mentioned cultures (8).

Thus, Pamariai (Baltic Coastal) Culture and its representatives had a hybrid character. It is necessary to note that different forms of Indo-European Corded Ware Culture spread over a wide area of Middle, East and North Europe, including the territories of Latvia, Estonia, southern Finland and south-eastern Sweden. According to M. Gimbutas (9), there were three waves of the Indo-European Kurgan people in 6,500–4,500 YBP; the third wave reached the Baltic region.

Linguistic data are of great importance for elucidation of interrelations between different ethnical groups. It is commonly accepted that the contacts between the Baltic and Finno-Ugric languages began during the expansion the Baltic tribes northwards and eastwards. The contact zone was very large, from the Baltic Sea in the West to the upper reaches of the rivers Oka and Volga in the East. The eastern stem of the Balts who did not survive till historical times had linguistic contacts with the tribes of Mari and Mordvi. In the western part of the Balts' territory (Latvia) the process is going on even nowadays. The influence of the Baltic language on Finnish was more evident: it gave more than

got. For instance, there are 1.1% of Baltisms in modern Finnish, and they include agricultural terms as well as the vocabulary of essential spheres of human social and cultural activities, even kindred and mythology, etc. On the contrary, only 30 toponyms of Finnish descent were registered in the northern part of Lithuania. Linguistic data do not demonstrate the substratum and superstratum relations (11). However, gene exchange was inevitable in this process.

It is reasonable to assume that the members of the same family of language are also genetically more closely related to each other than to the speakers of unrelated languages. However, recent studies (12, 13) have suggested that language might not always be the major factor in determining relatedness, but geographical vicinity can also play an important role – especially in the absence of barriers, such as big mountains or large water systems. This clearly seems too to be the case in the Baltic region. Published data, based on the careful analysis of both genetic and craniological material, reveal similarities and differences between Baltic and other populations. Geographic patterns of variations are seen on many scales. There are local differences, which form gradual clines or more abrupt changes called genetic boundaries.

The Y chromosome haplogroups 1 and 9 show complementary clines on the continental scale, from the southeast to the northwest of Europe. The strong clinal pattern of these two haplogroups resembles the first principal component of genetic variation of classical loci and is consistent with the demic diffusion hypothesis (Fig. 3).

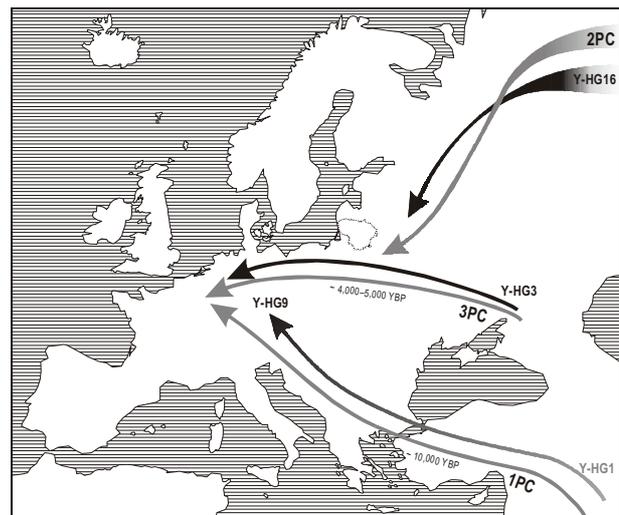


Fig. 3. Main synthetic gradients of genetic and genomic markers. 1PC, 2PC and 3PC – 1st, 2nd and 3rd principal components according to classic genetic markers. Y-HG1, Y-HG3, Y-HG9 and Y-HG16 – Y chromosome haplogroups 1, 3, 9 and 16

The distribution of Y chromosome haplogroup 3 is also strongly clinal (Fig. 3). It reaches its highest frequencies in central-eastern Europe, while the frequencies in the southeast and southwest are low. This distribution resembles the third principal component of variation of classical gene frequencies, which has been interpreted (14) as marking the movement, from north of the Caspian Sea, of the Kurgan people (Fig. 3). The haplogroup 16 of Y chromosome is at high frequency in the north-east of the Baltic Sea. Its pattern is clinal but regional (Fig. 3). This distribution resembles the second principal component of variation of classical gene frequencies and shows an eastern (Uralic) admixture in these populations.

In Northern Europe, as in the whole continent, strong geographical, linguistic and cultural barriers can be identified (Fig. 4). The zones of sharpest genetic changes were located in the whole Europe and especially in the North of Europe. These three main migration directions could have a real influence on the formation of the Lithuanian gene pool.

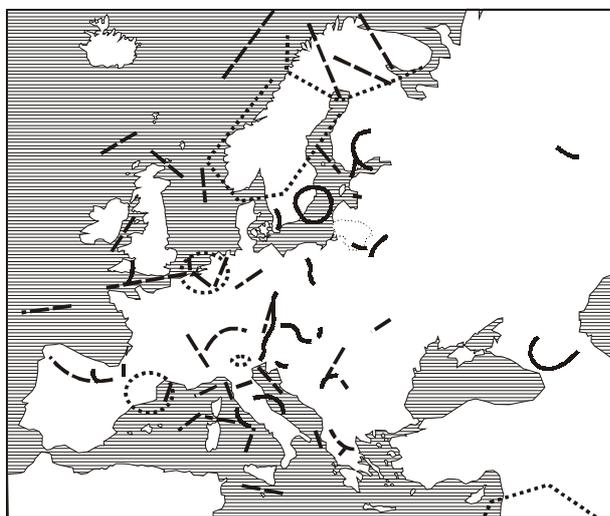
The strongest boundaries divide western populations from eastern ones, indicating that the geographical boundary played a major role in determining the genetic frequencies. Nevertheless, a zone of sharp genetic change is also present between Finno-Ugric (Estonians) and Balts (Latvians and Li-

thuanians), supporting the idea that other factors also contribute to genetic boundaries (Fig. 4), where the Latvians showed a greater similarity to the Lithuanians than to the Estonians, demonstrating that linguistic differences can have a lesser, but still important, influence on genetic diversity.

The Baltic peoples (Lithuanians and Latvians) show a mixture of the western and eastern genetic traits (Fig. 3).

The west-to-east gradient shows the distribution of the Rh⁻ haplotype (Rh blood group system), serum protein Gc-1F, α_1 -antitrypsin (PI), gene Z and S alleles. The frequency of the Rh haplotype cde was very high in the Lithuanian ethnolinguistic subgroups with a maximum value (0.4867; SD = 0.0293). A comparison of the variation in the frequencies of the allelic genes TF, GC and PI was made. Some genetic transferrin variants, particularly TF*DCHI which is a Finno-Ugric marker, were found in Finns and Estonians, but not in Latvians and Lithuanians (15). At the same time the frequency of GC*1F allele in Lithuanians was one of the lowest (0.1) in Europe (16). Two typical Western European mutations S and Z of the α_1 -antitrypsin (PI) deficiency have significantly higher frequencies in Balts in comparison to Finns (17). It shows a West European influence on the Baltic Sea region.

Studies of the Baltic "tribal" gene LW*B and PAH gene mutation R408W together with VNTR and STR haplotypes indicate the presence of a considerable Baltic admixture in the neighbouring Finno-Ugric and Slavic populations. The peculiar geographic distribution of the LW*B, relatively high frequencies in the Balts and zero or almost zero levels in Asiatic, African and West European populations make this blood group a very informative marker for the Baltic genetic influence, *i.e.* its presence in other populations in any appreciable frequency is likely to be due to a Baltic admixture. The LW*B allele is a Baltic tribal marker, but interestingly its frequency is also relatively high in Estonians, Finns, Russians and Poles (18, 19) suggesting a Baltic genetic influence on the neighbouring Finno-Ugric and Slavic populations. The LW*B allele frequency has been shown to vary between 7.5% in the North Samogitian and 2.7% in the inhabitants of the South Highlands of Lithuania. In the latter subgroup it was statistically significantly lower than in the rest of Lithuania. The finding of the highest LW*B allele frequency in the North Samogitian and the lowest one in the inhabitants of the South Highlands of Lithuania is in agreement with the assumption that the North Samogitian subgroup is an autochthonous population with the Curonian influence in the North, whereas the subgroup of



Genetic barriers in Europe according to:
 mtDNA markers (Simoni et al., 2000)
 ——— biallelic Y-chromosomal markers (Rosser et al., 2000)
 - - - - other genetic markers (Barbujani, Sokal, 1990)

Fig. 4. Genetic diversity barriers in Europe according to mtDNA markers (.....) (Simoni L et al., Am J Hum Genet 2000; 66: 262-78), biallelic Y-chromosomal markers (——) (13), and other genetic markers (——) (Barbujani G, Sokal R. Proc Natl Acad Sci USA 1990; 87: 1816-9)

inhabitants of the South Highlands of Lithuania may involve some influence from the Yotvingian gene pool.

The frequency of blood group B, which is generally a marker of eastern (Asiatic) influence, is relatively high in the Balts.

Mitochondrial DNA diversity has revealed that Lithuanians are characterized by the same mtDNA haplogroups that describe 95% of variation in Europe and are close both to Slavic (Indo-European) and Finno-Ugric speaking populations of Northern and Eastern Europe (20). The lack of correlation between genetic distances based on mtDNA and Y chromosome variation indicate different female and male histories. Most frequent (45% of all Lithuanian Y chromosomes) are haplogroup 3 chromosomes, which reflect the influence of Indo-Europeans during formation of the Balts (21). The second major component (37%) is haplogroup 16 (characterised by TatC allele) chromosomes. They are frequent in Uralic and Altaic speakers of northern Eurasia and reflect migrations from Asia. A lower gene diversity was detected in the Lithuanian haplogroup 16 but not in haplogroup 3 Y chromosomes, indicating a recent population bottleneck, which might be associated with the Indo-Europeanization process. The significant differences between Lithuanian and Estonian Y chromosome STR haplotypes suggest that these populations have different origins or have differentiated before Indo-Europeanization took place in Eastern Baltic.

All these materials allow some generalisations. Beginning with Epipaleolithic culture, through Mesolithic Nemunas and Kunda cultures up to Early Neolithic Nemunas and Narva cultures, the northern and the southern parts of the East Baltic area developed somewhat separately, contacting in the territory of present Latvia, and there was no common substratum of the Balts and the Finns, though the interaction between pre-Baltic and pre-Finnish backgrounds was constant.

The Finns, carriers of Comb and Pit ornamented Pottery culture, colonized the northern half of the Baltic a little before Baltic Indo-Europeans, producers of Corded ware culture, reached its southern half having influenced one another.

The southern part of the area got constant influxes from Middle Europe and from the East, while oriental influences in the northern part were evident and stable during the entire pre-historical period (Fig. 3).

Data on molecular genetics, paleopopulation genetics and craniology, as well as ethnic odontology and anthropology of modern population support this supposition. Therefore, there is no ground to allege

that the Balts and the Finns have a common ancestry. There are more differences than communities between them. In all appearances, some physical similarities of populations might occur due to a longstanding gene exchange between neighbors. It is impossible to date any genetic event in this case without employing a multidisciplinary approach.

CONCLUSIONS

1. Three main migration directions could have a real influence on the formation of the Lithuanian gene pool. Studies of the Baltic "tribal" gene LW*B and *PAH* gene mutation R408W together with VNTR and STR haplotypes indicate the presence of a considerable Baltic admixture in the neighbouring Finno-Ugric and Slavic populations. Significant differences between Lithuanian and Estonian Y chromosome STR haplotypes suggest that these populations have different origins or have differentiated before Indo-Europeanization took place in the Eastern Baltic region.

2. Anthropological, archaeological and linguistic data demonstrate that there was no common ancestry of the Balts and the Finns.

3. Genetic and phenetical similarities might occur due to gene exchange between adjacent populations of the northern and southern parts of the East Baltic area, which have been taking place from the Mesolithic.

4. It is impossible to date the emergence of some genetic and anthropological similarities between the Balts and the Finns.

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BALTAI IR FINAI ISTORINĖJE PERSPEKTYVOJE: MULTIDISCIPLININIS POŽIŪRIS

S a n t r a u k a

Įvadas. Žmonių populiacijos istorijos problema yra tokia sudėtinga, kad ją galima spręsti tik sutelkiantis genetikos, antropologijos, archeologijos ir lingvistikos pastangomis. Darbe apžvelgiami baltų ir finų santykiai šių mokslų požiūriu.

Medžiaga ir metodika. Ištirti 800 asmenų iš visos Lietuvos kraujo genetiniai žymenys, 6426 kaukolių iš Lietuvos ir kaimyninių kraštų diskretūs požymiai, taip pat kranologiškai išnagrinėta 3 734 kaukolės iš Lietuvos, datuojamos neolitu, žalvario amžiumi ir I bei II tūkstantmečiais po Kr.

Rezultatai. Vidutinių divergencijos matų pagal diskrečius kaukolės požymius klasterizacijos dendrogramoje (1 pav.) išryškėja atskiri baltų ir finų klasteriai. I tūkstantmetyje po Kr. pastebima migracija iš rytinės senojo baltų arealo pusės į Lietuvos teritoriją. II tūkstantmetyje (2 pav.) Lietuvos gyventojai buvo homogeniškesni negu Latvijos. Y chromosomos 1 ir 9 haplogrupės dėsningai pasiskirsčiusios Europoje iš pietryčių į šiaurės vakarus (3 pav.).

Išvados. Genetiniai, antropologiniai, archeologiniai ir kalbotyros duomenys rodo, kad baltai ir finai neturėjo bendro protėvio. Tam tikras genetinis ir fonetinis panašumas galėjo rasti dėl genų mainų tarp populiacijų senojo baltų arealo šiauriniame ir rytiniame paribyje. Baltų orientacija į Vidurio Europą yra akivaizdi, pradedant mezolitu ir baigiant šiuolaikiniais Lietuvos gyventojais. Kada susiklostė baltų ir finų genetinis panašumas, datuoti negalima.

Raktažodžiai: molekulinė genetika, paleopopuliacinė genetika, antropologija, baltai, finai