

BLOOD GROUPS DISTRIBUTION IN IRAN

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Abstract

Blood samples (291857) from 24 provinces of Iran were tested for ABO and Rh groups. The Rh complexes as well as Kell, Duffy, Kidd, Lutheran , Kp and Xg blood groups were tested only on a part of the material from Tehran. Results show a great deal of heterogeneity for ABO and Rh groups in various provinces of Iran. The calculated gene frequencies are compared with those of other investigations in Iran and those in Europe.

Introduction

The Iranian population is not uniformly distributed and is composed of many ethnic groups. The majority of Iranians are Indo-European and Moslems with some ethno-religious minorities of Indo-European origin such as Zoroastrians and Armenians and some of the Semitic origins such as Jews and Assyrians. There are also some population groups with East Asian origin such as Turkmans and Kazaks living in north east , and small groups of Arabs in south west and Negroes in Southern Iran.

Iran at the time of this study was formally divided into 24 provinces, their names are not always indicative of the ethnic origins (Fig 1). A

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systematic study of Iranian population on ABO, Rh, MNS, P,K,F y and JK had been done before, on a total of 1709 individuals (1).

The present work is a descriptive survey and the aim is not to establish a hypothesis, because the population of Iran is composed of various ethnic groups with very distinct origins.

Materials and Methods

The study concerns 291857 specimens, collected by the Organization of Blood Transfusion of Iran, in Tehran and other provinces of Iran, for ABO and Rh (anti-D) grouping. The Rh complexes and other blood groups are tested only on a part of the material from Tehran, the number of which is given in the table.

Blood specimens tested for antigens: A, B, D, C, c, E, e, D^u, K, k, Fy^a, Fy^b, Jk^a, Jk^b, Lu^a, Lu^b, Kp^a, Kp^b, and Xg^a.

Results and Discussion

The phenotypes and gene frequencies of the ABO and Rh blood groups are given in tables 1 and 2 respectively, those from the Rh complexes in table 3 and the other blood groups in table 4.

As it is evident from tables 1,2 a great deal of heterogeneity exists for ABO and Rh systems in Iranian provinces.

The West Azarbaijanis (northwest), show the highest frequency of P gene (26.63) and the people of Hormozgan (south) the lowest (13.79).

The people of Yazd (east central) show the highest q genes (24.06) and those of Boir Ahmad and Kohkiluyeh (west central) the lowest (9.26) frequencies. For the r gene inversely, the highest frequency is that of the people of Boir Ahmad and Kohkiluyeh (70.61) and the lowest for the people of Yazd (55.59).

However, the total of Iranian population shows a p gene frequency of 22.50, q frequency of 17.23 and r frequency of 60.27, which are in agreement

with those of other studies in Iran , 22. 24, 16.98 and 60.78 for p , q and r respectively (1).

On the whole , the Iranian population appears to exhibit higher q and lower p gene frequencies than those found in Europeans(2).

The frequency of d gene ranges from 35.74 among the people of Yazd to 27.44 among the people of Bushehr (south). The overall d gene frequency is 32.22% in Iran. The other investigations show d gene range of 48.20 to 12.17 with the average of 30.08% (1), which is comparable to present results. The Iranian population appears to exhibit a much lower d gene frequency than that of around 40% found in Europeans (2).

As it is evident from Tab.3, the frequencies of the principal Rh complexes in the Iranian population are as follow: CDe(R1)= 45.28, cde (r)=31.53, cDE(r2)=16.41, Cde(r)=3.01, cDe(R0)=2.67. cdE(r'')=0.75 and CDE(R2)=0.36, which are comparable with averages 48,28,14,3,6, 0.57 and 1% for above mentioned complexes respectively (1). On the whole, the Iranian population appears to exhibit much lower cde (r) but higher CDe (R1) and Cde(r) gene complex frequencies, than those found in northern European populations(2).

For the Kell system , kk shows the highest frequency (93.66) followed by KK (5.87) and KK (0.47). The frequency of the K gene is 3.405%. The average k gene frequency from other Iranian investigations is 2.46%(1), which is lower than what is found in this study. The Iranian populations appears to exhibit a K frequency similar to that varying between 1.54-5.82% in European populations (2).

For Duffy system , the highest genotype frequency is that of Fy (a⁺ b⁺)=47.84, followed by Fy(a⁺b⁻)=26.97 and Fy(a⁻ b⁺)=25.19. The Fy^a gene frequency is 50.89. The average Fy^a frequency for Iran reported in other studies (1) is 43.58 , which is lower than the results of the present study. The Iranian population appears to exhibit a much higher Fy^a frequency than that of around 40% in Europeans(2).

For Kidd system the frequency of Jk(a⁺b⁺) is the highest (42.03) and Jk^a (a⁻b⁻) the lowest (0.79). The frequency of Jk^a gene is 49.85. The average Jk^a in Iran, given by other investigators is 37.34 (1), which is much lower than this study. The Iranians , as given in present study , exhibit similar

Jk^a frequency to that of around 50% found in Europe (2).

For Lutheran system, the frequency of Lu(a⁺b⁺) phenotype is 3.38 and that of gene Lu^a is 1.69. The Lu^a average from other studies for Iran is 2.86(1) which is higher than present study. The average frequency of Lu^a gene in Iranians seems to be similar to that of about 2% in the Mediterranean area (2).

The frequency of phenotypes Kp(a⁺b⁺) is 2.42% and Kp(a⁻b⁺) is 97.58% and that of gene Kp^a is 1.21.

The frequency of the Xg^{at} antigens are as follow : Xg^{at} (M.)=51.27, Xg^{at} (F.)=73.75 and Xg^{at} (M.+F.)=62.26.

There is no other report of Kp and Xg blood groups in Iranian populations.

However, we might conclude that various factors like ethnic origins, historic affinities, and different selection factors have affected the gene pools of the Iranian populations.

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Table 1 - Phenotype & gene frequencies of ABO blood groups in various provinces of Iran.

| Provinces | nr. | % | | | | | % | | | | |
|------------------------------|--------|-------|-------|-------|------|-------|-------|-------|--|--|--|
| | | A | B | O | AB | P | q | r | | | |
| 1. Tehran | 126332 | 32.44 | 23.48 | 35.90 | 8.18 | 22.92 | 17.31 | 59.77 | | | |
| 2. Markazi | 25500 | 31.82 | 24.00 | 36.91 | 7.27 | 21.98 | 17.12 | 60.99 | | | |
| 3. Khorasan | 12761 | 29.89 | 26.83 | 35.04 | 8.24 | 21.35 | 19.42 | 59.22 | | | |
| 4. Isfahan | 13936 | 32.90 | 22.85 | 37.38 | 6.87 | 22.43 | 16.20 | 61.33 | | | |
| 5. Azarbaijan(East) | 20651 | 37.33 | 20.86 | 33.89 | 7.93 | 26.03 | 15.62 | 58.33 | | | |
| 6. Khuzistan | 7131 | 29.69 | 24.91 | 38.80 | 6.60 | 20.21 | 17.26 | 62.55 | | | |
| 7. Mazandaran | 14812 | 28.98 | 24.81 | 39.25 | 6.97 | 19.96 | 17.40 | 62.66 | | | |
| 8. Fars | 5897 | 28.83 | 24.94 | 39.02 | 7.21 | 20.02 | 17.62 | 62.33 | | | |
| 9. Gilan | 14308 | 30.51 | 22.07 | 41.03 | 6.39 | 20.59 | 15.12 | 64.22 | | | |
| 10. Azarbaijan(West) | 4733 | 37.44 | 20.92 | 32.88 | 8.77 | 26.63 | 16.13 | 57.22 | | | |
| 11. Kerman | 3350 | 26.99 | 28.51 | 37.10 | 7.40 | 19.01 | 19.95 | 61.02 | | | |
| 12. Bakhtaran | 5015 | 32.22 | 23.83 | 36.17 | 7.78 | 22.54 | 17.30 | 60.11 | | | |
| 13. Hormozgan | 171 | 19.88 | 28.07 | 46.20 | 5.85 | 13.79 | 18.65 | 67.53 | | | |
| 14. Sistan & Baluchistan | 547 | 26.51 | 28.70 | 38.39 | 6.40 | 18.14 | 19.94 | 62.33 | | | |
| 15. Kordestan | 2203 | 31.64 | 24.65 | 36.45 | 7.26 | 21.86 | 17.51 | 60.65 | | | |
| 16. Hamadan | 11228 | 32.86 | 23.71 | 35.80 | 7.63 | 22.88 | 17.15 | 57.97 | | | |
| 17. Lorestan | 3728 | 34.09 | 21.62 | 37.55 | 6.73 | 23.11 | 15.83 | 61.53 | | | |
| 18. Zanjan | 3502 | 34.04 | 21.82 | 35.87 | 8.28 | 24.01 | 16.36 | 59.66 | | | |
| 19. Yazd | 3883 | 26.65 | 32.42 | 31.01 | 9.92 | 20.35 | 24.06 | 55.55 | | | |
| 20. Bushehr | 279 | 27.24 | 27.24 | 40.14 | 5.38 | 17.98 | 17.98 | 64.02 | | | |
| 21. Chaharmahal & Bakhtirari | 921 | 32.14 | 19.54 | 43.87 | 4.45 | 20.43 | 12.86 | 65.83 | | | |
| 22. Ilam | 263 | 37.26 | 23.57 | 32.32 | 6.84 | 25.41 | 16.70 | 57.52 | | | |
| 23. Semnan | 10583 | 30.62 | 25.83 | 34.55 | 9.00 | 22.20 | 19.24 | 70.61 | | | |
| 24. Boir Ahmad & Kohgiluyeh | 113 | 31.86 | 13.27 | 50.44 | 4.43 | 20.13 | 9.26 | 70.61 | | | |
| Total | 291857 | 32.14 | 23.72 | 36.35 | 7.79 | 22.50 | 17.23 | 60.27 | | | |

Table 2- Phenotype & gene frequencies of Rh blood groups in various provinces of Iran.

| No. | Provinces | n | % | | % | |
|-----|--------------------------|--------|-------|-------|-------|-------|
| | | | D- | D+ | d | D |
| 1. | Tehran | 126332 | 10.42 | 89.58 | 32.28 | 67.72 |
| 2. | Mazrazi | 25500 | 10.82 | 89.18 | 32.89 | 67.11 |
| 3. | Khorasan | 12761 | 10.53 | 89.47 | 32.45 | 67.55 |
| 4. | Isfahan | 13936 | 10.48 | 89.52 | 32.37 | 67.63 |
| 5. | Azarbaijan(East) | 20651 | 11.39 | 88.61 | 33.75 | 66.25 |
| 6. | Khuzistan | 7131 | 8.82 | 91.18 | 29.70 | 70.30 |
| 7. | Mazandaran | 14812 | 9.92 | 90.08 | 31.50 | 68.50 |
| 8. | Fars | 5897 | 9.60 | 90.40 | 30.98 | 69.20 |
| 9. | Gilan | 14308 | 10.77 | 89.23 | 32.82 | 67.18 |
| 10. | Azarbaijan(West) | 4733 | 9.82 | 90.18 | 31.34 | 68.66 |
| 11. | Kerman | 3350 | 11.01 | 88.99 | 33.18 | 66.82 |
| 12. | Bakhtaran | 5015 | 8.97 | 91.03 | 29.95 | 70.05 |
| 13. | Hormozgan | 171 | 8.19 | 91.81 | 28.62 | 71.38 |
| 14. | Sistan & Baluchistan | 547 | 10.60 | 89.40 | 32.56 | 67.44 |
| 15. | Kordestan | 2203 | 9.08 | 90.92 | 30.13 | 69.87 |
| 16. | Hamadan | 11238 | 9.03 | 90.97 | 30.05 | 69.95 |
| 17. | Lorestan | 3728 | 8.13 | 91.87 | 28.51 | 71.49 |
| 18. | Zanjan | 3502 | 9.82 | 90.18 | 31.34 | 68.66 |
| 19. | Yazd | 3883 | 12.77 | 87.23 | 35.74 | 64.26 |
| 20. | Bushehr | 279 | 7.53 | 92.47 | 27.44 | 72.56 |
| 21. | Chahar Mahal & Bakhtiari | 921 | 11.18 | 88.82 | 33.44 | 66.56 |
| 22. | Ilam | 263 | 8.37 | 91.63 | 28.93 | 71.07 |
| 23. | Semnan | 10583 | 10.65 | 89.35 | 32.63 | 67.37 |
| 24. | Boir Ahmad & Kohkilyeh | 113 | 11.50 | 88.50 | 33.91 | 66.09 |
| | Total | 291857 | 10.38 | 89.62 | 32.22 | 67.78 |

Table 3- Phenotypes and gene frequencies of Rh complexes in Iran

| System | Number | Phenotyps | frequency | gene | frequency |
|-------------------------------|-------------|-------------------------------|-----------|-----------------------|-----------|
| Rh | <u>6641</u> | R ₁ r | 28.554 | CDe(R ₁) | 45.28 |
| | | r ₁ R ₁ | 20.503 | | |
| | | R ₁ R ₂ | 14.860 | cde (r) | 31.53 |
| | | R ₂ r | 10.348 | | |
| | | r ₂ r | 9.942 | cDE (R ₂) | 16.41 |
| | | R ₁ r' | 2.726 | | |
| | | R ₂ R ₂ | 2.693 | Cde(r') | 3.01 |
| | | R ₁ R ₀ | 2.418 | | |
| | | r ₁ r' | 1.989 | cDe(R ₀) | 2.67 |
| | | rR ₀ | 1.684 | | |
| | | R ₂ r' | 0.988 | cdE(r'') | 0.75 |
| | | R ₂ R ₀ | 0.876 | | |
| | | R ₁ r'' | 0.679 | CDE(R ₂) | 0.36 |
| | | r ₁ '' | 0.473 | | |
| | | R ₁ R ₂ | 0.326 | | |
| | | R ₂ r'' | 0.246 | | |
| | | rR ₂ | 0.227 | | |
| | | r'R ₀ | 0.161 | | |
| | | R ₂ R ₂ | 0.118 | | |
| | | r'r | 0.091 | | |
| | | R ₂ R ₀ | 0.071 | | |
| | | r'r'' | 0.045 | | |
| | | R ₂ r'' | 0.040 | | |
| | | r'R ₂ | 0.022 | | |
| R ₀ R ₂ | 0.019 | | | | |
| r''r'' | 0.006 | | | | |
| r''R ₂ | 0.005 | | | | |
| R ₂ R ₂ | 0.001 | | | | |

Table 4- Phenotypes and gene frequencies of other blood groups in Iran.

| System | Number | Phenotyps | frequency | gene | frequency |
|-----------------|--------|------------------------------------|-----------|-----------------|-----------|
| Kell | 5522 | | | | |
| | 26 | KK | 0.47 | K | 3.405 |
| | 324 | Kk | 5.87 | | |
| | 5172 | kk | 93.66 | k | 96.595 |
| Duffy | 3764 | | | | |
| | 1015 | Fy(a ⁺ b ⁻) | 26.97 | Fy ^a | 50.89 |
| | 948 | Fy(a ⁻ b ⁺) | 25.19 | Fy ^b | 49.11 |
| | 1801 | Fy(a ⁺ b ⁺) | 47.84 | | |
| Kidd | 3650 | | | | |
| | 1205 | Jk(a ⁺ b ⁻) | 33.01 | Jk ^a | 49.85 |
| | 882 | Jk(a ⁻ b ⁺) | 24.16 | Jk ^b | 41.69 |
| | 1534 | Jk(a ⁺ b ⁺) | 42.03 | Jk | 8.46 |
| | 29 | Jk(a ⁻ b ⁻) | 0.79 | | |
| Lutheren | 3199 | | | | |
| | 3091 | Lu(a ⁻ b ⁺) | 96.62 | Lu ^a | 1.69 |
| | 108 | Lu(a ⁺ b ⁺) | 3.38 | | |
| Kp | 1489 | | | | |
| | 1453 | Kp(a ⁻ b ⁺) | 97.58 | Kp ^a | 1.21 |
| | 36 | Kp(a ⁺ b ⁺) | 2.42 | | |
| Xg ^a | 3227 | | | | |
| | 846 | Xg ^{a+} (M.) | 51.27 | | |
| | 1163 | Xg ^{a+} (F.) | 73.75 | | |
| | 2009 | Xg ^{a+} (M.+F.) | 62.26 | | |
| | 804 | Xg ^{a-} (M.) | 48.73 | | |
| | 414 | Xg ^{a-} (F.) | 26.25 | | |
| | 1218 | Xg ^{a-} (M.+F.) | 37.74 | | |

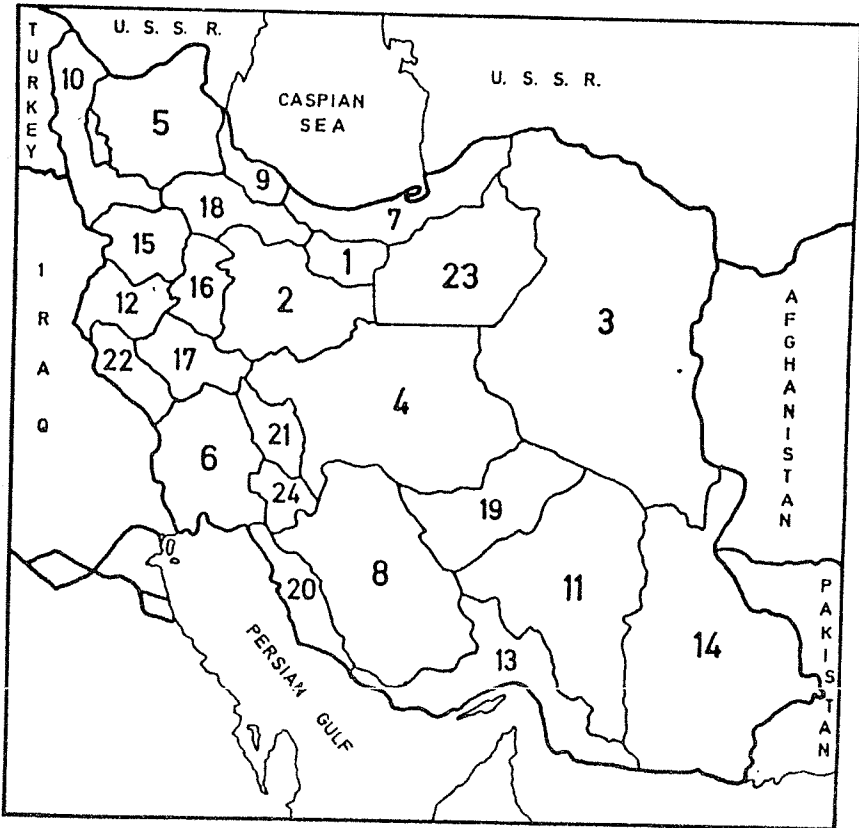


Fig. 1- Map shows the location of 24 provinces in Iran

References

1. Amirshahi, P. ; Farhud,D.D.; Sunderland, E. Tavakoli, Sh. and Daneshmand, P. (1987). A genetic Study of Iranian Populations, I.Blood groups. Iranian, J.Publ. Health. Vol. 16, No 1-4.
2. Mourant, L.A.; Kopec, A.C and Domaiewska, sbezak, K. (1976). Distribution of human blood groups and other polymorphisms. Oxford Univ. press , London.