# A Critical Notes and its Distribution on ABO Blood Groups with special reference to Manipur

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## Introduction

Blood type is inherited from parents and they do not change as a result of environmental influences during life, but the environmental potential can determined which blood types in a population will be passing on more frequently to the next generation through natural selection. Starting with the ABO systems, there are four blood groups- A,B, O was discovered by Karl Landsteiner (1900) during his early experiments with blood transfusion and the fourth blood group system AB by Decastello and Sturli 1902 which Bernstein (1924) study the mode of inheritance of ABO groups. The type of blood is based on the presence or absence of antigens and antibodies in blood. Antigens are proteins that stick to the surface of red blood cells, while antibodies are produced in the plasma or liquid portion of the blood. In addition to ABO typing system, blood type is also determined by the presence of absences of another antigen known as the Rh factor. Anthropological interest in ABO blood groups polymorphism began to the discovery of population variation which Hirsfeld and Hirsfels (1919) observed the existences of differences in the allele frequencies of the ABO blood groups from one population to another. This was followed by many extensively studies on various populations in different parts of the world for this system. The view that the blood groups are non adaptive traits, that they are not affected by environmental selection and as such one of the best criteria for racial classification. But, the establishment of pleiotropic effect of ABO alleles, that is determination of blood types as well as resistances and susceptibility to several diseases has shunned the concept of non adaptability. So, these blood group systems become one of the most extensively used traits in search of human variation or evolution. Also, understanding of blood type/group is useful to know how it affects

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your health. The importance of knowing blood type is to prevent the risk of receiving an incompatible blood type at a time of need, such as blood transfusion or during surgery. If two different blood types are mixed, it can lead to a clumping of blood cells that can be potentially fetal. Knowing Rh blood type is also important for pregnant women. If a woman is Rh- negative and pregnant with a baby who is Rh-positive, it can lead to a condition known as Rh incompatibility. Similarly, ABO incompatible marriage may lead to infertility of the couples, foetal loss, etc. Above all, one of the most valuable reasons to know about blood types is to help others. In the present study, attempt has been made to make understand, highlight its clinical significance and to find out the genetic distance among the available data on different tribes of Manipur.

**Materials and Methods**

The present study is based on both primary and secondary sources. A total of 2581 individuals belonging to twelve (12) populations of Manipur namely, Brahmin(109), Chiru (212), Kabui (200), Koireng(144), Lamkang(132), Meitei(105), Muslim(200), Tangkhul(350), Tarao(141), Purum(200), Koirao(488) and Simte(300) are consider. ABO and Rh (D) typing were done by direct slide method of Bernstein (1924) with anti A, anti-B and anti-D sera manufactured by Tulip Diagnostic (P) Ltd, Goa; Medipoint blood lancet (disposable) manufactured by Medipoint Inc.New York; Glass slide, ethyl alcohol and sterilized cotton. To collect blood samples, the tip of the ring finger of the subject, cleaned with cotton swab moistened with ethyl alcohol is punctured with disposable lancet and three small drops have been squeezed out have been put on three different spots on the surface of the slide. An equivalent amount of Anti-A is put on the first drop of blood, Anti-B to the second and Anti-D to the third. Each of the blood drops is stirred using different corners of a clean slide and the slide is gently rock for some time. The results of the blood groups can be found out after a few minutes. Appropriate statistical tools were used to describe the variations of different parameters. The processing and analysis of the primary data are accomplished using Microsoft office excel 2007. Depending upon the variability of the quantitative data, chi-square test was employed for inter-population comparison.

## Clinical Significance

### *Blood Transfusion*

The ABO system is the most important blood-group system in human-blood transfusion. Much of the routine work of a blood bank involves testing blood from both donors and recipients to ensure that every individual recipient is given blood that is compatible and is as safe as possible. If a unit of incompatible blood is transfused between a donor and recipient, a severe acute hemolytic reaction with hemolysis (RBC destruction), renal failure and shock is likely to occur, and death is a possibility. Antibodies can be highly active and can attack RBCs and bind components of the complement system to cause massive hemolysis of the transfused blood.

Patients should ideally receive their own blood or type-specific blood products to minimize the chance of a transfusion reaction

### *Red blood cell compatibility*

Blood group A individuals have the A antigen on the surface of their RBCs, and blood serum containing IgM antibodies against the B antigen. Therefore, a group A individual can receive blood only from individuals of groups A or O (with A being preferable), and can donate blood to individuals with type A or AB. Blood group B individuals have the B antigen on the surface of their RBCs, and blood serum containing IgM antibodies against the A antigen. Therefore, a group B individual can receive blood only from individuals of groups B or O (with B being preferable), and can donate blood to individuals with type B or AB. Blood group O (or blood group zero in some countries) individuals do not have either A or B antigens on the surface of their RBCs, but their blood serum contains IgM anti-A and anti-B antibodies against the A and B blood group antigens. Therefore, a group O individual can receive blood only from a group O individual, but can donate blood to individuals of any ABO blood group (i.e., A, B, O or AB). If anyone needs a blood transfusion in an emergency, and if the time taken to process the recipient's blood would cause a detrimental delay, O Negative blood can be issued. Blood group AB individuals have both A and B antigen on the surface of their RBCs, and their blood plasma does not contain any antibodies against either A or B antigen. Therefore, an individual with

type AB blood can receive blood from any group (with AB being preferable), but can donate blood only to another type AB individual.

**Table- 1**

**Relationship between ABO Blood Types with Antigens and Antibodies**

| Blood Type | Antigens on Red Blood Cell | Can Donate Blood To | Antibodies in Serum | Can Receive Blood From |
|---|---|---|---|---|
| A | A | A,AB | Anti-B | A,O |
| B | B | B,AB | Anti-A | B,O |
| AB | A and B | AB | None | AB,O |
| O | None | A,B,AB,O | Anti-A and Anti-B | O |

***ABO incompatible marriages and Haemolytic Disease of Newborn (HDN)***

The basis of human blood group system is the antigenic character of red cell antigens ABO which when introduced into the body can provoke the formation of specific antibodies. Antigens and their specific antibodies react with each other when they come in contact. Red cells carry the blood group factors which reside on the surface of the red cells. Their presence on the red cells determines the basic four blood groups- A, B, AB, and O. In cases of incompatible mating anti A and anti B appear to attack the foetus early in pregnancy resulting in abortion or miscarriage. Levine (1943 and 1958) also indicated that incompatible ABO mating, apart from such Rh(D) matings result in hemolytic diseases. The blood group incompatibility influences the fertility and mortality rates and also the viability of certainblood group phenotypes in populations

ABO incompatible marriage and the resultant haemolytic disease of the new born (HDN), also known as erythoblastosis foetalis, provide a mechanism for selecting blood group phenotypes. In sorogenetics, a mating is said to be incompatible when the husband possesses an antigen which is absent in the wife. The foetus by its

inherited antigen from father will provide an opportunity for production of maternal antibody by fowto-maternal stimulation. The newly developed maternal antibody, also called Immuned antibody, especially immunoglobulin of low molecular weight (IGG), enters the foetal circulation and destroys the red cells resulting to anemia, heart failure and intra-uterine death, etc. in compatible mating, both husband and wife possezs similar antigen of the antigen inherited by the foetus is not capable of providing antigenic stimulation for the production of antibody in the mother.

**Table-2**

**ABO Compatible and Incompatible in Marriage**

COMPATIBLE

| Sex | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| Husband | O | O | O | A | B | A | B | AB | O |
| Wife | O | A | B | A | B | AB | AB | AB | AB |

INCOMPATIBLE

| Sex | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Husband | A | B | AB | A | B | AB | AB |
| Wife | O | O | O | B | A | A | B |

Investigation on ABO incompatibility must not ignore Rh incompatibility, for the interaction of the two systems plays an important role in the maintenance of incompatible genotypes of both the systems. In the Rh system, mating between Rh negative wife and positive husband is incompatible, such that the mothers need to receive a treatment to help prevent the development of substances that may harm the unborn baby. Whereas isogenic (either negative or positive in both the couples) and negative husband with positive wife are compatible ones. However, the operational processes in incompatibility in the two systems are not exactly similar.

***Universal donors and universal recipients***

With regard to transfusions of whole blood or packed red blood cells, individuals with type O Rh D negative blood are often called universal donors. It is the only blood type that's compatible with all other blood types ($O^+$, $O^-$, $A^+$,$A^-$, $B^+$,$B^-$, $AB^+$,$AB^-$). O negative patients can only received blood from O negative donors. Those with type AB Rh D positive blood are called universal recipients, can receive blood from any blood types ($O^+$, $O^-$, $A^+$,$A^-$, $B^+$,$B^-$, $AB^+$,$AB^-$).

**Association with Diseases**

There are excellent studies on the relationship between ABO phenotypes and several chronic and infectious diseases. Mention may be made of significant association between blood group A and carcinoma of stomach (Aird et.al 1953), malaria (Athreya and Coriell, 1967); blood groups A and AB with plague (Vogel and Chakravartti, 1966), smallpox (Bernhard, 1966). Disease of digestive system (gastric and duodenal ulcer) (Murty and Padma, 1984) and cholera (Glass et. al 1985) are associated with blood group O. From the results of the analysis of associations with disease by probable age of their onset, Murty and Padma (1984) observed that group O is favorable in infancy and childhood and groups A and B in adult life which shows that there is a process of inversion. A large variety of inconclusive attempts to detect association of blood groups and diseases have been made, the detail of which will be beyond the purview of the present discussion. As a result, chronic and infectious diseases selection will have little effect to the gene pool of the next generation.

**Distribution**

In this blood group distribution, 12 populations had been considered. The percentage frequency distribution of ABO blood groups phenotype and gene frequencies of various populations of Manipur are displayed in table-3. Considering ABO blood group, the highest frequency of blood group 'A' is observed among Tarao (56%) whereas the lowest among Chiru (17%). Blood group 'B' shows maximum percentages frequency among Muslim with 27% and minimum among Tarao (5%). The most common 'O' blood group in Manipur, for which Koirao (55.1%) shows highest frequency and Brahmin (29.4) shows the lowest. The phenotypically rare blood group

'AB' shows the highest and lowest frequencies among Meitei (13.3%) and Tarao (0.7%) respectively. The gene frequencies of ABO blood groups of all the population show that allele 'r' is predominate over others. It is observed from the table-1 that, the tread of ABO gene frequency occurrences in all the population is r>p>q except among Chiru in which the gene frequency trend is r>q>p. The total average gene frequencies for the three alleles of the ABO system of all the available populations are approximately 0.624 for O, 0.228 for A and 0.145 for B.

**Table-3: Distribution of ABO Phenotype and its Gene frequency among various Population of Manipur**

| | Phenotype frequency (%) | | | | | Gene frequency | | | |
|---|---|---|---|---|---|---|---|---|---|
| Population | N | A | B | AB | O | p | q | r | Sources |
| Brahmin | 109 | 40.4 | 18.3 | 11.9 | 29.4 | 0.307 | 0.163 | 0.53 | Singh, K.S (1978) |
| Chiru | 212 | 17 | 22.1 | 7 | 53.8 | 0.12 | 0.15 | 0.73 | Singh & Shah (1997) |
| Kabui | 200 | 31.5 | 21.5 | 7.5 | 34.5 | 0.228 | 0.163 | 0.609 | Singh, L.R (1986) |
| Koireng | 144 | 31.9 | 15.3 | 1.4 | 51.4 | 0.18 | 0.1 | 0.72 | Shah & Singh (1996) |
| Lamkang | 132 | 46.2 | 20.4 | 10.6 | 22.7 | 0.353 | 0.17 | 0.477 | Singh & Shah (1999) |
| Meitei | 105 | 32.4 | 22.9 | 13.3 | 31.4 | 0.26 | 0.199 | 0.541 | Singh, K.S. et al., (1986) |
| Muslim | 200 | 21.5 | 27 | 8.5 | 43 | 0.15 | 0.18 | 0.67 | Singh & Shah (1997) |
| Tangkhul | 350 | 31 | 21 | 7 | 41 | 0.21 | 0.148 | 0.624 | Kapaiwo, Th. (1995) |
| Tarao | 141 | 56 | 5 | 0.7 | 38.1 | 0.35 | 0.04 | 0.61 | Shah, M.L (1994) |
| Purum | 200 | 26 | 20.5 | 8.5 | 45 | 0.172 | 0.138 | 0.671 | Vokendo, H (2005) |
| Koirao | 488 | 25.6 | 16 | 3.3 | 55.1 | 0.157 | 0.101 | 0.742 | Singh, M (2008) |
| Simte | 300 | 33.33 | 23 | 10.67 | 33 | 0.254 | 0.187 | 0.559 | Esther Lalremkim (2014) |
| Total | 2581 | 32.74 | 19.42 | 7.53 | 39.87 | 0.228 | 0.145 | 0.624 | |

For the purpose of inter- population comparisons, chi-square test have been applied as shown and presented in table- 4. A quick glance at the inference in the table below reveals the frequency of ABO blood groups varies within the populations of Manipur as majority shows statistical significant differences at 5 % level. The maximum value of statistical significant is observed among Chiru x Tarao (39.47) population whereas the minimum value among Meitei x Simte (0.36) population. Great variation occurs within and between the data available populations in Manipur which may be due to factors like migration, diseases, inter-compatible reproductive opportunity, geography and the initial blood type assigned. Hence, knowledge of blood type is essential so as to simply better understanding ourselves-health and life, help others, choosing partner to avoid infertility, etc.

**Table -4**

**Inter Population Comparisons in respect of ABO Blood Groups among Twelve Populations of Manipur**

| Popn | Bra | Chi | Kab | Koi | Lam | Mei | Mus | Tan | Tar | Pur | Koi | Sim |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bra | X | 20.71* | 2.64* | 15.63* | 1.44 | 1.54 | 10.56* | 4.60* | 21.27* | 7.09* | 16.12* | 1.49 |
| Chi | 20.71* | X | 8.46* | 9.56* | 20.61* | 12.65* | 2.37* | 5.84* | 39.47* | 1.73 | 3.94* | 11.06* |
| Kab | 2.64* | 8.46* | X | 8.42* | 5.65* | 1.69 | 3.38* | 0.46 | 22.85* | 1.87 | 7.66* | 0.56 |
| Koi | 15.63* | 9.56* | 8.42* | X | 21.51* | 15.98* | 11.10* | 6.01* | 14.04* | 6.87* | 1.60 | 12.70* |
| Lam | 1.44 | 20.61* | 5.65* | 21.51* | X | 4.27* | 16.43* | 8.99* | 22.86* | 13.22* | 23.86* | 4.14* |
| Mei | 1.54 | 12.65* | 1.69 | 15.98* | 4.27* | X | 5.41* | 3.34* | 29.76* | 4.31* | 14.54* | 0.36 |
| Mus | 10.56* | 2.37* | 3.38* | 11.10* | 16.43* | 5.41* | X | 2.66* | 37.40* | 1.36 | 6.95* | 4.36* |
| Tan | 4.60* | 5.84* | 0.46 | 6.01* | 8.99* | 3.34* | 2.66* | X | 22.31* | 0.78 | 4.59* | 1.80 |
| Tar | 21.27* | 39.47* | 22.85* | 14.04* | 22.86* | 29.76* | 37.40* | 22.31* | X | 27.60* | 21.88* | 26.45* |
| Pur | 7.09* | 1.73 | 1.87 | 6.87* | 13.22* | 4.31* | 1.36 | 0.78 | 27.60* | X | 3.87* | 3.14* |
| Koi | 16.1 | 3.94* | 7.66 | 1.60 | 23.86* | 14.5 | 6.95* | 4.59* | 21.88* | 3.87* | X | 11.70* |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2* | | | | | 4* | | | | | | |
| Sim | 1.49 * | 11.06* | 0.56 | 12.70* | 4.14* | 0.36 | 4.36* | 1.80 | 26.45* | 3.14* | 11.70* | X |

*=statistical significant at 0.05% level

Bra= Brahmin; Chi=Chiru; Kab=Kabui; Koi=Koireng; Lam=Lamkang; Mei=Meitei; Mus=Muslim; Tan=Tangkhul; Tar=Tarao; Pur=Purum; Koi=Koirao and Sim=Simte

**Discussion:**

Due to its medical importance in relation to different diseases, pursuing a line of investigation on the ABO blood group systems has been of significance for years. It is well known that these blood group systems are of great importance in blood transfusion, organ transplantation, and to understand its compatibility. Furthermore, the susceptibility to several diseases has been associated with the ABO phenotype (Aird et.al 1953; Athreya and Coriell, 1967; Vogel and Chakravartti, 1966; Bernhard, 1966 and Glass et. al 1985). Based on the finding, the population of Manipur will be prone to digestive system diseases as blood type O is maximum but such correlation remains controversial.

There are different reports on the distribution of the ABO blood group in various geographical, ethnic and socio-economic groups (Beardmore, J and Karimi-Booshehri , 1983). In spite of these diverse results, blood group O has been reported to be the most common blood group in most of the studies, whilst the least frequent was blood group AB which is in agreement with the present study . In general, the allele frequencies of the total population of the world to be O>A>B (McArthur and Penrose, 1950-51) which are similar to the alleles frequencies among the total considered populations in the order O=0.624; A=0.228 and B=0.145.

As with the inter- population comparison of ABO blood group system, majority of the population shows statistical significant difference (0.05%) though all the population are under the same geographical region. Great variations in chi-square values are observe between the populations of Tarao with other available population. The differences are most pronounced among Chiru x Tarao (39.47) population whereas the less value among Meitei x Simte (0.36) population. Such differences are due to varying degree in the frequency distribution of ABO blood groups among the different ethnic groups. Blood groups are non adaptive traits that they are not

affected by environmental selection. But, the establishment of pleiotropic effect of ABO alleles, that is determination of blood types as well as resistances and susceptibility to several diseases has shunned the concept of non adaptability

In short, it can be concluded that the present study will provide vital information on ABO blood groups, help understand medical importance in relation to different diseases, compatibility marriage to avoid foetal wastage, its distribution in Manipur and also, to know how it affects health. Nonetheless, a larger study is necessary for better determination. Moreover, a study on the association of ABO/Rh blood groups and certain diseases in this ethnic population is highly recommended.

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