# INCIDENCE OF ABO AND Rh BLOOD GROUPS IN MADHYA PRADESH*

*By*

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The distribution of ABO and Rh blood groups varies in different races and even in ifferent geographical locations for the same race.

Amongst Australian aborigines, Fijaians, Fillipions, Japanese and Chinese, the Rh haracter does not seem to exist at all. The incidence in the rest of south-western Asia seems o be related to the southern Europe and the Mediterranean basin, where the frequency of r is sually low, and that of $R_1$ higher than further north (4).

The incidence of Rh negative rates varies in different races and in different countries. his variation is very wide, ranging from 0% in Burmese and Indonesians to 42.25% amongst asques (6).

The distribution of Rhesus factor varies widely in different parts of India. Different orkers have observed an incidence varying from 0.8 to 12% (3). Khanolkar and Sanghvi ) attempted to explain this obvious paradox of varying incidence in the different States by rawing attention to social composition of India. Indians include Hindus, Moslems, tribes nd the rest consisting of Christians, Sikhs, Buddhists, Jains, Parsees and Jews. Browman (1) eported a disproportionately low incidence of Rh-negatives in group A but the finding has ot been confirmed ever since.

## MATERIALS AND METHODS

A random sample of 300 healthy medical students of both sexes of age-group 17 to 24 ears was investigated. These students gave a fairly good cross-section of the State, the ad- ission to the Medical College being open to competition on a Statewide scale.

Anti-A and anti-B sera (Slide Method) containing not less than 64 units isohaem- gglutinins per ml (high titre) of Haffkine Institute, Bombay, were used, for testing the lassical (ABO) blood groups.

For Rh factor, 50 cases were studied with anti-$Rh_o$' (anti-CD) serum (albumin-agglutia ating) containing not less than 32 units of isohaemagglutinins (high titre) of Haffkine Insti- ute. Bovine albumin (22% solution, pH 7.5) of the same Institute was used.

Paper read at the XII Annual Conference of the Association of Physiologists and Pharmacologists of India (1966).

0.4 parts of blood from finger were diluted to mark 11 with isotonic saline (0.9%) in a Thoma's pipette to obtain 2% suspension of red cells. One drop of the suspension was mixed with 1 drop of anti-CD serum (incomplete or monovalent agglutinin) and 1 drop of bovine albumin on a slide, rocked and kept in a moist chamber (Patri dish with damp filter paper to lessen the evaporation and drying). The chamber was then placed in an incubator at 37° C for 30 minutes. The results were confirmed under a microscope.

The remaining 250 cases were studied with hyperimmunized anti-D ($Rh_o$) serum of Indian (human) origin, of high specificity, titre and avidity; it contained saline (complete or bivalent) agglutinin, and was obtained from Bharat Laboratories, Bombay. For this study, rapid slide conglutination technique was used.

In the ABO system A, B and O serve as symbols of phenotype as well as genes. To denote gene frequency, the letters p, q and r are used to indicate the frequency of genes A, B and O respectively. Genotypes can be homozygous (AA, BB, OO) or heterozygous (AO, BO).

In the Rh system, gene corresponding to antigen D is called D (Rh); when D is absent from chromosomes, its place is occupied by the alternate form (allelomorph) called d (rh). An Rh gene is inherited from both father and mother. If gene D is carried by both sperm and ovum, the resulting gene composition (genotype) of the offspring is DD; if the gametes carry D and d respectively, the result is Dd; if both gametes carry d, the result is dd.

To calculate the genotype frequency :

1. With two like genes the genotype frequency is the square of the gene frequency.
2. With two unlike genes the genotype frequency is twice the product of the two frequencies.

*In Rh system*: 'DD'='D'2; 'Dd'—2 ('D'×'d'); 'dd'—'d'$^2$ ; where 'dd' denotes genotype frequency of dd (frequency of phenotype Rh negative).

When only anti-D serum is used the gene frequency will be :

$p^{rh}$ (d)$=\sqrt{\text{'dd'}}$ or $\sqrt{\text{rh negative}}$

$qR^h$ (D) 1 – d ($p^{rh}$,)

where $p^{rh}$ denotes frequency of rh, and rh negative denotes frequency of Rh negative individuals, and $qR^h$ denotes frequency of Rh.

*In ABO systems* : (when anti-A and anti-B sera are used) :

$p_A=\sqrt{\text{'O'}+\text{'A'}}-\sqrt{\text{'O'}}$

$q_B=\sqrt{\text{'O'}+\text{'B'}}-\sqrt{\text{'O'}}$

$r_O=\sqrt{\text{'O'}}$

where as $'A' = p_A^2 + 2p_A r_O$; $'B' = q_B^2 + 2q_B r_O$; $'O' = r_O^2$.

where $p_A$ denotes frequency of gene A, $q_B$ denotes frequency of gene B, and $r_O$ denotes frequency of gene O; and 'O', 'B' and 'A' denote the frequency of individuals (phenotype) of blood group O, B and A respectively.

The frequency of three allelic genes must total one.

$$p_A + q_B + r_O = \sqrt{'O'} + 'A' + \sqrt{'O' + 'B'} + \sqrt{'O'} = 1.$$

## RESULTS

TABLE I

*The Distribution of ABO Blood Groups in Medical Students (Madhya Pradesh)*

| Sex | No. of Persons Tested | O | A | B | AB |
|---|---|---|---|---|---|
| Male | 210 | 63 | 63 | 69 | 15 |
| Female | 90 | 28 | 26 | 27 | 9 |
| TOTAL | 300 | 91 | 89 | 96 | 24 |

TABLE II

*Phenotype Percentage Of ABO Blood Groups*

| Sex | O | A | B | AB |
|---|---|---|---|---|
| Male | 30.00 | 30.00 | 32.86 | 7.14 |
| Female | 31.11 | 28.89 | 30.00 | 10.00 |
| TOTAL | 30.33 | 29.67 | 32.00 | 8.00 |

TABLE III

*Genotype frequency and Gene Frequency of ABO Blood Groups*

| Genotype Frequency | | | | Gene Frequency | | |
|---|---|---|---|---|---|---|
| 'A' | 'B' | 'O' | 'AB' | p | q | r |
| 0.2967 | 0.3200 | 0.3033 | 0.0800 | 0.229 | 0.244 | 0.550 |

TABLE IV

*Distribution of Rh Factor in Madhya Pradesh*

| Sex | Total No. of Persons Tested | Rh positive | | Rh negative | |
|---|---|---|---|---|---|
| | | Number | percentage | Number | percentage |
| Male | 212 | 207 | 97.65 | 5 | 2.35 |
| Female | 88 | 83 | 94.32 | 5 | 5.68 |
| TOTAL | 300 | 290 | 96.67 | 10 | 3.33 |

TABLE V

*Genotype Frequecny and gene frequency of Rh Factor*

| Genotype frequency | | | Gene frequency | |
|---|---|---|---|---|
| DD (Rho Rho ) | Dd (Rho rh ) | dd (rhrh) | D (Rh) | d (rh) |
| 0.670 | 0.288 | 0.033 | 0.818 | 0.182 |

## DISCUSSION

Tables VI to IX have been provided to compare the results of the previous workers with those of the present investigation.

TABLE VI

*ABO Blood Groups Distribution in India (Phenotype Percentage)*

| | Punjabis | | Bengalees | Indians | Indians |
|---|---|---|---|---|---|
| | Talwar and Sahney (9) | Pathak (5) | Sen *et al* (7) | Shrivastava *et al* (8) | Bhargava and Rajani (1966) |
| **A** | 21.27 | 22.3 | 22.22 | 21.49 | 29.67 |
| **B** | 40.36 | 38.8 | 37.18 | 38.28 | 32.00 |
| **O** | 28.73 | 30.6 | 33.09 | 33.74 | 30.33 |
| **AB** | 6.49 | 9.64 | 8.3 | 7.40 | 8.00 |

TABLE VII

*Showing Percentage of Rh Negative Individuals in Various Parts of India* (After Mittal, (3) )

| S. No. | Authors | Centre | Population Surveyed | Total No. | % of Rh Negative |
|---|---|---|---|---|---|
| 1 | Greval and Roy Chowdhary, 1943 | Calcutta | Indians | 200 | 10.00 |
| 2 | Das Gupta, 1944 | Calcutta | Indians | 240 | 10.00 |
| 3 | Khanolkar and Sanghvi, 1945 | Bombay | Indians | 100 | 2.00 |
| 4 | Wiener *et al.*, 1945 | New York | Indians | 156 | 7.10 |
| 5 | Greval and Roy Chowdhary, 1946 | Calcutta | Indians | 200 | 7.85 |
| 6 | Ranganathan *et al*, 1946 | Madras | South Indians | 145 | 4.14 |
| 7 | Bird, 1946 | Madras | Indians | 390 | 1.10 |
| 8 | Mazumdar, 1894 | Lucknow | Indians | 116 | 5.43 |
| 9 | Ranganathan *et al*, 1948 | Madras | South Indians | 294 | 8.50 |
| 10 | Sanghvi and Khanolkar, 1949 | Bombay | Koksnath Brahmans | 200 | 3.50 |
| | | | Chandarseniys Prabhu | 200 | 10.0 |
| | | | Vadnagra Brahmans | 200 | 12.00 |
| | | | Dasasth Brahmans | 200 | 5.00 |
| | | | Marathas | 200 | 1.50 |
| 11 | Prasad *et al*, 1949 | London | Indian Students | 105 | 9.50 |
| 12 | Venkataraman, 1950 | — | Indians | 200 | 7.00 |
| 13 | Bird *et al*, 1951 | Poona | Indians | 408 | 7.50 |
| 14 | Rao, 1952 | Madras | South Indians | 132 | 3.79 |
| 15 | Siamons *et al*, 1953 | Madras | Chenchu South Indians | 108 | 6.00 |
| 16 | Venkatramiah and Rao, 1953 | Madras | Indianss | 100 | 8.00 |
| 17 | Pathak, 1954 | Amritsar | Punjabi | 227 | 7.49 |
| 18 | Mehrotra and Saksena, 1956 | Agra | Indians | 125 | 0.80 |
| 19 | Roy *et al*, 1959 | Calcutta | Bengalees | 1435 | 5.29 |
| 20 | Pathak, 1959 | Amritsar | Punjabis | 550 | 7.27 |
| 21 | Talwar and Sahney, 1959; | Amritsar | Punjabis | 1000 | 7.30 |
| 22 | Sen *et al*, 1959 | Calcutta | Bengalees | 2000 | 3.00 |
| 23 | Anklesaria and Mathur, 1961 | Ahmedabad | Indians | 1011 | 5.80 |
| 24 | ICMR Surveys, 1961 | Ludhiana | Indians | 1909 | 7.43 |
| | | Nagpur | ,, | 1066 | 1.03 |
| | | Lucknow | ,, | 3606 | 1.33 |
| | | Bombay | ,, | 4086 | 1.83 |
| | | Trivendrum | ,, | 1797 | 7.54 |
| | | Calcutta I | ,, | 4448 | 3.23 |
| | | Calcutta II | ,, | 2101 | 1.71 |
| 25 | Talwar, 1962 | Amritsar | ,, | 300 | 7.00 |
| 26 | Anand, 1962 | Jaipur | ,, | 1000 | 2.80 |
| 27 | Mittal, 1963 | Agra | ,, | 3500 | 1.06 |
| 28 | Bhargava and Rajani, 1966 | Bhopal | ,, | 300 | 3.33 |

TABLE VIII

*Representative Data of Allele Frequency of ABO Blood Groups of Indians*

| S. No. | Race (Population) | Tested by | No. of People Tested | Frequency of Groups | | | | p | q | r | p+q+r |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | O | A | B | AB | | | | |
| 1. | Hindus | Wiener & Wexler (10) | 1000 | .313 | .190 | .412 | .085 | .149 | .291 | .560 | 1.000 |
| 2. | Sikhs | Bird *et al* (1951) (Quoted from Wiener Wexler) | 600 | — | — | — | — | .180 | .230 | .590 | 1.000 |
| 3. | Bengalees | Sen *et al* | 2200 | .330 | .222 | .371 | .074 | .162 | .257 | .579 | 0.998 |
| 4. | Indians | Bhargava and Rajani (1966) | 300 | 0.303 | .297 | .320 | .080 | .229 | .244 | .550 | 1.023 |

TABLE IX

*Representative Data of Genotype Frequency and Gene Frequency of Rh System Among Indians*

| S.No. | Race (Population) | Tested by | No. of People Tested | Genotype Frequency | | | Gene Frequency | |
|---|---|---|---|---|---|---|---|---|
| | | | | DD | Dd | dd | D | d |
| 1. | Bengalees | Sen *et al* (1959) | 2200 | .683 | .286 | .030 | .826 | .173 |
| 2. | Indians | Mittal, 1959 | 3500 | .804 | .184 | .010 | .897 | .103 |
| 3. | Bengalees | Roy *et al* 1959 | 3800 | | | | .942 | .058 |
| 4. | Indians | Bhargava and Rajani, 1966 | 300 | .670 | .288 | .033 | .818 | .182 |

Till now the incidence of Rh factor has not been reported from Madhya Pradesh. We found the percentage of Rh negative persons to be 3.33, which is within the range so far reported in India. Our results with respect to the distribution of ABO blood groups are also in agreement with those of others.

The Rh distribution is not influenced by age, sex, religion, state of pregnancy or habitat of people, whether rural or urban, (5).

Gene frequencies are found out because, first, they afford a more direct way of comparing the blood group content of different populations than do the phenotype frequencies; second, they allow us to test the truth of theories concerning manner of inheritance of the groups; knowing the gene frequency we can calculate the expected frequency of children of different groups

from any type of mating; third, they show that a sample contains a reasonable distribution of the groups, thus giving us confidence in our technique.

Gene frequency analysis showed that the observed frequency of Rh positive and negative blood corresponded to the expected frequency.

SUMMARY

The incidence of ABO and Rh blood groups was determined in 300 medical students of both sexes (representing the population of Madhya Pradesh). Anti-D serum (both albumin-agglutinating and saline-agglutinating) was used for Rh typing. 3.33% incidence of Rh negative persons was found in this cross-section of population. Phenotype, genotype and gene frequencies have been calculated both for ABO and Rh blood groups.

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