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SEROANTHROPOLOGY OF ROMS (GYPSIES)

ABSTRACT: The study presents a brief history of the Roms and of their anthropological characteristics; it further deals with the anthropological significance of the studied genetic markers. It aims at providing data on gene frequencies of blood and serum groups and isoenzyme erythrocytes in Slovak Roms, and comparing them with data on European Roms and on non-Rom population.

KEY WORDS: Roms (Gypsies) — Frequency of blood and serum groups and isoenzymes.

INTRODUCTION

Within the relatively short time after the human blood group substance had been clarified at the beginning of this century and lognized for the transfusion purposes, the significance of the single human group corporal properties for the basic investigation was disclosed.

The first published discovery that the frequencies of ABO blood groups differed from one population to another was made by Professor Ludwik Hirszfeld and his wife Professor Hanna Hirszfeld when they were working at Saloniki at the end of World War I. They had an opportunity to test large numbers of soldiers and other persons from many different countries. Their statement that the group B proportion increases and simultaneously the group A decreases from West towards the East represented the basic knowledge of the new anthropology branch called seroanthropology. They published their observations in the paper "Essai d'application des méthodes sérologiques au problème des races" in the journal L'Anthropologie, edited in Paris, in the year 1919.

From that time on, the blood group investigation developed considerably and the long row of new blood systems, serum groups and erythrocyte isoenzymes noted for the genetic polymorphism was described.

In anthropology the genetic marker study is very important as it provides valuable information for the various population ethnogenese study.

To provide the information of the blood serum group and the erythrocyte isoenzyme frequencies in Roms living in Slovakia and to compare the European Roms and non-Rom population data, was the aim of this publication.

A BRIEF SURVEY OF ROMS (GYPSIES)

HISTORY

The Roms history dates back to the first record of their stay in Europe. Earlier historical sources demonstrating the origin of this ethnic group do not exist since the Roms had no written records or hypotheses about their origin. As a result, various, often mysterious legends came into existence. One of the oldest legends maintains that they had come from Egypt. Despite misunderstandings and inaccuracies, some Rom groups misused this legend. Near the Methon city of Peloponesos in Greece, there is a small hill called Gype, or "Little Egypt" where a community of the same name is situated. On this little hill some 100 to 300 poverty stricken Rom caravans and their inhabitants made a living mainly as blacksmiths, but

also as patchworkers, shoemakers and tanners (Vaux de Foletier 1974). We can suppose that the Roms originally considered this locality the place of their origin and not Egypt in north-eastern Africa. The second legend maintains that the long-run wandering of Roms was a retribution because they refused to help Maria when she was fleeing with her child before Herodot.

Such nomadic groups had their leaders, who were considered the nobility, e. g. in Transylvanian Roms they were called řvoivodaŕ and were regarded as the highest country representatives governing in the name of the Hungarian king. One Roman řvoivodaŕ, Ladislav, gained the protective attendant document given by the Hungarian king and German emperor Zigmund in 1423. Later, the term řvoivodaŕ was changed to řvajdaŕ which was the title of leading corporals in Greater Hungary (Horváthová 1988).

The legend about the Egyptian origin of the Rom ethnic group spread actively by its members gave rise to their name in many European countries, e. g. in Greece the name Ejiftos, Giftoi, in Albania Jevg, Evgit, in Roumania Jiftu, in England Gypsy, in Spain Egyptians, today Gitanos, in the Netherlands Egypeiers, Gyptenaers, and in Hungary Pharao Nepkha or Pharaos people. During the sixteenth century, the geographer Bellon visited the Nile Valley and met the inhabitants called European Egyptians (Vaux de Foletier 1974). In 1598, Krištof Harant of Polžice had a similar observation on his journey to Palestine, Arabia and Egypt. He stated that there were more Roms in these countries compared with central Europe but they were considered immigrants. His impressions were published in the book "Christian Odysseus" in Prague in 1607 (Suchý 1972).

In contrast to these testimonies the hypothesis about the Roms Egyptian origin continued to be generally accepted until the second half of the eighteenth century when linguists began studying the language of this ethnic group.

In 1763, Sekely von Doba published a paper in Wiener Anzeiger, in which he stated that the theologian Vali of Komárno region, met three young men from Malabar who spoke a very similar language to that of Roms living in region his native. He collected about 1,000 words of this language and after returning to his native country he compared them with the language spoken by the local Roms. This was the starting point for linguistic investigations. They were gradually cumulated, showing the relationship between the Roms language and the languages spoken in north-eastern India (Rudiger 1782). Grellmann in 1787 stated that the similarities between the Roms language and that spoken on the right side of the Sind River gave the scientific basis for linguistic research. Many of his observations have been valid even today. As a scholar with a broad vision, he demonstrated the need to solve questions of Roms origins not only from a linguistic viewpoint but also from ethnographic and historical points of view.

Other scholars such as Graffunder (1835) and Pott (1845) began to pay attention to the evidence on the Indian origin of Roms; they deduced it directly from Sanskrit and designated their origin to be in north-eastern India. The Slavic scholar Miklosich (1874) incorporated the observations of the Greek Gypsylogist Paspati (1870) into his own work and stated that the language of Roms living in the Slavic area is similar to that of the Hindukus Dardes and consequently that its origin lies in non-Indian dialects. Ventzel and Čerenkov (1976) also compared the lexicon of Roms language with the Hindi language and Sanskrit.

The aforementioned linguistic studies confirm that the Roms originated in India. The former homeland of the Roms is probably central India. They were expelled and went north to Punjab due to the Arabian invasions during the seventh and eighth centuries (Rex-Kiss et al. 1973).

In regard to Roms migration, the question arises about the cause of their ancestors' departure from India. The stimulus for such migration can be sought in some significant political events as the invasion of foreign armies, etc. In agreement with Horváthová (1988) it can be assumed that the impetus for dispersion of some populations does not stem from outside interventions but rather from the traditional Indian social structure.

At the turn of the second and first millennia B. C., the system of four social castes called "Varn" was formed which has survived in various forms to date. The highest caste was formed of the "Brahman" comprising of the most educated people as priests, scholars and teachers. They occupied the chief political and administrative functions. The "Kastrioves" formed the second caste and their domain were military affairs. The "Vaisioves" formed the third class and were divided into farmers, cattle-breeders, craftsmen and businessmen. The fourth caste was the "untouchable" who executed different services and auxiliary works for the former three castes. According to the divisions of the caste system, the "Jatis" had been developed, literally meaning the genus. The castes were strictly endogamous. In whatever caste an individual was born, both he and his progeny were destined to stay for their whole lives. This caste system, therefore, regulated professional activities, social and legal classifications, the choice of spouses, the participation in social events, and the possibility to interact with members of other castes in general.

The three latter castes were all strictly separated from the first caste. Education was prohibited for the lowest castes and likewise they were not allowed to read or listen to the "veda" texts, i. e. the Indian sacred books, they were not allowed to participate in religious celebrations, to perform more important ceremonies and to take part in advanced Indian culture. The members of the lowest caste, "the untouchable", were thought to be "untouchable" i. e. "haridzan", and were not allowed to touch members of the higher castes. In central and southern India, they had to keep away from the members of the three higher castes. The "untouchable" worked as sweepers and dirt-removers or as washers, navvies, and they prepared wood for cremations. For fishermen, they carried and stretched nets. They also skinned and processed animal fells. They were groomers, executioners and knackers, semi-nomadic smiths, musicians, dancers and performed snake-dances. They were also professional thieves especially skilled in cattle robbery.

The "untouchable" were designated by various terms. Tamiles call them "parajan" giving rise to the word "paria" which is well known in Europe. For us the Kaschmir term: "dum, dom": is very important. The relevant people accepted and thus the term was used by the groups moving over the Syrian linguistic milieu. Among Armenians this form of designation was changed to "lom" and later on in Europe to "rom" (Horváthová 1988).

In agreement with the last generally accepted thesis put forward by Turner (1926), the migration of the Roms toward north-eastern India is believed to have started as soon as the third century B. C. (Suchý, 1968, San Roman, 1976). Pott (1845) and Miklosich (1874) assumed on the basis of their linguistic studies, that the Roms left north-eastern India during the eleventh century and migrated towards the west. This is based on the fact that the Indo-Asian dialects changed approximately during the tenth century.

At present, most scholars accept the hypothesis of an Indian origin of the Roms. The results of the linguistic studies demonstrated that the Rom language is a part of an ancient branch of the western neo-Indian languages belonging to the Indo-Iranian group (Suchý 1968). This ancient language is linked to Sanskrit in the same way as modern Romanic languages are linked to classical latin. According to Miklosich (1874) it remains closely related to the modern languages of the Dardite group in India and according to Coon (1969) with to Sanskrit languages.

On the basis of various dialects of the Romani language, a probable migration route from India towards Europe through Afghanistan and Iran was drawn.

The Roms used two directions :
a) toward Armenia and the Byzantine Empire and
b) toward north Africa through Syria

During this migration, the Roms adopted new words into their own language and various Roms dialects arose in Europe accordingly. It is possible to elaborate the linguistic differences, which was the aim of the linguistic scholar F. K. Miklosich. He divided the Roms into thirteen linguistic groups coinciding with accepted expressions from various languages of those nations where the Rom groups spent the longest time. They were: Greek, Turkish, Roumanian, Czech, German, Russian, Kurdish, Scandinavian, English, Italian, Basque, and Spanish. Each group enriched the Rom vocabulary in a characteristic way. The common sign is the existence of some Greek, Roumanian and Old Slavic words incorporated into the Indian base. These linguistic groups, however, should not be confused with the different Rom groups, i. e. with the Roms division. The Roms were not yet divided on the basis of linguistic, ethnic, or social criteria. According to Hubschmannová (1976), the dialect differentiation of the Roms languages is roughly the same as the differences between various Slavonic languages.

As mentioned above, the migration of the Roms into Europe occurred in two ways. The first branch was directed to Spain through Syria, Egypt, and north Africa. However, there is no evidence confirming this hypothesis. Suchý (1968) believes that they probably came to Spain from the south as early as the ninth century along with Arabian people. This opinion has been confirmed by Clebert (1965) who stated that the Roms language in Spain contains more than 2000 Arabic words or words derived from Arabic. Similarly, based on certain customs of the Spanish Roms, Bataillard (1880) believes that at least a part of them had to come from the south.

The second branch went to the Balkans through Armenia. The first contact of the Roms with Europe occurred on Greek territory which was their temporary home for a long time. The original Rom language was strongly influenced by the Greek language. Later on, Roms spread towards the west and north. It is known that in the sixteenth century the contact between western-European scholars and the Roms was possible through the help of the Greek language. In most European languages the name "Cigan" is derived from the Greek word "Atsigonos" ("Zigeuner" in German, "Tsigan" in Bulgarian, "Czigany" in Hungarian, "Zingari" in Italian, "Cingaro" in Spanish, "Tsighan" in Turkish, and "Ciganos" in Portuguese) (Rishi 1976).

The entry of the first Roms into Europe cannot be precisely determined – somewhere during the time of the Byzantine Empire. This part of the Balkan peninsula can be characterized through mixture of cultures where various ethnic and cultural influences met. It is probable that the first Rom groups did not differ in appearance with those Asiatic people who were characterized as the Persian type in their body features.

As early as in 835, the first record on the Roms presence in Sicily appeared in the Byzantine chronicles. Later, in 1100, a monk living in a monastery on Anthos Hill wrote that people were living in Constantinopolis, which were called "Ascincani" and they were known as sorcerers (Ferrer 1965).

During the following century they were reported in Central Europe, predominantly in Hungary. At the beginning of the thirteenth century, the Roms immigrated to the west, mainly to Bohemia escaping before the Tatar invasion. In the Dalimil Chronicle, a record from 1242 indicates that many people were wandering and carried posters with the words "kartas bog" which was later translated as "hunger came" or "I am hungry". Some historians incorrectly considered them to be Tatar spies (Horvathová 1964). The

main period of Roms immigration to the north and west of Europe came during the fifteenth century and its course is documented by many historical records. Some documents exist, however, that indicate that the Roms were in central Europe one hundred years earlier. Wandering groups in Slovakia are recorded. It is evident that there was no continuous migration, but the relatively "settled" groups shifted into certain new territories. The new immigration wave of the Roms arrived to Hildesheim in 1407, to southern Bohemia in 1411, to Hesen and Basel in 1414, and to Prague and Meissen in 1416. Later on they arrived to German cities and towns and further to Zurich, Bologna and Rome in 1442, where they gained the recommendation certificate from the pape Martin. From there they proceeded along the coast to Marseille and came to Paris in 1427. From France they invaded Spain in 1447 where they met with the so-called northern African branch whose members had come there during the period of the Arabian occupation. The Roms came to England in 1500. They came to America and Australia as late as the second half of the ninenteenth century together with many other European immigrants.

Their immigration proceeded to northern Europe via either eastern or western Europe. In Hungary and Poland there were good conditions for settlement of Roms as demonstrated by the community names, the handicraft names and even the noblemen names as early as in the fifteenth century. It seems likely that this territory was the starting point for the migrations to the north. During this period the Rom groups also appeared on the Russian territory either directly from the Balkans or from the side from Armenia. During the sixteenth century, they appeared in Ukraine and in Byelorussia probably via Poland. They migrated through Finland and in 1532 they were reported from Sweden for the first time.

The western branch left Germany and The Netherlands and travelled through Denmark to Norway during the sixteenth century. Until the end of the Middle Ages, the Rom migration in Europe represented a politically and strategically well organized act. The Rom chiefs proclaimed themselves to be noblemen from little Egypt and dressed and behaved likewise. It is interesting to note that they usually spoke the local languages and claimed to have been forced to come to Europe for various reasons.

In later times, the Roms history is a history of discrimination. During the fifteenth century, many laws and regulations were published with the aim to exclude the Roms from local society and to allow for their persecution. These rulings were often repeated. Not until the Enlightenment, the Age of Reason, did pogroms and massacres of the Roms end. The monarchs tried to force them to settle (Suchý 1972). There is no exact data about the numbers of Roms during the eighteenth and nineteenth centuries in individual countries. At the end of the nineteenth century their numbers in Europe were not great except for the southern and eastern countries. In 1893, the census in Hungary counted 274,940 Gypsies, while in Germany their number was only 2,000. After 1900 another immigration wave came to central Europe. During World War I, the number of Gypsies in Europe was estimated to be of 6,000 – 8,000.

It is difficult to find data on the numbers of Roms in various parts of Europe after this shift. The front lines during World War I forced the Roms to migrate to various places of the continent. This did not stop fully during the following years when the new political structures joined the arising economical and social changes in Europe. The exact demographic description of the nomadic and seminomadic populations is lacking. Malá et al. (1969) published an estimate of the Roms population for the European states. Only small numbers of Roms living in central Europe between the two World Wars survived until 1944 as nomadic populations. Many were victims of racism, killed in various ghettos or in villages. Mroz (1966) estimates that 400,000 were killed in Nazi concentration camps.

In *Table 1* there are estimates of the European Rom population during the period of 1970 – 1972 elaborated by Hübschmannová (1976). The given data are gathered from different sources and represent only a rough information incomparable from a demographic view. In the table there are relatively great differences between the estimations, census, and some other statements. These differences are caused mainly by the fact that it is relatively difficult to determine the Rom population, as also other wandering people are often grouped with the Roms. It applies especially to western Europe where the original ethnonymic base has been nearly lost from their apelatives. For example, in English the name Gypsy is used for any wandering people without respect to their ethnic origin. While the estimates of Rom population are mostly over-estimated, the results of public censuses are underestimated. This is confirmed by the example from Hungary and Sweden where the sociological research determined that in one case the population was 8 times higher and in the other 6 times higher than the census estimate. These discrepancies demonstrate the difficulty resulting from the two features: their existence as an ethnic society and simultaneously as a social stratum.

For countries outside Europe, the estimates of Roms numbers are even more uncertain. About 12,000 Roms are estimated to live in central Asia, about 6,000 in Turkey, about 80,000 in Iran, and 1,000 in Syria. The USA census in 1970 counted 1,588 Roms (Hübschmannová 1976). There is information about the Roms in Canada, Latin America, Egypt, and Australia but no census figures exist for these countries. Information about the Roms clan of Greek and Czech origin in Australia have been documented in the newspapers. At present, the total number of Roms in the world is estimated at approximately 10 millions, and in Europe four to five millions (McDowell 1970).

During the short period after World War II, the last migration from the East occurred. Many Roms living now on the teritory of the Czech Republic and Slovakia immigrated recently from Hungary and Romania. Their family names demonstrate their origin from the few but very branched families. Many came to Bohemia from Slovakia where approximately 100,000 lived before the War. Many of them were settled and this was one way they escaped persecution. Only musicians reached an important social status. Those who have recently come from Romania and Hungary and who were accustomed to the nomadic lifestyle have become a new social problem. From 1958 on, the state has given the Roms permanent dwellings in the Czech Republic and Slovakia. Their village dwellings slowly vanish and the population shift toward larger towns and industrial areas continues. In Slovakia, however, more than 60% of Roms live in villages (Dubayová 1990). While the general increase in population growth is low due to low birthrate, there has been an explosion within the Roms population. This is similar to many non-European nations in developing countries where the hygienic-epidemiological situation and nutrition have improved.

ANTHROPOLOGICAL CHARACTERISTICS OF ROMS (GYPSIES)

Roms belong to the white race called Euro-Asian or Indo-European, too. Similarly to every other ethnic group, the Roms do not represent a united entity as for their physical properties. Various types can be differentiated. However, dark eye and hair pigmentation and yellowish-brownish skin colour dominate.

As for the typological composition of Roms, Indo-Afghanistan and Iran-Afghanistan admixtures are especially characteristic beside the mediterranoid, oriental, sublapoid, veddoidal and other components (Deniker 1926, Marquer 1967, Suchý 1972).

The history of Roms is very informative as it indicates the way how any new component has come into the European population composition. Up to the present Roms represent the last wave among the various populations immigrating to Europe.

Roms subethnical groups are primarily and secondarily differentiated (Suchý 1968). The primary differentiation was caused by the social structure of India castes, having the characteristics of endogamous groups with typical professions. In this manner endogamy reproduced the specific caste type. Therefore Roms possessed the various typological components already during their departure from their original homeland. With a few exceptions the course of the secondary differentiation was given by the isolation vector dominance caused by the different ethnocultural and historic-social European conditions, influencing consequently the Roms biological development. Based on the social and language differentiation various groups arose and assimilated more or less the lifestyle and cultural habits, i. e. integrated into the adjacent populations (Hubschmannová 1972 a, b). The groups rose and became the isolants, it means that certain signs were fixed by means of endogamous crossing. Therefore the various local types, and variants or the specialities could arise, e. g. the occurrence of the relatively lighter pigmentation or rutilism.

Dávidová-Turčínová (1970, 1972) tried to divide the Roms within their inner differentiations from the ethnographic and sociologic views. She divided them approximately into three groups according to the traditional lifestyle:

1. "Olach" ("Valach") Roms lived as wanderers till the law edition Nr. 74 in 1958 and in some other forms their lifestyle survives up to the present. These Roms differ from the others anthropologically, philologically, ethnographically, sociologically and culturally. They came from the past Valashka principality and therefore some authors call them "Valach Roms". The representatives of Roms extensive families (s. c. grand families) belong to them. Olach Roms form only 5% of the total Rom population in Slovakia.
2. Semi-settled Roms changed often their residences and occupations and settled especially in East Slovakia after the year 1945.
3. Settled Roms form the largest part of our Rom ethnic group. Davidová-Turčínová believes the main migration motivation to be industrialization and urbanization with their possibilities of occupation and accommodation. These factors have been the impulse for the integration of Rom minority into the non-Rom majority and for leaving social isolation.

ANTHROPOLOGICAL APPLICATION OF STUDY MARKERS

Serology of blood groups properties takes an important role in anthropological research. It may be a consequence of broadened knowledge of blood groups systems as their non-coincident distribution in various nations and races. Since blood groups of ABO system have been discovered, more than 20 group systems were disclosed with more than 160 erythrocytic antigens (Race and Sanger, 1975). If we consider only 9 group systems and calculate their potential phenotypic combinations, we will come to the value of 600,000. In the evaluation of genotypes the number is understandably greater and overlaps the value of 7 millions (Kout 1958). This fact makes possible almost individual identification of humans by blood groups.

Group properties of blood according to which human population is divided, are considered to be rather constant within the same physiological characteristics of the organism. It is even assumed that the differentiation in them had been realized earlier than distinguishable morphological markers occur. That is why ,seroanthropology is so important and is considered to be a special scientific branch. Percentage distribution of blood groups in the population is of

importance for therapeutical needs. As it may be seen in world's literature, some relations between blood groups and deseases are detectable (Aird et al. 1954, Becker 1968). For example, increased incidence of giardiosa in east Slovakia Rom children with B blood group was found out (Giboda and Bernasovský 1983). The problem on the relation between blood groups and individual diseases has not been solved yet, though intervening in all clinical branches. To be generally valid it is not explicitely explained why the occurrence of some blood groups is more or less frequent in various places nor yet either.

As mentioned in the introduction, the study of genetic polymorphism in blood and serum groups as well as in red blood cell enzymes plays an important role in our anthropological research of the Rom ethnic groups members.

The ABO Blood Group System

As already mentioned in the introduction, Professor Hirszfeld and his wife pointed out the relation between the ABO blood group system frequency and races as soon as in 1919. In Macedonia during World War I they tested 500 soldiers of 16 different nationalities. Based on the blood group representation they divided them into three types:

The first type was represented by high A group and low B group percentage, and they called it European type.

The second type included high B group percentage and low A percentage – that was Asian-African type.

The third type included A and B groups in equal proportion. The Russians, Turks, Arabs and Jews belong to this type.

ABO system is known within the longest period and it is therefore the best investigated system from the anthropological point of view.

Mourant's paper "The Distribution of the Human Blood Groups" (1954) reporting the data about the ABO system blood group distribution in the world is the most extensive sero-anthropological study of ABO system. Later the well arranged atlas of the ABO blood system distribution (Mourant et al. 1958) appeared, and was reedited in 1976.

The ABO blood group system occurrence in the population of one area or in one race group appears to be relatively stable. Differences are found between the various areas. The fact is known that in Europe the decrease in A group and the increase in B group occur in the direction West towards East in white people.

The A group occurs mainly in the Atlantic ocean areas to the utmost in the nothern nations, Eskimos and Laplander people, where more than 50% occurrence was stated (Levine 1958, Heide 1963, Khazanová and Shamlyan 1970). The A group was found to occur in Poles, Russians and Ukrainians in 32 – 40% (Asejeva 1936, Sablinský 1959, Bashlay 1964, Umnová et al. 1964, Charzewski et al. 1965).

The subgroup A_2 occurs most often in Europe and Africa. In Eskimos in east Asia and in American Red Indians this group was not found. (Matson and Swanson 1965, Chown and Lewis 1962, Heide 1963). The Middle East represents the transition between Europe and east Asia.

The B group is found most often in east and south-east Asia in Indians and Indonesians (30 – 40%) (Almeida 1968).

The O group occurs very often in Basks (more than 50%), in Irish men, Icelanders (Picazo Guillén 1958, Gott Iturriaga and Velasco Alonso 1965, Kopéc 1970). The O group reaches nearly 80% in some African tribes (Carmona 1962, Hiernaux 1962). In American Red Indians it occurs in the majority of people (Pollitzer et al. 1962).

In this country only slight differences in A and B group occurrence were found between West and East. In the direction towards East B group increases and A and O groups decrease (Vlčková and Vlček 1962, Juríčková et al. 1993a).

The MNSs Blood Group System

The occurrence of the rare antigene m and n alleles in various races as well as S^u and U alleles is anthropologically very significant.

In India and south-east Asia M gene occurs more often as compared with Europe (Miki et al. 1960, Mya-Thu et al. 1966, Moullec 1968). In the Australian aborigines its frequency reaches 0.30 – 0.40. In Sardinia inhabitants with high O group frequency the high m gene frequency was noted (0.75) (Carcassi et al. 1957). This gene occurs mostly in the American aboriginal population (0.75 – 0.90) (Hulse 1955). In Jawa and Borneo and in Australian aborigines its frequency is lower as compared with Europe (Birdsell and Boyd 1940).

High values of M sign representation are stated in the whole Pacific region, with the highest ones in New Guinea (Simmons et al. 1961, Lai 1966).

Anthropological significance of the MN system was substantially increased owing to the SS antigene discovery. In Europe this S gene occurs most often in combination with m and its frequency is 0.30 – 0.35 (Wendt and Theile 1963). In Africa and Asia inhabitants this is less frequent as compared with Europe and occurs usually in combination with n gene (Gilles 1965). In India it is divided equally between m and n genes and its frequency is lower in comparison with Europe. In the aboriginal Australia population it is totally missing (Sanger et al. 1951, Simmons et al. 1962). In some tribes of American Red Indians its frequency is higher than 0.30 (Chown and Lewis 1955).

The P Blood Group System

From the anthropological point of view the P group system is investigated less frequently. P_1 and P_2 gene occurrence is not the same among all populations. For white men the average frequency of $P_1 = 0.54$, $P_2 = 0.46$ is given (Hrubiško and Dobrý 1974, Mourant et al. 1976) in Finland, however, this relation is reverse (Anttinen 1953, Kaarsalo et al. 1962). In negroes a higher P_1 gene occurrence was noted (Moullec et al. 1952, Barnicot and Lawler 1953, Gessain et al. 1965), and in the Chinese and Japanese a low P_1 gene frequency was noted (Furuhata and Hasebe 1955, Nakajima et al. 1967, Lessa 1970). In the British population the gene P_1 has a frequency of slightly over 50% (Mourant et al. 1976), and similar frequencies are found throughout Europe and among Europeans overseas. In negroes the frequency is much higher, around 80% (Buettner-Janusch et al. 1960) and the average strength of the antigen is higher than in Europeans. In India, south-east Asia and the Pacific islands, the frequencies are mostly similar to those found in Europe, but in eastern Asia and among American Indians they are on the whole considerably lower (Simmons et al. 1954, Lewis et al. 1961).

The Rh Blood Group System

In anthropology the Rh group system is very important due to the unequal gene complex occurrence in various populations as well as from the point of view of various race-specific gene occurrence (e^s in the negroes) (Sanger et al. 1960). The single Rh group occurrence in white men remains approximately the same (Mourant et al. 1976).

Higher Rh positive property occurrence is found in the yellow-brown and black races (Harrison et al. 1964).

In most European countries Rh negative property occurs in about 16%, corresponding with the cde gene complex frequency, i. e. approximately 0.40. In Europe, however, some exceptions occur and some special attention must be paid to Basks. In them Rh negative property is represented much more often (30%) corresponding with the cde gene complex frequency 0.50 – 0.60 (Valls Medina 1958, Elosegui et al. 1950). In contrast to this, Sardinia inhabitants produce its low frequence (0.17%) (Stangoni et al. 1969). In Roms living in Slovakia the cde lower frequency was stated (0.16, resp. 0.23) (Bernasovský 1987) in comparison with the other inhabitants 0.40, resp. 0.39 (Bernasovský et al. 1975, 1976a, Ferák et al. 1971, Juríčková et al. 1993a).

Low cde gene complex frequency and high CDe frequency were stated in various nations living in the area round the Mediterranean Sea (Mourant et al. 1976). Similar Rh gene frequency was stated in India (Das et al. 1961).

In Africa, the Rh system single phenotype occurrence was studied only in some nations. The highest cDe complex frequencies in the whole world were stated there. In west Africa and in some east and south Africa nations cDe gene complex frequency reaches as much as 0.60 (Shapiro 1951, Livingstone et al. 1960).

In Asia, i. e. in China and Barma Rh negative property is found only scarcely (Mya-Thu et al. 1971), CDe gene complex being the most frequent one.

In the Australian aborigines population cde gene complex frequency is very low, too (Simmons et al. 1948).

A specifity is found in the Rh phenotype division between the American Red Indians with their high cDE complex frequency reaching and in some cases overlapping CDe gene complex frequency (Chown and Lewis 1953, Matson et al. 1954).

The Kell Blood Group System

The Kell group system is of great anthropological significance due to the unequal Kell property occurrence as well as due to the specific occurrence of some of its antigenes in various races (Js^a in the negroes) (Giblett 1958, Fraser et al. 1966). Generally the K gene frequency among all investigated races could be declared as low (Mourant et al. 1976, Chown and Lewis 1955, Corcoran et al. 1959, Grimmo and Lee 1964, Lessa 1970).

Its frequency in European populations is usually between 3 and 5%, (Prokop et al. 1953, Wendt et al. 1968), but somewhat higher in parts of Scandinavia, though very low among Lapps (Kornstad et al. 1966). The highest known frequencies of the K gene are found among the peoples of the Arabian and Sinai Peninsulas, in whom it often exceeds 10% (Maranjian et al. 1966). The Kp^a gene has a frequency of around 1% in populations of European origin (Race et al. 1968). Little is known of its distribution in other peoples.

The Kidd Blood Group System

In the Kidd blood group system Jk^a gene occurrence differs in the various races causing its anthropological significance. In Europe Jk^a gene frequency fluctuates within the range 0.42 – 0.58 (Lundevall 1956, André et al. 1956, Nijehuis 1961, Spodaryk 1966, Arzhelas and Rezniková 1968). In the negroid kind members high Jk^a gene occurrence (0.80) was found (Ikin and Mourant 1952). Cavalli-Sforza et al. (1969) observed high Jk^a gene occurrence (0.92) in African Pygmies; on the other hand, relatively low occurrence of the mentioned gene was observed in American Red Indians (Matson et al. 1968, Alfred et al. 1969, Niswander et al. 1970) as well as in the Japanese (Nakajima et al. 1967). In the aboriginal Australian inhabitants Jk^a gene frequency value is given as 0.65 (Scott and Scott 1966).

The phenotype Jk (a-b-) has been found in a very few persons. It is present in 5 of 88 Indians of the Matto Grosso, Brazil, tested by Silver et al. (1960).

The Duffy Blood Group System

In anthropology the Duffy group system is very important though only scarce knowledge about its frequency in the individual populations is available due to the fact that in most population studies only anti-Fy^a serum was applied. In Europe the Fy^a gene frequency is of about 0.40 (Mourant et al. 1976). Its frequency in Prague was found to be 0.38 (Kout 1959) and in Bratislava 0.51 (Hrubiško 1968), in east Slovakia inhabitants 0.46 (Juríčková et al. 1992). In Lapps Fy^a gene frequency is higher (Allison et al. 1952), in China and Japan it reaches even 0.90 – 1.00 (Grimo and Lee 1964). In contrast, in Africa inhabitants Fy^a gene frequency is low (Shapiro 1953, Cunha 1968).

The phenotype (a-b-) occurrence in white kind members is very rare (Spielmann et al. 1968). The Roms with their 2.9% Fy (a-b-) phenotype occurrence represent an exception (Bernasovský et al. 1976c). The mentioned high phenotype frequency was described in the negroid kind inhabitants (Sanger et al. 1955, Raco and Sanger 1968, Lowe et al. 1971).

The Lutheran Blood Group System

From the anthropological point of view the Lutheran group system is relatively less investigated. Hrubiško and Dobrý (1974) give the following data for the single genotype occurrence in the European population:

Lu^aLu^a = 0.001 up to 0.002
Lu^aLu^b = 0.075
Lu^bLu^b = 0.923
Lu (a-b-) = extremely rare

Lu^a and Lu^b do not occur in the populations in equal extent. Lu^a frequency in the white and black kind members is stated to be about 0.04; for Lu^b, however, it is 0.96 (Mourant et al. 1976). Lu^a does not occur at all in Eskimos, Japanese, aboriginal Australian inhabitants and in American Red Indians (Sanger et al. 1951, Chown and Lewis 1959, Matson and Swanson 1965, Denniston 1966). The Lu^a gene is less frequent in comparison with Lu^b gene. In persons of northern European origin, the Lu^a gene has a frequency of about 4% (similar to that of K) (Linnet-Jepsen et al. 1958). In the Mediterranean area the frequency falls to about 2% (Mourant et al. 1976) but in Africa, though frequencies are variable, the average is nearly as high as in northern Europe (Mourant et al. 1976). Up to the present no population with very high Lu^a gene frequency was found.

The Lewis Blood Group System

From the anthropological point of view the Lewis group system is less investigated. For the European population the phenotype Le (a-b-) is given to be 10% (Kelus 1951, Salmon and Malassenet 1953, Bernasovský et al. 1976a), for the negroes it increases up to 43% (Spedini and Gresta 1968). The average Le (a+) frequency in the white men represents 20% (Pham-Mua-Trung et al. 1961). The Roms with their 27% Le (a+) frequency represent an exception (Bernasovský et al. 1976c). Similar Le (a+) frequency was stated in India inhabitants, too (Bird 1953, Wickremasighe et al. 1963). In American Red Indians Le (a+) frequency decreases to zero value (Chown and Lewis 1953, Niswader et al. 1970).

The Le gene appears to have a frequency of about 80% in northern and north-western Europe (Brendemoen et al. 1950), and 66% in Italy (Ceppellini 1954). It is about 45% in Africans (Lawler et al. 1960), 70% in Australian aborigines (Vos and Comley 1967), and ranges from 36 to 57% in South American Indians (Beckman 1964).

The Haptoglobin Serum Groups

In anthropology the haptoglobin serum groups are very important. The frequency of the Hp^1 gene in Europe varies around 40%, it is difficult to see any definite regional trends, but it tends to be lower in the south than the north (Bernasovský and Bernasovská 1983). Jewish populations average about 30% (Fried et al. 1963). Hp^1 gene frequency is mostly low, around 15%, in the Indian region (as well as in European Gypsies) and somewhat higher, around 25%, in eastern Asia (Beckman et al. 1965, Vilímová et al. 1968, Fraser et al. 1969). In south-western Asia it is around 30% (Godber et al. 1973), rising to nearly 50% in southern Arabia, while in Africa south of the Sahara it is usually high, varying considerably but averaging about 70% (Neel et al. 1961). It is, however, lower in San (Bushmen) (30%) and Pygmies (40%) (Mourant et al. 1976).

In Eskimos Hp^1 shows frequencies around 30 to 50% (Scott et al. 1966b) and similar values are found in North American Indians (Scott et al. 1966b, Mourant 1976).

In the Pacific area, high Hp^1 frequencies around 70% are found in New Guinea and in Polynesia (Douglas et al. 1966), but with lower values in the intervening islands, and lower ones still, around 20%, in Australian aborigines (Kirk 1962b).

The Gc Serum group Factor

In Europe only genes Gc^1 and Gc^2 have been reported in population surveys. The frequency of gene Gc^2 is nearly always between 20 and 30% (Kaarsalo and Melartin 1967), but in Hungary (Walter 1965) and Poland (Kobiela et al. 1965) the average is a little over 30% and it is only 18% in the Lapps (Seppälä et al. 1969), and 19% in Gypsies.

In southern and south-western Asia frequencies are on the whole similar to those in Europe but in Iran Gc^2 is mostly over 30%, and there is considerable variation in India, with only 10% of Gc^2 in the extreme south (Kirk et al. 1963), but 37% in the tribal Kurumba of the Nilgiri Hills in southern India. In southeast Asia and among the expatriate Chinese, Gc^2 frequencies are mostly a little over 20%, but are around 10% in the tribal peoples of Taiwan. The Taiwan Chinese, Japanese, Ainu and Koreans average respectively 27, 25, 25, and 30% of Gc^2 (Mourant et al. 1976).

The relatively few African populations tested differ considerably from those of Europe and Asia, mostly having over 90% of Gc^1 and less than 10% of Gc^2 (Kirk et al. 1963).

The Acid Phosphatase

In ACP three principal alleles are known, P^a, P^b, and P^c. The products of gene P^a are the fastest and those of P^c the slowest of the three common alleles. The types differ somewhat in quantitative activity, the ratio for the homozygotes of the three common alleles P^a, P^b, and P^c being approximately 2:3:4.

Europeans average about 32, 61, and 6% respectively of these three alleles, with the frequency of P^a falling and that of P^b rising from NW to SE (Mourant et al. 1976). Negroes have about 20, 79, and 1% respectively of the same alleles, together with about 1% of another allele P^r (Tashian et al. 1967). The frequency of P^r is considerably higher than this in the Khoisan. Asiatic populations vary considerably. They and Papuans average about 30% of P^a and 70% of P^b, with very low frequencies of P^c (Lai 1966). Eskimos have about equal frequencies of P^a and P^b with almost no P^c(Scott et al. 1966b). American Indians have a wide range of frequencies of P^a and P^b, again with hardly any P^c (Pollitzer et al. 1970, Niswander et al. 1970).

The Phosphoglucomutase

In population studies the most useful system is PGM_1 with two common genes PGM_1^1 and PGM_1^2 varying widely in frequency in different populations, and at least six rarer genes. With a very few known exceptions, the frequency of PGM_1^1 always exceeds 50%. It is therefore convenient to describe populations in terms of their frequencies of the gene PGM_1^2, and of the rarer genes where they occur. (Mourant et al. 1976).

European populations have frequencies of PGM_1^2 increasing from 14% in Ireland (Bajatzadeh et al. 1969), and 18% in Iceland (Mourant et al. 1967), eastward and southward to 31% in Greece (Hopkinson and Harris 1966) and 32% in Turkey (Hopkinson and Harris 1966, Hummel et al. 1970). Lapp populations mostly have higher frequencies, up to 53% (Eriksson et al. 1971). Near Eastern and Jewish populations mostly have 25 to 30% but the Habbanite (Arabian) and Cochin (Indian) Jews have respectively 58 and 59%.

Frequencies of PGM_1^2 in India exceed 30% but the Chinese and Japanese have between 20 and 25%, the former having also about 1% each of $PGM_1^6$and PGM_1^7(Mourant et al. 1968, Lie-Injo Luan Eng et al. 1968). American Indians and Eskimos mostly have between 10 and 20% (Scott et al. 1966) but the Chilkotin Indians of British Columbia have only 3% (Alfred et al. 1970).

The Adenosine Deaminase

Spencer et al. (1968) were shown to be the products of a pair of allelic genes ADA^1 and ADA^2 at an autosomal locus. Other genes ADA^3, ADA^4, and ADA^5 are so rare as to be of very little interest in populations so far studied, and even ADA^2 is not known to exceed 20% in frequency in any population.

The few European data which we possess seem to show an eastward increase in the frequency of ADA^2 from 5% in Ireland (Tills 1971) and 6% in England (Tills 1971) to 8% in Germany (Tariwerdian and Ritter 1969) and 9% in Italy (Scozzari 1970). The same trend continues in Asia with 12% in Iranian Kurdistan, India, and Nepal (Branden et al. 1971, Lehmann et al. 1973). In Papua 12% of the gene is found again in Kar Kar Island (Branden et al. 1971) but 17% in Goroka on the mainland (Mourant et al. 1976). In Africa the average frequency is under 1% (Branden et al. 1971). Further data from the peoples of eastern Asia, and the Pacific Islands, and from Eskimos and American Indians would be of great interest.

METHODS

Venous blood samples without anticoagulating agent were treated sterile for the blood group determination. The drawn blood was stored in refrigerator at 4°C and treated till the 3rd day.

The individiual blood groups were determined by the test-tube method according to the instruction attached to the diagnostical sera. Complete diagnostical sera were applied for A_1A_2BO, MN, P, Kell and Lewis blood group system determination. Incomplete diagnostical sera were applied (with the application of Coombs serum) for the Lutheran, Duffy and Kidd blood group system determination. For the blood group determination we applied standard diagnostical sera: anti-B, anti-AB, anti-D, anti-C, anti-E and anti-P_1 prepared by Regional Haematological Department KÚNZ and FN Košice, anti-H lektin, anti-e, anti-K, anti-k prepared by TONsP Banská Bystrica, anti-A_1, anti-M, anti-N prepared by ÚSOL Prague, anti-C^w, anti-Jk^a, anti-Jk^b, Coombs serum supplied by Immunodiagnostika Vienna, anti-Le^a supplied by DADE (Division American Hospital Supply corporation Miami), anti-Le^b supplied by Biotest Serum Institut GmbH Frankfurt am M.

Haptoglobin types were determined by the horizontal starch-gel electrophoresis method described by Smithies (1955), Gc factor by Hirschfield method (1960). Horizontal starch-gel electrophoresis was also employed for the erythrocyter isoenzyme polymorphism. The acid phosphatase (ACP) was determined by the method described by Hopkinson et al. (1963), phosphoglucomutase (PGM) by the method described by Spencer et al. (1964), adenosindeaminase (ADA) by Spencer et al. (1968) and esterase by the D method according to Hopkinson et al. (1973).

The gene and haplotype frequencies were calculated by the method described by Mourant et al. (1976).

RESULTS AND DISCUSSION

Distribution of Blood, Serum Groups and Isoenzymes of Red Cells in Roms of east Slovakia, settlement Podskalka near Humenné, Slovakia, settlement of "Olach" Roms of Vinodol near Nitra, and in non-Rom inhabitants of east Slovakia.

The data of phenotypic and gene (haplotypic) distribution of blood and serum groups, red blood cells isoenzymes in the studied Rom collections and in non-Roms of east Slovakia, as well as the comparison with the data by the other authors are given in *Tables 2 – 54*.

Tables 2, 5, 15 and *24* demonstrate phenotypic and gene distribution of A_1, A_2, B and O blood systems in Roms of east Slovakia, as well as of Podskalka, Slovakia and in "Olach" Roms. Only the groups of European Roms with determined $A_1(p_1)$ and $A_2(p_2)$ sub-groups (*Table 39*) were selected for the comparison. The table shows that the B (q) gene frequency, being especially the object of our interest, varies from the value of 4, 9% in Swedish Rom population (Beckman et al. 1965) to the value of 31, 8% in French Roms (Cazal et al. 1951). The values in our investigated groups of probants are within the highest ones, excluding "Olach" Roms, in whom very low (5%) B (q) gene frequency was calculated (Bernasovský et al. 1992).

Small value of the gene frequency was likely determined in Swedish (Beckman et al. 1965), English (Clarke 1973), Welsh (Harper et al. 1977) and Yugoslavian Roms (Hočevar 1965).

The ratio of p/q genes frequency in Roms of east Slovakia (Bernasovský et al. 1976a), Podskalka (Bernasovská et al. 1976) and Slovakia (Bernasovský et al. 1993) varied between the values of 1.1 to 1.4. In "Olach" Roms the ratio reaches the value of 2.2. Great values of the p/q ratio were found in Swedish (7.9), English (4.7), Yugoslavian (3.9) and in Welsh (3.3) Roms. In non-Rom east Slovakian population the ratio was evaluated to be 2.1 (Bernasovský et al. 1976a). For the Indian subcontinent population, where the world's highest frequency of B blood group was found (Lehman and Cuntbush 1952, Kirk et al. 1962a, Glasgow et al. 1968, Hakim et al. 1973, Race and Sanger, 1975, Mourant et al., 1976), low values of p/q ratio are characteristic.

Phenotypic and haplotypic distribution of Rh system in investigated Roms is given in *Tables 3, 6, 17* and *25*. Their comparison with European Roms as well as with non-Rom population of east Slovakia can be found in *Table 40*.

Frequency of "d" gene in the majority of European Roms falls to the range of 30 – 45%. In Roms of Podskalka (Bernasovská et al. 1976) the value of "d" gene was found to be only 24.2%. Similar low frequencies of "d" gene in Swedish (21.7%) (Beckman et al. 1965) and Welsh (25.3%) (Harper et al. 1977) Roms were found. In Indian population the values vary from 10 to 30% (Mourant et al. 1976).

High frequencies of CCDee phenotype in Roms living in Podskalka (58.17%) (Bernasovská et al. 1976) (*Table 6*) and from Slovakia (47.14%) (*Table 17*) are important (Bernasovský et al. 1993). While the estimated frequency of that phenotype in Europeans is 20%, the values in European Roms are in the range of 30 – 60%. This is caused by evidently higher CDe haplotype frequency in European Roms. The frequency of C allele is also greater in almost all investigated Rom collections. Very high frequency of CCDee phenotype is characteristic of Indian subcontinent. According to the data found in different Indian populations (Boyd and Boyd 1954, Chandhuri et al. 1967, Das et al. 1967) the CCDee distribution is found in more than 40%, with its maximal value to 76%.

The distribution of MN blood system in Roms of east Slovakia (Bernasovský et al. 1976b), Podskalka (Bernasovská et al. 1976), Slovak Roms (Bernasovský et al. 1993) and "Olach" Roms (Bernasovský et al. 1992) is shown in *Tables 4, 8, 16* and *26*. The comparison of the data in European Roms with those in east Slovakian non-Roms (Juríčková et al. 1993a) is given in *Table 41*.

Gene m frequency in our investigated Rom groups is within the range of 53 – 69.8% and is not different from the frequency shown by Mourant et al. (1976) in the Indian subcontinent population. The highest m gene frequency was observed in "Olach" Roms (69.8%). Likely the high occurrence of m gene (70.2%) was found by Clarke (1973) in English Roms.

The other studied blood group systems in Roms, phenotypic and genotypic distribution of which are demonstrated in *Tables 9 – 14, 18 – 23* and *27 – 32*, give less information since only few data on Rom and Indian populations are accessible and the differences between the gene frequencies in European and Indian populations are therefore not so evident.

The occurrence of Fy (a-b-) phenotype is of 2.9%, or 2.8% and of Fy gene frequency of 17.1% (Bernasovský et al. 1976a) or 16.9% (Bernasovský et al. 1993) (*Tables 13* and *22*). Occasional news about individuals wearing Fy (a-b-) have also reference to other Rom ethnic group members (Hrubiško et al. 1976). In the European population this allele occurs very rarely (Race and Sanger 1975).

It is known that Fy allele gives resistence against Plasmodium vivax that caused tertiary malaria (Miller et al. 1976). Fy allele occurs often in negroes, as described by Lowe et al. (1971). Mourant et al. (1968) ascertained round 10% frequency of Fy allele in Indian Bhutan population.

The study of the so called "Olach" Roms was expanded by serum groups of haptoglobines assay, as well as of Gc factor and red cells enzymes – acid phosphatase (ACP), phosphoglucomutase (PGM), adenosine-deaminase (ADA), and esterase D (EsD) (Bernasovský et al. 1992). The phenotypic and gene frequencies of the above mentioned systems and the comparison with the data in European Roms and non-Rom populations are given in *Tables 33 – 38* and *48 – 52*.

Hp^1 gene frequency of serum haptoglobine system in the majority of investigated Rom groups has a lower value than 25%, excluding English Roms (Clarke 1973), in whom the occurrence of the allele was up to 41%. We have found 30.3% occurrence of that gene in "Olach" Roms. Hp^1 allele distribution in Indian population occurs within the range of 10 – 25% (Mourant et al. 1976) comparing P^a, P^b genes, isoenzyme of acid phosphatase (ACP) frequency comparison in "Olach" Roms and the data in Slovak Roms (Siváková 1983) and Roms from Wales (Harper et al. 1977) with non-Rom population (Juríčková et al. 1993c) (*Table 50*) shows the lowest P^a gene frequency in "Olach" Roms. There was not a single case of acid phosphatase occurrence determined by P^c allele in our collection, similarly to Slovak Roms (Siváková 1983). That means that the allele is not represented at all.

The distribution of "c" gene is relatively greater in the white population (Speiser and Pausch 1968, Brocteur et al. 1970). A very low P^a and P^c alleles frequency is typical for the negro population, and on the other hand, a high P^b distribution (Hopkinson et al. 1964, Hassan et al. 1968, Bonné et al. 1971) was found in them.

Both low P^a gene frequency and very low occurrence of P^c allele is characteristic of Indian subcontinent inhabitants (Singh et al. 1974, Papiha et al. 1972, Blake et al. 1971). The Indian origin of Roms is supported by low P^a gene frequency as well as by P^c allele missing in them.

PGM_1^1 gene frequency of isoenzyme phosphoglucomutase in European Roms varies within the range of 65.6 to 80.5 % (*Table 51*). Similar distribution was also ascertained in India (Singh et al. 1974, Papiha et al. 1972, Blake et al. 1971), which also demonstrates genetic afinity of Roms to inhabitants of the Indian subcontinent, as well as because their share of European admixture in "Olach" Roms is not significant.

In further investigated systems of D esterase (*Table 52*) high EsD^1 gene representation (88.9%) in our group of "Olach" Roms was also found (Bernasovský et al. 1992), being in accordance with the data in English Roms (Welch and Lee 1974) and Welsh Roms, too (Harper et al. 1977).

Any study on isoenzyme adenosine-desaminase (ADA) in Roms is not known so far. That is the reason for which we give only a distribution of individual phenotypes and calculated gene frequencies (*Table 37*) (Bernasovský et al. 1992).

The collection consisting of non-Rom population from east Slovakia was subjected for A_1, A_2, B, O, Rh, MN, Lutheran, Kell, Lewis, Duffy, and Kidd blood group systems examination as well as serum haptoglobin system, Gc system, Inv system and isoenzymes of red cells ACP, PGM, ADA, EsD investigation (*Tables 53, 54*) and their comparison with other authors (Juríčková et al. 1993 a, b, c).

In the A_1, A_2, B, O blood group system, there was a difference in the gene B (q) frequency, being higher in our set than in Prague (Herzog 1992) and Bratislava (Bambúchová 1985) sets. This is in good agreement with the European regional drift of the B blood group eastward.

In the Rh blood group system, our results were compared only with those in inhabitants of Bratislava (Ferák 1971). Higher frequency in haplotype CDe was found in our set.

The MN blood group system evaluated in the same manner as the above systems, showed higher occurrence of the m gene in our set. In the P system, no differences in gene frequencies were seen between sets compared.

In the Duffy system, an increased Fy^a gene frequency was observed in our set. Increasing frequency of this gene towards the East was also reported by Kušíková (1975).

Comparing the Lutheran system, higher proportion of Lu^a gene was found in our study.

No marked differences of gene frequencies were found in the Lewis blood group system.

Higher proportions of genes k and Jk^a were noticed in the Kell and Kidd systems, respectively.

The gene frequencies of chosen serum group systems in east Slovakian population and their comparison with those in non-Rom inhabitants of Prague and of Bratislava are given in *Table 53*.

Seroanthropological study of haptoglobins in European populations (Mourant et al. 1976) showed that the frequency of the Hp^1 gene is about 41% with a decreasing tendency from the north to the south.

Within the Czech Republic and Slovakia there is a decreasing tendency from the west to the east as documented by 41% in Prague (Herzog 1992), 35% in Bratislava (Nováková 1992) and 34% (Bernasovský and Bernasovská 1983) and 33% (Juríčková et al. 1993b) in east Slovakia.

The frequency of the Inv gene could be compared only with the data from Bratislava (Bambúchová 1985). However, no significant differences were found.

On the other hand, significant differences were found in the frequency of the Gc^1 gene, being higher

in our set as compared to Prague population (Herzog 1992).

In ACP isoenzyme, our set exhibited significantly higher occurrence of the P^b gene and lower frequency of the P^c gene.

Lower frequency of the PGM^1 gene was observed in our set, as documented by 73.3%, when compared to 77.2% in Prague inhabitants (Herzog 1992). On the other hand, no significant differences were seen in comparison with the Bratislava set (71.6%) (Bambúchová 1985).

The gene frequencies of ADA and EsD isoenzymes were found to be similar to the literature data.

According to the results of seroanthropological investigation in Roms, three conclusions may be postulated:

1. The genetic pool of the present-day Rom population in Europe is significantly different from that of the majority of other European population.
2. The differences between gene frequencies in both Rom and non-Rom populations support an assumption of the Indian origin of Roms.
3. The genetic variability within the present Rom population is very great and appears greater than in the compared groups of non-Rom population. Before looking for some possible causes of the differences in gene distribution observed in various Rom populations, we should know the nature of individual Rom populations.

The investigation of Rom populations may be roughly divided into two categories: the first consisted of investigations dealing with Rom isolates and the second consisted of some "ordinary" Rom population studies.

The few existing publications on the first category are as follows: the study of Yugoslavian Rom population with approximate number of 700 persons (Hočevar 1965), the study by Ely (1961, 1966) about two little isolate groups of French Roms and our investigations of about 350 persons in Podskalka, as well as the study of 900 "Olach" Roms of Vinodol.

With regard to the Indian origin of European Roms it is susceptible to expect a significant tendency to consanguinic marriage in them. Since this tendency is characteristic for a great part of populations living on the Indian subcontinent (Sanghvi 1966), they have practically extremly high values of inbreeding coefficient. Marriage customs are known to be the most stable and conservative features in the Indian society.

Excluding the sample of "Olach" Roms, the data obtained from the mentioned populations are not detailed, and therefore the calculated degree of genetic isolation compared with other Rom and non-Rom populations could not be satisfactory. However, in the majority of cases the isolation from non-Rom population is evident.

One of the indicators of isolation is consanguinity. In Roms the inbreeding F coefficient reaches high values, similarly to the Indian population. In population-genetic analysis of congenital glaucoma with recessive autosomic type of heredity in Slovak Rom population, Ferák et al. (1982) ascertained that the parents of afflicted patients are in kinship to each-other in 46% of cases and the value of inbreeding coefficient is very high (F = 0.091) in them.

The high frequency of consanguinity within French Roms from Avignon was found by Ely (1966), as well as within Roms living in Wales by Williams and Harper (1977). These estimations show that the majority of investigated Rom groups had been developed as small and endogamous isolates with a high degree of inbreeding. Genetic shift and the founder effect could apply and cause the present genetic differentiation in Roms. One cause of the mentioned fact might be the prohibition to marry members of non-Rom population. Who gets married with the "white" gets to the "prastapen", which means something like excommunication. That law was accepted within the group of Czech Roms, the majority of which were exterminated by the Nazi during World War II. The law was respected also within Rom groups living in Moravian and west Slovakian regions (Hübschmannová 1984).

On the basis of our results in nine erythrocytic and serum systems and two isoenzymes in the so called "Olach" as well as in Slovak Roms, Siváková et al. (1985) tried to estimate genetic differentiation extent between "Olach" and Slovak Roms and non-Rom population (Ferák 1971, Bambúchová 1985) and Punjabi inhabitants of India (Papiha et al. 1972).

The genetic estimation was realized by the mode of genetic distinctions calculated using E index (Edwards and Cavalli-Sforza 1972) and D (Nei 1971). The mentioned indexes indicated that there is the largest genetic distance and therefore the most different alleles frequency between "Olach" and Slovak Roms. The Slovak Roms are mostly relatives with the Indian population so that the results of Sunderland (1982) are confirmed. The alleles frequency of "Olach" Roms is more similar to that of Slovak non-Roms than that of the Indian population, and contrary to the Slovak Rom groups they indicate greater differences with the Slovak non-Roms as compared with those of India.

Siváková et al. (1985) examined 444 "Olach" Roms from the district of Nitra, Slovakia and stated the inbreeding coefficient to be F = 0.0281, being the highest value of this parameter stated so far in Europe. The frequency of consanguinal marriages in this population is 30.7%. High values were stated also for Roms in England (Williams and Harper 1977) and in Canada (Cohn 1973) as well as in many other Indian areas (Donamraju and Meera Khan 1960, Sanghvi 1966, Vijaykumar and Malhotra 1983).

The high inbreeding coefficient in Roms can result in considerable increases in the frequency rate of recessive hereditary diseases and to a certain extent also in the occurrence rate of multifactorial threshold determined pathological conditions.

As already mentioned, the genetic pool heterogeneity in many reproductively closed groups — as the Roms undoubtedly are — can be caused esp. by the genetic drift and founder effect. However, this may be true also when we consider many of the so called "general" Rom populations investigated. Particularly in the West European countries, the "general Rom population" is often represented by a single small isolated community. For example, all Swedish Roms, the sample of whom has been investigated by Beckman et al. (1965) are mainly descendants of only a few families that came to Sweden around the turn of the century, the Welsh Roms (Harper 1977, Williams and Harper 1977) also form an inbred social isolate, etc. It is thus conceivable that also the gene frequencies of these Roms communities have been affected by founder effect and genetic drift to a large extent.

There are only few countries in Europe where the Rom populations are extensive enough so that their present-day gene pools, as a whole, cannot be subjected to any appreciable chance fluctuations. These are, besides the Balkan countries, Hungary, the Czech Republic and Slovakia. Even here, however, the situation might have been quite different few generations ago.

According to the latest census in the year 1980 199,853 Roms have been living in Slovakia (the signal information gained from the Regional Statistical Office in Košice 1985). The Census in 1927 stated 62,000 and in the year 1893 their number was estimated to be only of 36,000 (Horváthová 1964). Though the information on their number more generations ago is missing, we suppose that only some few hundred lived in this area. The indirect evidence confirming this estimation was given by Genčík et al. (1980) who found an extremely high congenital glaucom frequency with recessive autosomal hereditary type in Slovak Rom population.

Most papers on the genetic polymorphism of various Rom populations in the Czech Republic and Slovakia confirmed the expectation that their gene pools greatly differ in comparison with the European populations (Gáliková et al. 1969, Beneš 1974, Siváková, 1983). This statement is supported by our results in Roms from east Slovakia, Podskalka and Slovakia. Many differences indicate such character confirming the high allele B (q) and D (Rh+) frequency and the low frequency Hp^1. Other blood group systems give us much more important information as their gene frequencies are similar to the Indian and European populations.

Some studies of European Roms, however, (Hočevar 1965, Clarke 1973, Beckman et al. 1965) indicate similar gene frequencies as in non-Rom populations as well as to ABO and haptoglobin systems. Swedish, Yugoslavian, Welsh and "Olach" Roms indicate even lower allele B (q) frequency as compared with the European average.

The above mentioned facts confirm the opinion of Harper et al. (1977) that the observed genetic variability among the Rom populations can be explained by the influence of a non-selective factor.

The alternative explanation would be that the heterogeneity is due to the varying amount of European admixture in different Rom groups, and/or that it reflects the genetic diversity of original Rom populations, of whom Roms are descendants. The admixture hypothesis as the only explanation is rendered unlikely by all available data. It cannot account for the findings of, say, B allele frequencies in Swedish, Yugoslavian, English and Welsh Roms that lie under the European value, neither can it explain why many of the groups studied show a high "admixture" rate in some genetic systems and none in the others. The hypothesis of a heterogeneous origin of Roms is difficult to test with our almost complete lack of information about the historical events of the Rom migration from India and their movements over Europe.

REFERENCE TABLES

TABLE 1. *Number of Roms from Europe in 1970—1972 by Hübschmannová (1976).*

STATE	Census absolute number	% of the other population	Estimate	% of the other population
ALBANIA			50,000	2.27
BELGIUM			14,000	0.14
BULGARIA			300,000	2.41
DENMARK			3,000	0.06
CZECHOSLOVAKIA	219,554	1.53		
FINLAND	5,091	0.11	6,000	0.13
FRANCE	120,000	0.27	190,000	0.37
HOLLAND	1,000	0.01	3,000	0.02
IRISH FREE STATE	1,466		10,000	0.33
ITALY			80,000	0.15
YUGOSLAVIA	78,485	0.38	650,000	3.25
HUNGARY	34,957 320,000	0.34 3.10	480,000	4.65
EAST GERMANY			500	
WEST GERMANY			50,000 70,000	0.09 0.12
NORWAY			4,000	0.10
POLAND			52,000	0.16
PORTUGAL			40,000	0.41
AUSTRIA			9,000	0.12
ROUMANIA			540,000	2.67
GREECE			45,000	0.51
SOVIET UNION			414,000	0.17
SPAIN			280,000	0.84
SWEDEN	1,000	0.08	6,000 8,000	0.08 0.10
SWITZERLAND			10,000	0.16
ENGLAND			50,000	0.09

Czechoslovakia 1980, 288 440, 1.89
east Slovakian region 1980, 108 356, 7.70
(The signal information of Regional Statistical Office in Košice 1985.)

TABLE 2. *Phenotype and gene frequencies of A_1A_2BO blood group system in Roms from east Slovakia.*

Phenotype	N	Obs. Freq.	Exp. Freq.	Gene Frequencies	
A_1	966	0.3291	0.3256	$p_1(A_1)$	0.2360
A_2	71	0.0242	0.0243	$p_2(A_2)$	0.0220
B	740	0.2521	0.2490	q(B)	0.1930
O	885	0.3015	0.3015	r(O)	0.5490
A_1B	248	0.0846	0.0912		
A_2B	25	0.0085	0.0084		
	2935	1.000	1.000		

TABLE 3. *Phenotype and gene frequencies of Rh blood group system in Roms from east Slovakia.*

Phenotype	N	Obs. Freq.		Gene Frequencies	
Rh + (D)	2628	0.8954		D	0.6770
Rh – (d)	307	0.1046		d	0.3230
	2935	1.000			

TABLE 4. *Phenotype and gene frequencies of MN blood group system in Roms from east Slovakia.*

Phenotype	N	Obs. Freq.	Exp. Freq.	Gene Frequencies	
M	110	0.2716	0.2806	m	0.5300
MN	209	0.5161	0.4982	n	0.4700
N	86	0.2123	0.2212		
	405	1.000	1.000		

TABLE 5. *Phenotype and gene frequencies of A_1A_2BO blood group system in Roms from settlement Podskalka near Humenné in east Slovakia.*

Phenotype	N	Obs. Freq.	Exp. Freq.	Gene Frequencies	
A_1	56	0.3660	0.3343	$p_1(A_1)$	0.2730
A_2	2	0.0131	0.0167	$p_2(A_2)$	0.0180
B	49	0.3203	0.2934	q (B)	0.2520
O	32	0.2091	0.2092	r (0)	0.4570
A_1B	12	0.0784	0.1374		
A_2B	2	0.0131	0.0090		
	153	1.000	1.000		

TABLE 6. *Phenotype and haplotype frequencies of Rh blood group system in Roms from Podskalka.*

Phenotype	N	Obs. Freq.	Exp. Freq.	Haplotype Freq.	
ccDee	24	0.1569	0.1569	cde	0.1520
CCDee	89	0.5817	0.2730	Cde	0.0930
CcDee	25	0.1634	0.4648	cde	0.0000
ccDEe	4	0.0261	0.0182	cDe	0.1520
CcDEe	2	0.0131	0.0265	CDe	0.5840
ccddee	8	0.0523	0.0523	cDE	0.0190
CCddee	1	0.0065	0.0020	CDE	0.0000
Ccddee	0	0.0000	0.0063		
	153	1.000	1.000		

TABLE 7. *Phenotype and gene frequencies of C^{w+} and C^{w-} signs in Roms from Podskalka.*

Phenotype	N	Obs. Freq.		Gene Frequencies	
C^w +	5	0.0329			0.0180
C^w –	147	0.9671			
	152	1.000			

TABLE 8. *Phenotype and gene frequencies of MN blood group system in Roms from Podskalka.*

Phenotype	N	Obs. Freq.	Exp. Freq.	Gene Frequencies	
M	60	0.3922	0.3938	m	0.6270
MN	72	0.4706	0.4675	n	0.3730
N	21	0.1372	0.1387		
	153	1.000	1.000		

TABLE 9. *Phenotype and gene frequencies of P blood group system in Roms from Podskalka.*

Phenotype	N	Obs. Freq.	Exp. Freq.	Gene Frequencies	
P_1^+	78	0.6240	0.6242	P	0.3870
P_2^-	47	0.3760	0.3758	p	0.6130
	125	1.000	1.000		

TABLE 10. *Phenotype and gene frequencies of Lutheran blood group system in Roms from Podskalka.*

Phenotype	N	Obs. Freq.	Exp. Freq.	Gene Frequencies	
Lu (a+b+)	7	0.0460	0.1020	Lu^a	0.0540
Lu (a+b-)	1	0.0066	0.0029	Lu^b	0.9460
Lu (a-b+)	144	0.9474	0.8951		
	152	1.000	1.000		

TABLE 11. *Phenotype and gene frequencies of Kell blood group system in Roms from Podskalka.*

Phenotype	N	Obs. Freq.	Exp. Freq.	Gene Frequencies	
K	0	0.0000	0.0002	K	0.0150
Kk	4	0.0298	0.0297	k	0.9850
k	130	0.9702	0.9701		
	134	1.000	1.000		

TABLE 12. *Phenotype and gene frequencies of Lewis blood group system in Roms from Podskalka.*

Phenotype	N	Obs. Freq.		Gene Frequencies	
Le (a+b-)	25	0.2717		Le	0.3920
Le (a-b+)	33	0.3587		le	0.6080
Le (a-b-)	34	0.3696			
	92	1.000			

TABLE 13. *Phenotype and gene frequencies of Duffy blood group system in Roms from Podskalka.*

Phenotype	N	Obs. Freq.	Exp. Freq.	Gene Frequencies	
Fy (a+b+)	34	0.3301	0.3302	Fy^a	0.4980
Fy (a+b-)	43	0.4175	0.4174	Fy^b	0.3310
Fy (a-b+)	23	0.2233	0.2233	Fy	0.1710
Fy (a-b-)	3	0.0291	0.0291		
	103	1.000	1.000		

TABLE 14. *Phenotype and gene frequencies of Kidd blood group system in Roms from Podskalka.*

Phenotype	N	Obs. Freq.	Exp. Freq.	Gene Frequencies	
Jk (a+b+)	52	0.5149	0.4766	Jk^a	0.6040
Jk (a+b-)	35	0.3465	0.3699	Jk^b	0.3960
Jk (a-b+)	14	0.1386	0.1535		
	101	1.000	1.000		

TABLE 15. *Phenotype and gene frequencies of A_1A_2BO blood group system in Roms from Slovakia.*

Phenotype	N	Obs. Freq.	Exp. Freq.	Gene Frequencies	
A_1	39	0.2786	0.2982	p_1	0.2230
A_2	5	0.0357	0.0165	p_2	0.0150
B	40	0.2857	0.2948	q	0.2270
O	40	0.2857	0.2823	r	0.5350
A_1B	16	0.1143	0.1013		
A_2B	0	0.000	0.0069		
	140	1.000	1.000		

TABLE 16. *Phenotype and gene frequencies of MN blood group system in Roms from Slovakia.*

Phenotype	N	Obs. Freq.	Exp. Freq.	Gene Frequencies	
M	64	0.3857	0.3643	m	0.6040
MN	61	0.4357	0.4785	n	0.3960
N	25	0.1786	0.1572		
	140	1.000	1.000		

TABLE 17. *Phenotype and haplotype frequencies of Rh blood group system in Roms from Slovakia.*

Phenotype	N	Obs. Freq.	Exp. Freq.	Haplotype Freq.	
CCDee	66	0.4714	0.4499	cde	0.2330
CCddee	2	0.0143	0.0056	Cde	0.0740
CcDEe	8	0.0572	0.0482	cdE	0.0000
CcDee	39	0.2786	0.3559	cDe	0.0570
Ccddee	6	0.0428	0.0347	CDe	0.6000
ccDEe	2	0.0143	0.0207	cDE	0.0360
ccDee	6	0.0428	0.0295	CDE	0.0000
ccddEE	0	0.0000	0.0013		
ccddee	11	0.0786	0.0542		
	140	1.000	1.000		

TABLE 18. *Phenotype and gene frequencies of P blood group system in Roms from Slovakia.*

Phenotype	N	Obs. Freq.		Gene Frequencies	
P_1^+	123	0.8786		P_1	0.6510
P_1^-	17	0.1214		P_2	0.3490
	140	1.000			

TABLE 19. *Phenotype and gene frequencies of Lutheran blood group system in Roms from Slovakia.*

Phenotype	N	Obs. Freq.	Exp. Freq.	Gene Frequencies	
Lu (a+b+)	7	0.0500	0.0490	Lu^a	0.0250
Lu (a+b-)	0	0.0000	0.0006	Lu^b	0.9750
Lu (a-b+)	133	0.9500	0.9504		
	140	1.000	1.000		

TABLE 20. *Phenotype and gene frequencies of Kell blood group system in Roms from Slovakia.*

Phenotype	N	Obs. Freq.	Exp. Freq.	Gene Frequencies	
KK	0	0.0000	0.0002	K	0.0150
Kk	4	0.0296	0.0294	k	0.9850
kk	131	0.9704	0.9704		
	135	1.000	1.000		

TABLE 21. *Phenotype and gene frequencies of Lewis blood group system in Roms from Slovakia.*

Phenotype	N	Obs. Freq.		Gene Frequencies	
Le (a+b-)	12	0.0869		Le	0.2530
Le (a-b+)	49	0.3551		le	0.7470
Le (a-b-)	77	0.5580			
	138	1.000			

TABLE 22. *Phenotype and gene frequencies of Duffy blood group system in Roms from Slovakia.*

Phenotype	N	Obs. Freq.	Exp. Freq.	Gene Frequencies	
Fy (a+b+)	55	0.3929	0.3363	Fy^a	0.4830
Fy (a+b-)	51	0.3643	0.3959	Fy^b	0.3480
Fy (a-b+)	30	0.2143	0.2393	Fy	0.1690
Fy (a-b-)	4	0.0285	0.0285		
	140	1.000	1.000		

TABLE 23. *Phenotype and gene frequencies of Kidd blood group system in Roms from Slovakia.*

Phenotype	N	Obs. Freq.	Exp. Freq.	Gene Frequencies	
Jk (a+b+)	46	0.3433	0.4992	Jk^a	0.4970
Jk (a+b-)	41	0.3060	0.2308	Jk^b	0.5030
Jk (a-b-)	47	0.3507	0.2700		
	134	1.000	1.000		

TABLE 24. *Phenotype and gene frequencies of A_1A_2BO blood group system in "Olach" Roms from settlement Vinodol near Nitra in west Slovakia.*

Phenotype	N	Obs. Freq.	Exp. Freq.	Gene Frequencies	
A_1	24	0.2017	0.1897	p_1	0.1100
A_2	5	0.0420	0.0395	p_2	0.0240
B	8	0.0672	0.1004	q	0.0600
O	81	0.6807	0.6498	r	0.8060
A_1B	1	0.0084	0.0167		
A_2B	0	0.0000	0.0039		
	119	1.000	1.000		

TABLE 25. *Phenotype and haplotype frequencies of Rh blood group system in "Olach" Roms.*

Phenotype	N	Obs. Freq.	Exp. Freq.	Haplotype Freq.	
ccDee	0	0.0000	0.0000		
CCDee	34	0.2857	0.2892	CDe	0.5380
CcDee	60	0.5042	0.4882		
ccDEe	2	0.0168	0.0076	cDE	0.0080
CcDEe	0	0.0000	0.0090		
ccddee	23	0.1933	0.2050	cde	0.4540
CCddee	0	0.0000	0.0000		
Ccddee	0	0.0000	0.0010		
	119	1.000	1.000		

TABLE 26. *Phenotype and gene frequencies of MN blood group system in "Olach" Roms.*

Phenotype	N	Obs. Freq.	Exp. Freq.	Gene Frequencies	
M	53	0.4454	0.4865	m	0.6980
MN	60	0.5042	0.4220	n	0.3020
N	6	0.0504	0.0915		
	119	1.000	1.000		

TABLE 27. *Phenotype and gene frequencies of Kell blood group system in "Olach" Roms.*

Phenotype	N	Obs. Freq.	Exp. Freq.	Gene Frequencies	
KK	0	0.0000	0.0040	K	0.0630
Kk	15	0.1260	0.1181	k	0.9370
kk	104	0.8740	0.8779		
	119	1.000	1.000		

TABLE 28. *Phenotype and gene frequencies of P blood group system in "Olach" Roms.*

Phenotype	N	Obs. Freq.	Exp. Freq.	Gene Frequencies	
P_1^+	43	0.3613	0.3613	P_1	0.2010
P_1^-	79	0.6387	0.6387	P_2	0.7990
	122	1.000	1.000		

TABLE 29. *Phenotype and gene frequencies of Lutheran blood group system in "Olach" Roms.*

Phenotype	N	Obs. Freq.	Exp. Freq.	Gene Frequencies	
Lu (a+b+)	46	0.3866	0.3119	Lu^a	0.1930
Lu (a+b-)	0	0.0000	0.0373	Lu^b	0.8070
Lu (a-b+)	73	0.6134	0.6508		
	119	1.000	1.000		

TABLE 30. *Phenotype and gene frequencies of Lewis blood group system in "Olach" Roms.*

Phenotype	N	Obs. Freq.		Gene Frequencies	
Le (a+b-)	15	0.1328		Le	0.4760
Le (a-b+)	67	0.5929		le	0.5240
Le (a-b-)	31	0.2743			
	113	1.000			

TABLE 31. *Phenotype and gene frequencies of Duffy blood group system in "Olach" Roms.*

Phenotype	N	Obs. Freq.	Exp. Freq.	Gene Frequencies	
Fy (a+b+)	83	0.6975	0.4987	Fy^a	0.5250
Fy (a+b-)	21	0.1765	0.2758	Fy^b	0.4750
Fy (a-b+)	15	0.1260	0.2255		
Fy (a-b-)	0	0.0000	0.0000		
	119	1.000	1.000		

TABLE 32. *Phenotype and gene frequencies of Kidd blood group system in "Olach" Roms.*

Phenotype	N	Obs. Freq.	Exp. Freq.	Gene Frequencies	
Jk (a+b+)	94	0.7900	0.4997	Jk^a	0.4870
Jk (a+b-)	11	0.0924	0.2375	Jk^b	0.5130
Jk (a-b+)	14	0.1176	0.2628		
	119	1.000	1.000		

TABLE 33. *Phenotype and gene frequencies of Hp serum group system in "Olach" Roms.*

Phenotype	N	Obs. Freq.	Exp. Freq.	Gene Frequencies	
Hp 1-1	12	0.1008	0.0915	Hp^1	0.3030
Hp 1-2	48	0.4034	0.4220	Hp^2	0.6970
Hp 2-2	59	0.4958	0.4865		
	119	1.000	1.000		

TABLE 34. *Phenotype and gene frequencies of Gc serum group factor in "Olach" Roms.*

Phenotype	N	Obs. Freq.	Exp. Freq.	Gene Frequencies	
Gc 1-1	37	0.3109	0.2984	Gc^1	0.5460
Gc 1-2	56	0.4706	0.4957	Gc^2	0.4540
Gc 2-2	26	0.2185	0.2059		
	119	1.000	1.000		

TABLE 35. *Phenotype and gene frequencies of ACP red cell isoenzyme in "Olach" Roms.*

Phenotype	N	Obs. Freq.	Exp. Freq.	Gene Frequencies	
AA	6	0.0508	0.0563	P^a	0.2370
BB	68	0.5763	0.5817	P^b	0.7630
AB	44	0.3729	0.3620		
	119	1.000	1.000		

TABLE 36. *Phenotype and gene frequencies of PGM red cell isoenzyme in "Olach" Roms.*

Phenotype	N	Obs. Freq.	Exp. Freq.	Gene Frequencies	
PGM 1-1	14	0.6087	0.6130	PGM_1^1	0.7830
PGM 1-2	8	0.3478	0.3394	PGM_1^2	0.2170
PGM 2-2	1	0.0435	0.0476		
	23	1.000	1.000		

TABLE 37. *Phenotype and gene frequencies of ADA red cell isoenzyme in "Olach" Roms.*

Phenotype	N	Obs. Freq.	Exp. Freq.	Gene Frequencies	
ADA 1-1	72	0.7200	0.7396	ADA^1	0.8600
ADA 1-2	28	0.2800	0.2408	ADA^2	0.1400
ADA 2-2	0	0.0000	0.0196		
	100	1.000	1.000		

TABLE 38. *Phenotype and gene frequencies of EsD red cell isoenzyme in "Olach" Roms.*

Phenotype	N	Obs. Freq.	Exp. Freq.	Gene Frequencies	
EsD 1-1	93	0.7949	0.7903	EsD^1	0.8890
EsD 1-2	22	0.1880	0.1974	EsD^2	0.1110
EsD 2-2	2	0.0171	0.0123		
	117	1.000	1.000		

Gene frequencies of blood group systems in Roms of Europe and their comparison with non-Rom population of east Slovakia (*Tables 39 – 47*).

TABLE 39. *A_1A_2BO system.*

Population	Authors	N	p_1	p_2	q	r
Roms						
Slovakia	Bernasovský et al. (1993)	140	0.223	0.015	0.227	0.535
east Slovakia	Bernasovský et al. (1976)	2,935	0.236	0.022	0.193	0.549
Podskalka	Bernasovská et al. (1976)	153	0.273	0.018	0.252	0.457
"Olach"	Bernasovský et al. (1992)	119	0.101	0.024	0.050	0.825
Hungary	Rex-Kiss et al. (1973)	600	0.231	0.033	0.217	0.519
Yugoslavia	Hočevar (1965)	350	0.207	0.125	0.085	0.583
France	Cazal et al. (1952)	113	0.185	0.042	0.316	0.457
Sweden	Beckman et al. (1965)	115	0.296	0.093	0.049	0.562
England	Clarke (1973)	109	0.200	0.109	0.064	0.627
Wales	Harper et al. (1977)	70	0.201	0.047	0.075	0.676
Non-Roms						
east Slovakia	Juríčková et al. (1993a)	1,466	0.202	0.065	0.182	0.551

TABLE 41. *Mn system.*

Population	Authors	N	m	n
Roms				
Slovakia	Bernasovský et al. (1993)	140	0.604	0.396
east Slovakia	Bernasovský et al. (1976)	405	0.530	0.470
Podskalka	Bernasovská et al. (1976)	153	0.627	0.373
"Olach"	Bernasovský et al. (1992)	119	0.698	0.302
Hungary	Rex-Kiss et al. (1973)	536	0.559	0.441
Yugoslavia	Hočevar (1965)	350	0.426	0.574
France	Cazal et al. (1951)	86	0.593	0.407
Sweden	Beckman et al. (1965)	115	0.479	0.521
England	Clarke (1973)	109	0.702	0.298
Wales	Harper et al. (1977)	70	0.464	0.536
Greece	Bartsocas et al. (1979)	200	0.678	0.323
Non-Roms				
east Slovakia	Juríčková et al. (1993a)	1,455	0.668	0.332

TABLE 42. *P system.*

Population	Authors	N	P_1	P_2
Roms				
Slovakia	Bernasovský et al. (1993)	140	0.651	0.349
Podskalka	Bernasovský et al. (1976)	125	0.387	0.613
"Olach"	Bernasovský et al. (1992)	122	0.195	0.805
France	Cazal et al. (1951)	74	0.651	0.349
Wales	Harper et al. (1977)	48	0.487	0.513
Non-Roms				
east Slovakia	Juríčková et al. (1993a)	1,937	0.580	0.420

TABLE 43. *Lutheran system.*

Population	Authors	N	Lu^a	Lu^b
Roms				
Slovakia	Bernasovský et al. (1993)	140	0.025	0.975
Podskalka	Bernasovský et al. (1976)	152	0.054	0.946
"Olach"	Bernasovský et al. (1992)	119	0.108	0.892
England	Clarke et al. (1973)	107	0.033	0.967
Non-Roms				
east Slovakia	Juríčková et al. (1993a)	2,707	0.086	0.914

TABLE 44. *Kell system.*

Population	Authors	N	K	k
Roms				
Slovakia	Bernasovský et al. (1993)	135	0.015	0.985
Podskalka	Bernasovský et al. (1976)	134	0.015	0.985
"Olach"	Bernasovský et al. (1992)	119	0.063	0.937
England	Clarke et al. (1973)	108	0.034	0.976
Wales	Harper et al. (1977)	70	0.000	1.000
Greece	Bartsocas et al. (1979)	200	0.067	0.933
Non-Roms				
east Slovakia	Juríčková et al. (1993a)	4,463	0.032	0.968

TABLE 45. *Lewis system.*

Population	Authors	N	Le	le
Roms				
Slovakia	Bernasovský et al. (1993)	140	0.253	0.747
Podskalka	Bernasovský et al. (1976)	92	0.392	0.608
"Olach"	Bernasovský et al. (1992)	113	0.476	0.524
Non-Roms				
east Slovakia	Juríčková et al. (1993a)	1,229	0.238	0.762

TABLE 46. *Duffy system.*

Population	Authors	N	Fy^a	Fy^b	Fy
Roms					
Slovakia	Bernasovský et al. (1993)	140	0.483	0.348	0.169
Podskalka	Bernasovský et al. (1976)	103	0.498	0.331	0.171
"Olach"	Bernasovský et al. (1976)	119	0.525	0.475	0.000
England	Clarke (1973)	106	0.362	0.638	0.000
Wales	Harper et al. (1977)	69	0.398	0.602	0.000
Greece	Bartsocas et al. (1979)	118	0.606	0.394	0.000
Non-Roms					
east Slovakia	Juríčková et al. (1993a)	1,596	0.460	0.540	0.000

TABLE 47. *Kidd system.*

Population	Authors	N	Jk^a	Jk^b
Roms				
Slovakia	Bernasovský et al. (1993)	134	0.480	0.520
Podskalka	Bernasovský et al. (1976)	101	0.608	0.392
"Olach"	Bernasovský et al. (1992)	111	0.487	0.513
Non-Roms				
east Slovakia	Juríčková et al. (1993a)	2,320	0.578	0.422

Gene frequencies of serum group systems in Roms of Europe and their comparison with non-Rom population of east Slovakia (*Tables 48 – 49*).

TABLE 48. *Haptoglobins.*

Population	Authors	N	Hp1	Hp2
Roms				
"Olach"	Bernasovský et al. (1992)	119	0.302	0.698
Slovakia	Gáliková et al. (1969)	360	0.150	0.850
Wales	Harper et al. (1977)	76	0.237	0.763
England	Clarke (1973)	103	0.417	0.583
Sweden	Beckman et al. (1965)	115	0.117	0.883
Yugoslavia	Fraser et al. (1969)	38	0.171	0.829
Hungary	Rex-Kiss et al. (1973)	520	0.200	0.800
Non-Roms				
east Slovakia	Juríčková et al. (1993b)	4,107	0.332	0.668

TABLE 49. *Gc factor*

Population	Authors	N	Gc^1	Gc^2
Roms				
"Olach"	Bernasovský et al. (1992)	119	0.546	0.454
Yugoslavia	Fraser et al. (1969)	18	0.805	0.195
Non-Roms				
east Slovakia	Juríčková et al. (1993b)	2,458	0.677	0.323

Gene frequencies of red cell isoenzymes in Roms of Europe and their comparison with non-Rom population of east Slovakia (*Tables 50 – 52*).

TABLE 50. *ACP red cell isoenzyme.*

Population	Authors	N	P^a	P^b	P^c
Roms					
"Olach"	Bernasovský et al. (1992)	119	0.237	0.763	0.000
Slovakia	Siváková (1983)	235	0.289	0.711	0.000
Wales	Harper et al. (1977)	64	0.336	0.624	0.040
Non-Roms					
east Slovakia	Juríčková et al. (1993c)	2,402	0.328	0.640	0.032

TABLE 51. *PGM red cell isoenzyme.*

Population	Authors	N	$PGM^1{}_1$	$PGM^2{}_2$
Roms				
"Olach"	Bernasovský et al. (1992)	23	0.783	0.217
Slovakia	Siváková (1983)	231	0.656	0.344
Wales	Harper et al. (1977)	69	0.805	0.195
Non-Roms				
east Slovakia	Juríčková et al. (1993c)	1,304	0.733	0.267

TABLE 52. *EsD red cell isoenzyme.*

Population	Authors	N	EsD^1	EsD^2
Roms				
"Olach"	Bernasovský et al. (1992)	117	0.889	0.111
Wales	Harper et al. (1977)	68	0.949	0.051
England	Welch, Lee (1974)	153	0.895	0.105
Non-Roms				
east Slovakia	Juríčková et al. (1993c)	2,092	0.894	0.106

TABLE 53. *Comparison of gene frequencies of blood group systems in non-Rom population of east Slovakia with non-Rom populations of Prague and Bratislava.*

System	Population		
	east Slovakia N = 1,466	Prague N=2,298 Herzog (1992)	Bratislava N=1,295 Bambúchová (1985)
A B O			
A_1	0.2017	0.2042	0.2247
A_2	0.0648	0.0702	0.0463
B	0.1825	0.1574	0.1600
O	0.5510	0.5682	0.5690
Rh	N=1638	Bratislava N=1,491 Ferák (1971)	
CDE	0.0000	0.0040	
CDe	0.4869	0.4191	
Cde	0.0000	0.0292	
cDE	0.0989	0.1204	
cDe	0.0171	0.0225	
cdE	0.0000	0.0045	
cde	0.3971	0.4003	
MN	N=1,455	Prague N=1,186 Herzog (1992)	Bratislava N=1,271 Bambúchová (1985)
m	0.6680	0.5489	0.5775
n	0.3320	0.4511	0.4225
P	N=1,937	N=891	N=1,153
P	0.5898	0.5995	0.5680
p	0.4102	0.4005	0.4320
Duffy	N=1,596	N=500	N=1,150
Fy^a	0.4604	0.4396	0.4504
Fy^b	0.5396	0.5604	0.5496
Lutheran	east Slovakia N=2,707	Prague N=985 Herzog (1992)	Bratislava N=8 Bambúchová (1985)
Lu^a	0.0859	0.0284	0.0625
Lu^b	0.9141	0.9716	0.9375
Lewis	N=1,229	N=200	N=155
Le	0.2387	0.2064	0.2665
le	0.7613	0.7936	0.7335
Kell	N=4,463	N=510	N=1,153
K	0.0321	0.0462	0.0433
k	0.9679	0.9538	0.9567

TABLE 53. *Cont.*

Kidd	N=2,320	N=675	N=147
Jk^a	0.5783	0.5247	0.4490
Jk^b	0.4217	0.4753	0.5510

TABLE 54. *Comparison of gene frequencies of serum group systems and red cell isoenzymes in non-Rom population of east Slovakia with non-Rom populations of Prague and Bratislava.*

System	Population		
	east Slovakia N=4,107	Prague N=918 Herzog (1992)	Bratislava N=1,278 Bambúchová (1985)
Hp			
Hp^1	0.3316	0.4129	0.3646
Hp^2	0.6684	0.5871	0.6354
Gc	N=2,458	N=560	N=1,259
Gc^1	0.6766	0.5813	0.6726
Gc^2	0.3234	0.4187	0.3274
Inv	N=4,181		N=1,259
Inv^1	0.0399		0.0439
Inv^2	0.9601		0.9561
ACP	N=2,402	N=783	N=1,149
P^a	0.3277	0.3444	0.3530
P^b	0.6397	0.5943	0.5940
P^c	0.0326	0.0613	0.0530
PGM	N=1,304	N=646	N=1,152
PGM^1	0.7328	0.7717	0.7160
PGM^2	0.2672	0.2283	0.2840
ADA	N=1,948	N=616	
ADA^1	0.9279	0.9351	
ADA^2	0.0721	0.0649	
EsD	N=2,092	N=100	
EsD^1	0.8939	0.8850	
EsD^2	0.1061	0.1150	

CONCLUSION

Within the framework of seroanthropological study of Rom ethnic groups and non-Rom inhabitants, gene and haplotype frequencies (given in %) were ascertained as follows:

Rom inhabitants of east Slovakia:

$p_1 = 23.6$, $p_2 = 2.2$, $q = 19.3$, $r = 54.9$, $D = 67.7$, $d = 32.3$, $m = 53.0$, $n = 47.0$.

Roms of Podskalka near Humenné:

$p_1 = 27.3$, $p_2 = 1.8$, $q = 25.2$, $r = 45.7$, $cde = 15.2$, $Cde = 9.3$, $cDe = 15.2$, $CDe = 58.4$, $cDE = 1.9$, $c^w = 1.8$, $m = 62.7$, $n = 37.3$, $P_1 = 38.7$, $P_2 = 61.3$, $Lu^a = 5.4$, $Lu^b = 94.6$, $K = 1.5$, $k = 98.5$, $Le = 39.2$, $le = 60.8$, $Fy^a = 49.8$, $Fy^b = 33.1$, $Fy = 17.1$, $Jk^a = 60.4$, $Jk^b = 39.6$.

Slovak Roms:

$p_1 = 22.3$, $p_2 = 1.5$, $q = 22.7$, $r = 53.5$, $cde = 23.3$, $Cde = 7.4$, $cDe = 5.7$, $CDe = 60.0$, $CDE = 3.6$, $m = 60.4$, $n = 39.6$, $P_1 = 65.1$, $P_2 = 34.9$, $Lu^a = 2.5$, $Lu^b = 97.5$, $K = 1.5$, $k = 98.5$, $Le = 25.3$, $le = 74.7$, $Fy^a = 48.3$, $Fy^b = 34.8$, $Fy = 16.9$, $Jk^a = 48.0$, $Jk^b = 52.0$.

"Olach" Roms:

$p_1 = 11.0$, $p_2 = 2.4$, $q = 6.0$, $r = 80.6$, $CDe = 53.8$, $cDE = 0.8$, $cde = 45.4$, $m = 69.8$, $n = 30.2$, $K = 6.3$, $k = 93.7$, $P_1 = 20.1$, $P_2 = 79.9$, $Lu^a = 19.3$, $Lu^b = 80.7$, $Le = 47.6$, $le = 52.4$, $Fy^a = 52.5$, $Fy^b = 47.5$, $Jk^a = 48.7$, $Jk^b = 51.3$, $Hp^1 = 30.3$, $Hp^2 = 69.7$, $Gc^1 = 54.6$, $Gc^2 = 45.4$, $P^a = 23.7$, $P^b = 76.3$, $PGM_1{}^1 = 78.3$, $PGM_1{}^2 = 21.7$, $ADA^1 = 86.0$, $ADA^2 = 14.0$, $EsD^1 = 88.9$, $EsD^2 = 11.1$.

Non-Rom inhabitants of east Slovakia:

$p_1 = 20.2$, $p_2 = 6.5$, $q = 18.2$, $r = 55.1$, $cde = 39.7$, $CDe = 48.7$, $cDE = 9.9$, $cDe = 1.7$, $m = 66.8$, $n = 33.2$, $P_1 = 58.9$, $P_2 = 41.1$, $K = 3.2$, $k = 96.8$, $Le = 23.9$, $le = 76.1$, $Fy^a = 46.0$, $Fy^b = 54.0$, $Jk^a = 57.8$, $Jk^b = 42.2$, $Lu^a = 8.6$, $Lu^b = 91.4$, $Hp^1 = 33.2$, $Hp^2 = 66.8$, $Gc^1 = 67.7$, $Gc^2 = 32.3$, $Inv^1 = 3.9$, $Inv^2 = 96.1$, $P^a = 32.8$, $P^b = 64.0$, $P^c = 3.2$, $PGM^1 = 73.3$, $PGM^2 = 26.7$, $ADA^1 = 92.8$, $ADA^2 = 7.2$, $EsD^1 = 89.4$, $EsD^2 = 10.6$.

The comparison of our results with the data of other authors who investigated blood groups frequencies in Roms shows that B(q) gene frequency of ABO blood system varies from 4.9% to 31.8%. The values in our studied groups are within the range of the greatest ones, except for "Olach" Roms, in which very low gene frequency was calculated.

The frequency ratio value of p/q genes in Roms living in east Slovakian Podskalka and Slovakia was determined to be within the range of 1.1 and 1.4. In "Olach" Roms the ratio reaches the value of 2.2. High gene frequency and low values of p/q ratio are typical for Indian subcontinent population, where the greatest B blood group distribution was found.

D gene (Rh^-) frequency in the majority of European Roms falls into the range of 30 – 45%. In Rom children from Podskalka 24% distribution of the gene was found. The value varies from 10 to 30% in Indian population.

Higher CCDee phenotype frequency was observed in Roms from Podskalka (58.17%) and Slovakia (47.14%) than in non-Rom population from east Slovakia (22.79%) and "Olach" Roms (28.57%).

For the Indian subcontinent a broad distribution of CCDee phenotype is typical.

The gene frequency in our studied Rom population can be found within the range of 53.0 – 69.8% and is not different from the Indian subcontinent.

The further investigated blood group systems in Roms are less informative and the reason is that their gene frequencies are very similar to those in both European and Indian populations. In Rom samples

from Podskalka and Slovakia identical frequencies of Fy allele (17.1%, 16.9%) were found. In the European population this allele occurs very rarely. The occurrence of that atypical allele in Roms indicates that more intensive care during some immunogenetical paternity expertises is needed.

In the "Olach" Rom group 30.3% occurrence of Hp^1 allele was found, overlapping the value in Slovak Roms as well as in the Indian population.

Comparing the P^a and P^b genes frequencies of acidphosphatase (ACP) isoenzymes in "Olach" Roms with the data in Slovak Roms and Roms from Wales the lowest P^a gene frequency as well as P^c allele absence was found in our group.

Gene $PGM_1{}^1$ frequency of isoenzyme phosphoglucomutase (78.3%) in "Olach" Roms, similar to that in Indian population, points also to genetic affinity of Roms to Indians.

High frequency of EsD^1 gene system of D esterase was observed in "Olach" Roms to be in accordance with the situation in English Roms as well as in Roms from Wales.

According to the results of seroanthropological research in "Olach" Roms their genetic pool is essentially different from non-Rom population as well as from other studied Rom groups.

The results of genetic differentiation assessment by calculating the genetic distinctions using E, D and S indexes on the basis of gene frequencies in the studied genetic markers in "Olach" and Slovak Roms show that there are the greatest genetic distinctions, and the most distinct alleles frequencies between "Olach" and Slovak Roms and that there is the most evident similarity between Slovak Roms and the Indian population.

Both our and the data of the European Roms point to the fact that the genetic pool in Rom population is different from that in the host population.

This difference supports the assumption of Indian origin of Roms. Interpopulational genetic variability in European Roms is most probably due to the genetic drift and to the founder efect.

The tendency of increasing B (q), D (Rh) and Fy^a gene frequencies towards the East was observed during the comparison of our results in non-Rom inhabitants from east Slovakia with the data from Prague, Brno and Bratislava.

On the other side, the tendency of decreasing Hp^1 gene frequency from the West to the East is shown by our study of haptoglobin serum system as part of a general European tendency.

Gene frequencies calculated in both Rom and non-Rom population can be used as an important basis for calculation of Essen-Moller-Geyger tables of critical values of paternity probability in juridical-judgment paternity expertises, further for planned blood transfusion service as well as for further anthropological research.

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