African Journal of Biotechnology Vol. 10(38), pp. 7324-7329, 25 July, 2011
Available online at http://www.academicjournals.org/AJB
DOI: 10.5897/AJB10.1395
ISSN 1684–5315 © 2011 Academic Journals

Full Length Research Paper

Distribution of ABO and Rh-Hr blood group antigens, alleles and haplotypes in the mountain region of Ajara (Georgia)

M. Nagervadze*, A. Diasamidze, L. Akhvlediani, G. Dumbadze, R. Khukhunaishvili, M. Koridze and S. Tckvitinidze

Department of Biology, Shota Rustaveli State University, Batumi, Georgia.

Accepted 18 March, 2011

ABO and Rh-Hr blood group antigens represent a genetically stably determined trait with many-sided biological and clinical significance. The indigenous Ajarian population (105 subjects) was investigated for ABO Rh-Hr red cell blood group antigens. Using immunoserologic methods, seven blood group antigens (A, B, C, c, D, E and e) were studied. The obtained results were statistically processed. 44 ± 4.9% of the said region's population are carriers of the blood group 0(I), 37 ± 4.82% are carriers of the phenotypic group A(II). The concentration of the B(III) blood-group carriers (17 ± 3.7%) is rather high and the AB(IV) blood group is observable in 2 ± 1.4%. In studying individual antigens of the Rh system in the Khulo population, the maximum frequency distribution of the *e* antigen was found (100 ± 3.12%), and followed in frequency by the *c* antigen (89 ± 3.12%). The frequency of the *D* antigen was 82 ± 3.8%, that of the *c* antigen was 61 ± 4.8%, and that of the *E* antigen was 23 ± 4.2%. Six Rh-phenotypic groups of various frequencies were fixed. The CcDee phenotype is the most characteristic of the said region's population. Its distribution frequency is 38 ± 4.8%.

Key words: Blood group antigens, Rh system, ABO system, blood, immunoserology.

INTRODUCTION

The blood cell group antigens represent genetically stably determined features (Anstee, 1990; Schenken-Brunner, 2000). In spite of the stable specific traits, the respective hereditary factors are characterized by rather high polymorphism at the level of populations and species within the species' gene pool. This in itself is indicative of the essential significance of the phenotypic individuality determined by different gene combinations in the establishment of a common adaptive balance with the respective genotype environment. Hence, the erythrocytic antigenic trait is of a many-sided biological and clinical significance.

The principal bio-clinical significance of the erythrocytic group antigens is still associated with the living immune characteristics. It plays a special role in blood transfusion (Schonewille, 2006), epidemiology (Vojvodic, 2000) and transplantology (Bolan et al., 2001; Matsui et al., 1999; Schonewille et al., 2006; Bucin et al., 2006). The significance of the said systems in human genetics is distinguished (Cartron, 1994; Shubin et al., 1997) and particularly in terms of studying its population peculiarities (Paoli and Franceschi, 1990; Nasidze, 1995; Kucher et al., 2000; Nersisian et al., 1996).

The erythrocytic group systems have special significance in ethical anthropology (Salamatina and Nasidze, 1993; Varsahr et al., 2003; Schmidt and Scheil, 2003; Shneider et al., 2002). Their hereditary basis is so stable that their study in order to identify the origin of a specific ethnical group will provide reliable data (O'Rourke et al., 1992). Humans have individual group antigens, and they can serve as their identity identifiers. Based on the said property, blood group systems are widely used in forensic medicine (Pandey et al., 1995; Ikemoto, 1995) and criminology.

As it seems, the composition of the blood group systems' antigens in human populations is a result of a balance polymorphism established during the evolutionary periods. According to literary sources (Kiango,

*Corresponding author. E-mail: Marinager@inbox.ru.

1982; Kolesnik and Khludok, 1992; Khetsuriani and Gamkrelidze, 1995; Su et al., 2001; Graziano et al., 1997), a correlation between the balance polymorphism and various infectious or non-infectious diseases has been established by the erythrocytic group antigens.

From the foregoing, we have set an objective to establish the genetic geography of the erythrocytic group antigens in the highland Khulo region of Ajara. The available data concerning the distribution of the erythrocytic group antigens in the Ajarian Autonomous Republic are rather scarce. The relevant statistics have been obtained from the archive (Archives LGC IoGen, №141).

MATERIALS AND METHODS

The indigenous Ajarian population of the Khulo region have been studied for the ABO and Rh-Hr erythrocytic group markers. 105 unrelated, healthy persons were included in the investigation. Blood samples were collected by finger puncture. Red cells were washed tree times with 0.9 saline. Tests for red cell antigens were performed immediately after bleeding. Tests were carried out by standard test-tube technique and plate reaction for the following antigens: A, B, C, c, D, E and e.

In the course of the work, the following specific test systems were used: anti-AB, -B, -A, -D, -C, -c, -E and -e (Gemostandart Ltd., Moscow). The obtained results were statistically processed. The ABO system gene alleles' frequency was computed by the formula proposed by F. Bernstein and used in investigation of three-allele genetic systems. The frequency of the 0, A and B genes in the given case were indicated by the letters *r*, *p* and *q*:

$$r = \sqrt{O}$$

$$p = 1 - \sqrt{A + O}$$

$$q = 1 - \sqrt{B + O}$$

Where, 0, A and B – 0(I), A(II) and B(III) is the ratio of the group carrier people in relation to the total number of the subjects of the study. The frequency of the Rh-system genes and haploid types was computed by using the following formulas:

$$D = 1 - \sqrt{dd}$$

$$C = 1 - \sqrt{cc}$$

$$E = 1 - \sqrt{ee}$$

$$c = 1 - \sqrt{CC}$$

$$e = 1 - \sqrt{EE}\ .$$

Where, D, C, E, c and e is the number of the gene-carrying persons in correlation with the number of the study subjects, and dd, cc, ee, CC and EE are the corresponding phenotype frequency.

The Rh-haplotypes frequency is computed by the formula proposed by A. E. Mourant:

$$cde = \sqrt{ccddee}$$

$$Cde = \frac{Ccddee}{2cde}$$

$$cdE = \frac{ccddEe}{2cde}$$

$$cDe = \frac{ccDee}{2cde}$$

$$cDE = \sqrt{ccDEE + cdE^2} - cdE$$

$$CDe = \sqrt{CCDee + Cde^2} - Cde$$

$$CDE = \frac{CCDEe}{2(CDe + cde)}$$

Where, ccddee, Ccddee, ccddEe, ccDee, CCDee and ccDEE are the corresponding phenotypes' frequency. The errors in the frequency of genes were computed by the formula:

$$M = \sqrt{P(100 - P)/n}$$

Where, P is the frequency of antigens in percentage and n is the number of the study subject.

RESULTS AND DISCUSSION

Number of peculiarities was fixed in studying the Khulo region population for the erythrocytic group antigens. 44 ± 4.9% of the said region's population are carriers of the blood group 0(I) and 37 ± 4.82% are carriers of the phenotypic group A(II). The concentration of the carriers of the B(III) blood group is higher (17 ± 3.7%). The AB(IV) blood group carriers constitute 2 ± 1.4% (Figure 1).

When studying concentrations of the ABO-system r, p, q alleles, it was revealed that the r allele concentration equaled 0.6. There is a non significant difference between the concentrations of the p(0.21) and q(0.19) alleles (Figure 2). When studying individual alleles of the Rh system, the maximum frequency (100 ± 0%) of the e antigens was revealed in the Khulo region population, followed by the frequency value of the c antigen (89 ± 3.2%). The frequency of the D-antigen was 82 ± 3.8%. The C-antigen frequency is 61 ± 4.8%, and the E-antigen has less concentration (23 ± 4.2%) (Figure 3). The *e* alleles had the highest concentration of the Rh-system alleles in the Khulo region population. Their frequency in the said population equals 0.87; the concentration of the *c* allele is somewhat lower (0.64). The *D* allele

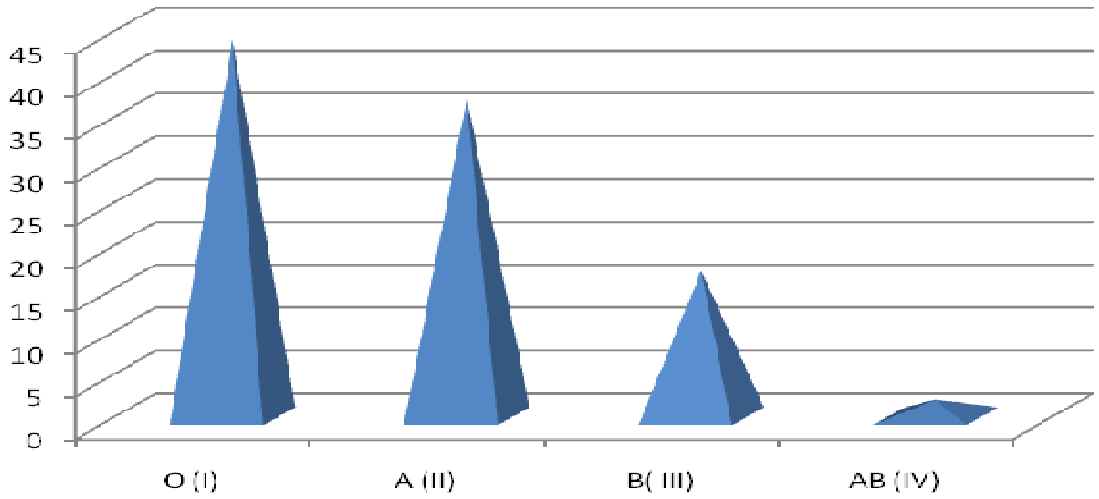

Figure 1. Peculiarities of the ABO-system phenotypic groups' distribution in the Ajarian population of Khulo region.

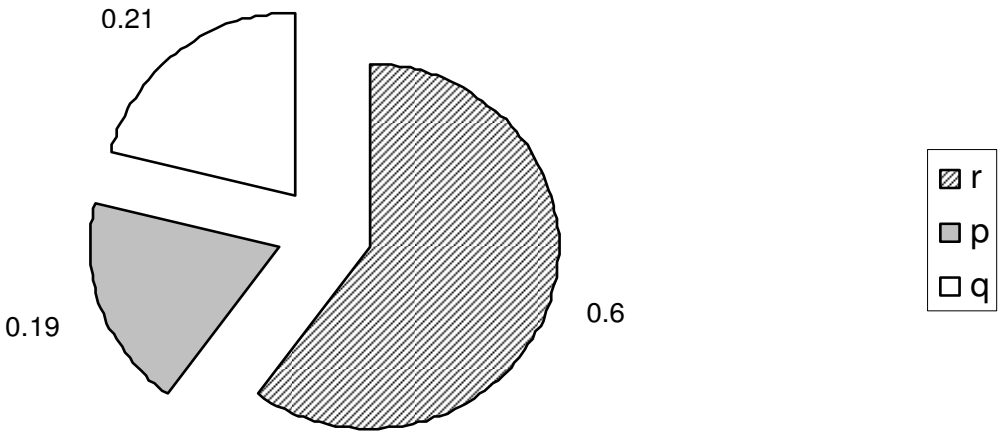

Figure 2. Concentrations of the ABO-system alleles in the Khulo region population.

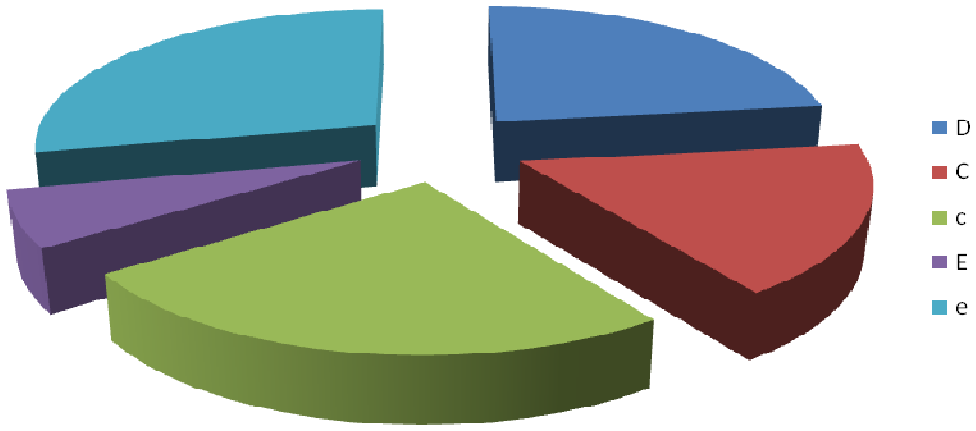

Figure 3. Peculiarities of the Rh-system antigens distribution/frequency in the Khulo region population of Ajara.

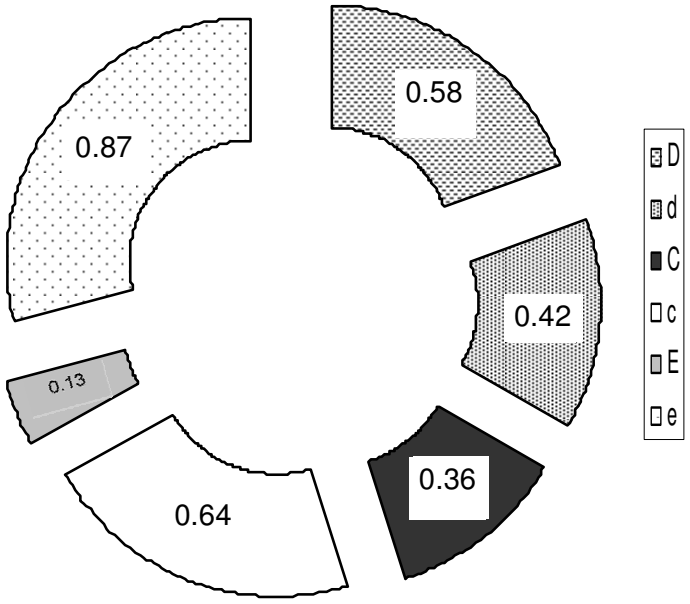

Figure 4. Concentrations of the Rh-system alleles in the Khulo region population.

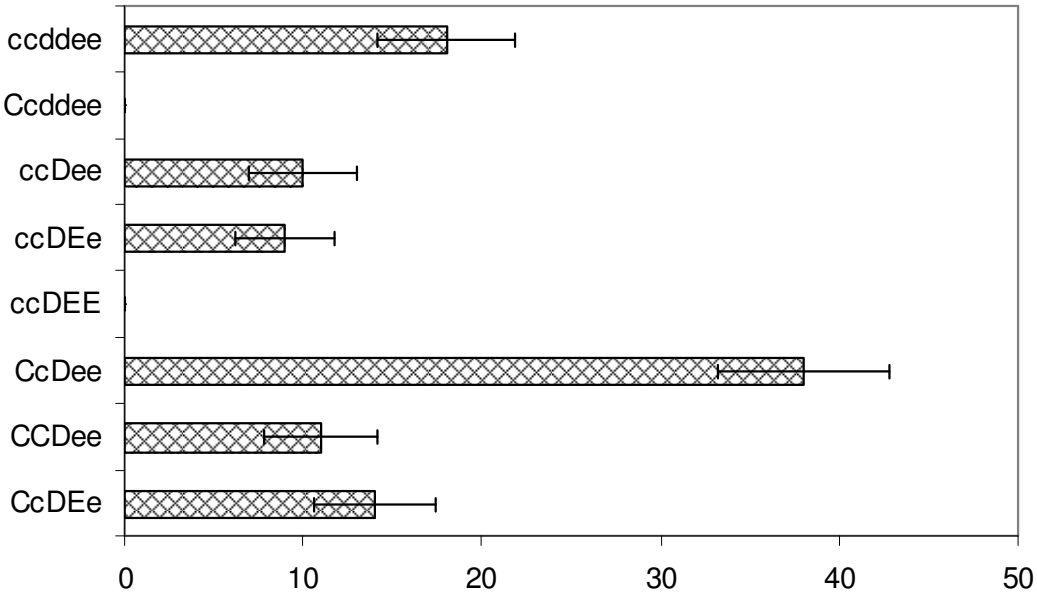

Figure 5. Distribution peculiarities of the Rh-phenotypic groups in the Khulo region population of the Ajarian Autonomous Republic.

concentration equals 0.58 and that of the *d* allele is 0.42. The *C* allele had a relatively low concentration (0.36). The lowest concentration value (0.13) is a characteristic of the *E* allele (Figure 4).

Six Rh-phenotypic groups with various frequency distributions were fixed for the Khulo region population. The most characteristic of the said region's population is the CcDee phenotype. Its frequency distribution is 38 ± 4.8%. Twice less frequency is characteristic of the ccdee (18 ± 3.84%). The concentration of the CcDEe phenotype carriers totals 14 ± 3.4%. The CCDee-phenotype frequency distribution equals 11 ± 3.12%. Almost equal frequency is a characteristic of the ccDEe (9 ± 2.8%) and ccDee (10 ± 3%) phenotypic groups (Figure 5). In contrast to other regions of Ajara, the Ccddee and ccDEE phenotypic groups have not been fixed in Khulo

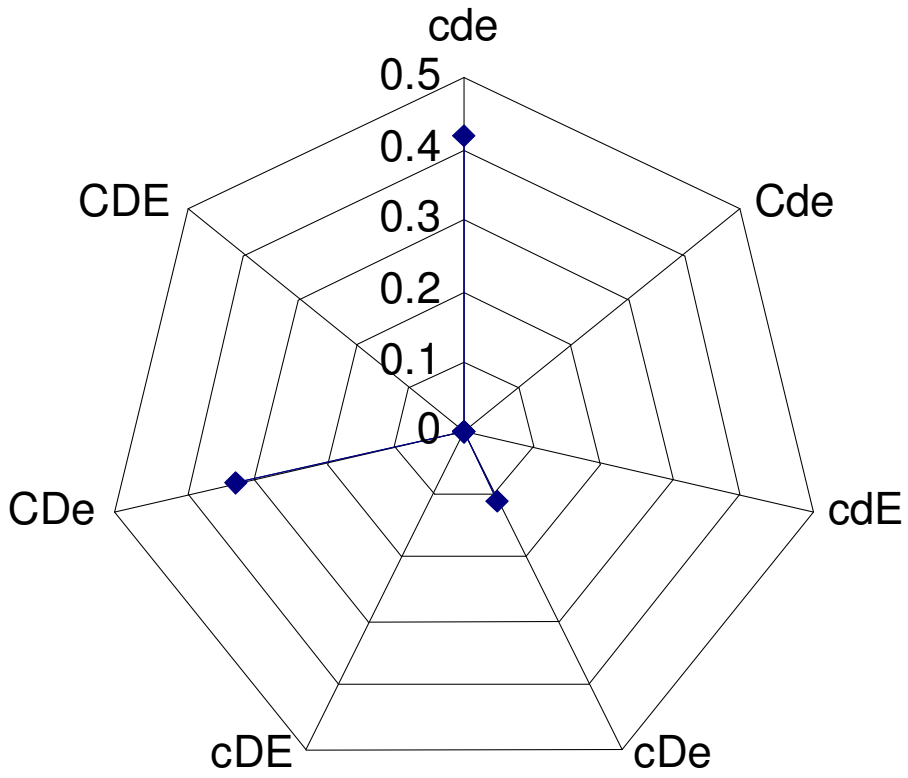

Figure 6. Concentration of the Rh haplotypes in the Khulo region population.

region.

Using statistical methods, only three CDe, cDe, cde haplotypes have been fixed for the Khulo region population. Other haplotypes are not generally seen in the composition of the said region's population. The CDe haplotype concentration is 0.31. The concentration of the cDe haplotype equals 0.11. The highest frequency distribution is a characteristic of the cde haplotype (0.42) (Figure 6).

The research showed that according to the erythrocyte group antigens, the earlier stated population is characterized by rather high polymorphism. The study of the obtained data is of great importance for the rational preparation of blood components for the purpose of their use in transfusion.

REFERENCES

Bolan CD, Leitman SF, Griffith LM, Wesley RA, Procter JL, Stroncek DF, Barrett AJ, Childs RW (2001). Delayed donor red cell chimerism and pure red cell aplasia following major ABO-incompatible nonmyeloablative hematopoietic stem cell transplantation. J. Blood, 98(6): 1687-1694.

Bucin D, Johansson S, Malm T, Jogi P, Johansson J, Westrin P, Lindberg LO, Olsson AK, Gelberg J, Peres V, Harling S, Bennhagen R, Kornhall B, Ekmehag B, Kurkus J, Otto G (2006). Heart transplantation across the antibodies against HLA and ABO. Transplant Int. 19(3): 239-44.

Cartron JP (1994). Defining the Rh blood group antigens. Biochemistry and molecular genetics. Blood Rev. 8(4): 199-212.

Graziano SL, Tatum AH, Gonchoroff NJ, Newman NB, Kohman LJ. (1997) Blood group antigen A, and flow cytometric analysis in resected early-stage non-small cell lung cancer. Clin. Cancer Res. 3: 87-93.

Ikemoto S (1995). Searching for genetic markers--in the fields of forensic medicine and human genetics. Nippon Hoigaku Zasshi, 9(6): 419-31.

Anstee DJ (1990). Blood group active surface molecules of the human red blood cells. Vox Sang. 58: 1-20.

Khetsuriani NG, Gamkrelidze AG (1995). Erythrocyte antigens as immunogenetic markers of respiratory atopic diseases in Georgians. J. Investig. Allergol Clin. Immunol. 5(1): 35-39.

Kiango JS, Missingo R, Mzula E (1982). The relationship of blood groups and hepatitis B virus antigen carrier state. East Afr. Med. J. 59(12): 816-818.

Kolesnik VV, Khludok EA (1992). The significance of the association of erythrocyte antigens in rheumatism Lik Sprava. (6): 76-79.

Kucher AN, Puzyrev VP, Chernetsov DB, Erdynieva LS, Sanchat NO (2000). Polymorphism of immunological and biochemical marker genes in rural populations of the Tuva Republic. *Genetika*, 36(4): 562-569.

Matsui T, Shimoyama T, Matsumoto M, Fujimura Y, Takemoto Y, Sako M, Hamako J, Titani K (1999). ABO Blood Group Antigens on Human Plasma von Willebrand Factor After ABO-Mismatched Bone Marrow Transplantation. Blood, 94(8): 2895-2900.

Nasidze IS (1995) Genetic polymorphisms of the Caucasus ethnic groups: Distribution of some serum protein and red cell enzyme genetic markers. Gene Geogr. 9(2): 91-116.

Nersisian VM, Kazanchian AV, Arutiunian GA (1996). Features of the distribution of haplotype phenotypes and genes in the Armenian population. Genetika, 32(12): 1673-1677.

O'Rourke DH, Mobarry A, Suarez BK (1992). Patterns of genetic variation in Native America. Hum. Biol. 64(3): 417-434.

Pandey M, Gautam A, Shukla VK (1995). ABO and Rh blood groups in patients with cholelithiasis and carcinoma of the gall bladder. BMJ.

310: p. 1639.
Paoli G, Franceschi MG (1990). Genetic studies in the Garfagnana population (Tuscany, Italy). Anthropol. Anz. 48(4): 333-345.
Salamatina NM, Nasidze IS (1993). Genetic polymorphisms in a rural Ossetian community. Gene Geogr. 7(3): 251-255.
Schenken-Brunner H. (2000). Human blood groups. Chemical biochem. basis antigen specificity, p. 636.
Schmidt HD, Scheil HG (2003). Blood group frequencies in Romania: microregional and ethnic differences. Anthropol Anz. 61(4): 381-393.
Schonewille H, van de Watering LM, Loomans DS, Brand A (2006). Red blood cell alloantibodies after transfusion: factors influencing incidence and specificity. Transfusion, 46(2): 250-256.
Shneider IUV, Shilnikova IN, Zhukova OV (2002). Materials for studying the gene pools of Russia and neighboring countries: the Russian population of the Pskov region. Genetika, 38(11): 1561-1565.
Shubin PN, Morokov VA, Efimtseva EA, Chelpanova TI (1997). Ethnogenetics of the Komi-Zyrians according to data on the distribution of gene frequencies of erythrocyte and serum systems in the blood. Genetika, 33(2): 235-242.
Su M, Lu SM, Tian DP, Zhao H, Li XY, Li DR, Zheng ZC (2001). Relationship between ABO blood groups and carcinoma of esophagus and cardia in Chaosan inhabitants of China. World J. Gastroenterol. 7: 657-661.
Varsahr AM, Dubova NA, Kutuvev IA (2003). Serological researches in the south of Moldavia in connection with the problem of the Gagauzes, the Moldavians and Bulgarians. Anthropol. Anz. 61(4): 395-411.
Vojvodic S (2000). Inhibitory activity of blood group antigens M and N in inhibition of virus hemagglutination reactions of influenza viruses. Med. Pregl. 53(1-2): 7-14.