

Study of pattern of parents' and children's blood group - a statistical analysis

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Manuscript Details

Available online on <https://www.irjse.in>
ISSN: 2322-0015

Editor: Dr. Arvind Chavhan

Cite this article as:

Khadse Tushar and Nagawanshi Meena. Study of pattern of parents' and children's blood group – a statistical analysis, *Int. Res. Journal of Science & Engineering*, 2020, Special Issue A9: 179-184.

Article published in Special issue of International e-Conference on "Emerging trends and Challenges In life sciences" organized by Department of Botany, Indraraj Arts, Commerce & Science College, Sillod-431112, Dist Aurangabad, Maharashtra, India date, June 18-19, 2020.



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Abstract

Today, the ABO blood grouping system forms the basis of a variety of research in medicine, genetics, blood transfusion and immunity. The present study was aimed to analyze the pedigree pattern of blood group between parents and their children. The maximum recorded Blood group among both maternal and paternal relatives was "A+ve" and the general tendency was towards positive Rh type. Among the surveyed, family-wise and gender-wise, the children's blood group matched with the mother's blood group or the father's blood group with equal frequency. Since the grandparents in both side of the family were "A+ve", both families predominantly display "A+ve" blood group. But, wherever any other blood group (A+ve, B+ve, AB+ve, O+ve and B-ve) was introduced through marriage, those blood groups appeared in the next generation.

Keywords: ABO Blood Grouping, Parental relationship, pedigree analysis

Introduction

At present, 33 blood group systems representing over 300 antigens are listed by the International Society of Blood Transfusion [1-2]. The ABO blood group system, discovered by the Austrian Biologist Karl Landsteiner in the year 1901, is based on the antigens and antibodies that are naturally present on the RBCs. The Rh typing of the blood group, jointly discovered by Karl Landsteiner and Alexander S. Wiener, depends upon the presence (+ve) or absence (-ve) of Rh factor [3].

The ABO blood grouping system is controlled by Glycosyl transferase enzyme producing gene, which is present in three allelic forms *viz.*, IA, IB and IO. The two alleles IA and IB are co-dominant, but both are dominant over the IO [4]. Thus, their combinations are A, B, AB and O, all appearing in either positive or negative form depending on the presence of Rh factor. The frequencies of ABO and Rh blood groups vary from one population to another and time to time in the same region. This basis of classification remains the most important one for the purpose of medical treatments, blood transfusion, genetic research and anthropology [5-6]. As genetic markers employed in population genetics, the association of ABO blood group with certain pathological conditions has been reported; for example, a higher prevalence of stomach cancer among people with blood group A, susceptibility to malarial infection among persons with O blood group [7-9].

According to the Mendelian genetic basis and laws, various types of blood groups which are inherited are shaped by laws and social processes. Various studies have been carried out all over India to study the relationship between blood groups of parents and children [10, 11]. This study will document a blood group database, create social awareness, facilitate safe blood transfusion and prevent hemolytic disease of new born and fetus by studying ABO and Rh typing.

Methodology

The present survey was conducted amongst the close blood relatives of the author, during 2019. Since the relatives are scattered in different towns and villages, the data for blood group analysis has been taken from standard pathological reports and later analyzed in the Department of Zoology, Deogiri College. An informed consent was obtained from all the participants.

Results and Discussions

“Blood type” refers to a specific pattern of reaction to testing antisera within a given system. Most of the blood types have been cloned and sequenced. The genes of these blood group systems are autosomal, except XG and XK which are X-borne, and MIC2 which is present on both X and Y chromosomes. The antigens can be integral proteins where polymorphisms lie in the variation of amino acid sequence (e.g., Rhesus [Rh]), glycoproteins or glycolipids (e.g., ABO). A Statistical survey was carried out to understand the hereditary nature of Blood Groups among Parents and Children in close blood relatives of the investigator’s family. In total, 67 individuals were involved in the survey. Among them, 41 persons are male and 26 persons are female (Table 1).

Table 1: Number of Relatives involved in present research

Sr No.	Types of relatives	Number	Types of relatives	Number
	Paternal Relatives	46	Maternal Relatives	21
	Male Relatives	29	Male Relatives	12
	Female Relatives	17	Female Relatives	09

Table 2: Details of paternal relatives’ blood group as total number and percentage

No.	Blood Group	No. of Relatives	% of Blood Group
1	‘A’ Positive	24	52.17 %
2	‘B’ Positive	05	10.86 %
3	‘AB’ Positive	10	21.73 %
4	‘O’ Positive	03	06.52 %
5	‘A’ Negative	00	00.00 %
6	‘B’ Negative	03	06.52 %
7	‘AB’ Negative	01	02.17 %
8	‘O’ Negative	00	00.00 %
	Total no. of Relatives	46	

Among the eight Blood groups, the trend was A+ve > AB+ve > B+ve > O+ve > B-ve > AB-ve. We did not find any relatives with "A-ve" and "O-ve" blood groups. Positive Rh Typing of Blood groups were observed more when compared to the Negative Rh Typing Blood groups.

Table 3: Details of maternal relatives' blood group as total number and percentage

Sr. No.	Blood Group	Number of Relatives	% of Blood Group
1	'A' Positive	08	38.09 %
2	'B' Positive	06	28.57 %
3	'AB' Positive	06	28.57%
4	'O' Positive	01	04.76 %
5	'A' Negative	00	00.00 %
6	'B' Negative	00	00.00 %
7	'AB' Negative	00	00.00 %
8	'O' Negative	00	00.00 %
	Total No. of Relatives	21	

Among the maternal relatives the trend was A+ve > B+ve > AB +ve > O +ve . In our survey, we did not find any persons with "A-ve", "B-ve", "AB-ve" and "O-ve" Blood groups. Only Positive Rh Typing of Blood groups were observed.

Table 4: Gender wise details of paternal relatives' blood group

No.	Blood Group	Gender and Blood Group of %	
		Male (%)	Female (%)
1	'A' Positive	15 (62.50 %)	09 (52.95 %)
2	'B' Positive	01 (03.44 %)	04 (23.52 %)
3	'AB' Positive	08 (27.58 %)	02 (11.76 %)
4	'O' Positive	02 (06.89 %)	01 (05.88 %)
5	'A' Negative	00 (00.00 %)	00 (00.00 %)
6	'B' Negative	02 (06.89 %)	01 (05.88 %)
7	'AB' Negative	01 (03.44 %)	00 (00.00 %)
8	'O' Negative	00 (00.00 %)	00 (00.00 %)
Total		29 Male	17 Female

The Gender wise details of Blood Groups of paternal relatives were analyzed. Among male persons, the highest percentage of Blood group was recorded as "A+" (62.50 %) followed by "AB+" (27.58 %), "O+" & "B -" both (6.89 %) and "AB -" & "B+" (3.44 %). The Blood groups "A -" and "O-" were not observed in the male persons. For female persons, the highest percentage of Blood group was recorded as "A+" (52.95%) followed by "B+" (23.52%), "AB+" (11.76 %), and "O+" & "B-" (5.88%). The Blood groups "A-", "AB-" and "O -" were not observed in the female persons.

Table 5: Gender wise details of maternal relatives' blood groups

No.	Blood Group	Gender and Blood Group of %	
		Male (%)	Female (%)
1	'A' Positive	06 (50.00 %)	02 (22.22 %)
2	'B' Positive	01 (08.33 %)	05 (55.55 %)
3	'AB' Positive	04 (33.33 %)	02 (22.22 %)
4	'O' Positive	01 (08.33 %)	00 (00.00 %)
5	'A' Negative	00 (00.00 %)	00 (00.00 %)
6	'B' Negative	00 (00.00 %)	00 (00.00 %)
7	'AB' Negative	00 (00.00 %)	00 (00.00 %)
8	'O' Negative	00 (00.00 %)	00 (00.00 %)
Total		12 Male	09 Female

The Gender wise details of Blood Groups of maternal relatives were analyzed. Among male persons, the highest percentage of Blood group was recorded as "A+" (50 %) followed by "AB+" (33.33 %), "B+" & "O+" (8.33 %). The

Rh negative type of Blood group was not observed in the male persons. For female persons, the highest percentage of Blood group was recorded as "B+" (55.55 %) followed by "A+" & "AB+" (22.22 %). The rest of the Blood groups were not observed in the female persons.

Table 6: Parental matching of Blood group between the Parents and Children, family wise among Paternal relatives

No.	Families of Paternal (Blood Group)	Paternal matching of Blood Group		
		Fathers Blood Group matching	Mothers Blood Group matching	Unmatched Father and Mother Blood Group
1	1 st Family (A+/A+)	05	05	00
2	2 nd Family (A+/A+)	02	02	00
3	3 rd Family (B-/A+)	00	02	02
4	4 th Family (A+/A+)	01	01	01
5	5 th Family (AB+/A+)	01	01	00
6	6 th Family (A+/A+)	03	03	00
7	7 th Family (A+/O+)	01	00	00
8	8 th Family (A+/B+)	01	00	01
9	9 th Family (AB+/AB+)	01	01	01
10	10 th Family (A+/B-)	00	00	02
11	11 th Family (B-/A+)	00	00	01
12	12 th Family (AB+/B+)	00	01	00
13	13 th Family (O+/AB+)	00	00	02
14	14 th Family (B+/A+)	00	00	02
	Total	15	16	12

Parental matching of Blood group between the Parents and Children family-wise was studied in amongst the paternal relatives. Among the surveyed, 15 persons' blood group matched with Father's blood group, 16 persons' blood group matched with Mother's blood group while 12 persons' blood group did not matched with Father or Mother's blood group.

Table 7: Parental matching of Blood group between the Parents and Children, family wise among Maternal relatives

No.	Families of Maternal (Blood Group)	Maternal matching of Blood Group		
		Fathers Blood Group matching	Mothers Blood Group matching	Unmatched Father and Mother Blood Group
1	1 st Family (AB+/A+)	01	02	00
2	2 nd Family (A+/A+)	02	02	00
3	3 rd Family (AB+/B+)	01	03	00
4	4 th Family (A+/AB+)	02	01	00
5	5 th Family (AB+/B+)	00	01	00
6	6 th Family (O+/B+)	00	01	00
	Total	06	10	00

Parental matching of Blood group between the Parents and Children family-wise was studied in maternal relatives. Among the surveyed, 6 persons' blood group matched with Father's blood group, 10 persons' blood group matched with Mother's blood group.

Table 8: Gender wise parental matching blood group between the parent and children among paternal relatives

No.	Families (Blood Group)	Fathers Blood Group matching	Mothers Blood Group matching	Unmatched with Father and Mother
1	1 st Family (A+/A+)	Male 02 Female 03	Male 02 Female 03	Male 00 Female 00
2	2 nd Family (A+/A+)	Male 02 Female 00	Male 02 Female 00	Male 00 Female 00
3	3 rd Family (A+/B-)	Male 00 Female 00	Male 01 Female 01	Male 01 Female 01
4	4 th Family (A+/A+)	Male 01 Female 00	Male 01 Female 00	Male 00 Female 01
5	5 th Family (A+/AB+)	Male 01 Female 00	Male 01 Female 00	Male 00 Female 00
6	6 th Family (A+/A+)	Male 02 Female 01	Male 02 Female 01	Male 00 Female 00
7	7 th Family (A+/O+)	Male 01 Female 00	Male 00 Female 00	Male 00 Female 00
8	8 th Family (B+/A+)	Male 01 Female 00	Male 00 Female 00	Male 01 Female 00
9	9 th Family (AB+/AB+)	Male 01 Female 00	Male 01 Female 00	Male 00 Female 01
10	10 th Family (B-/A+)	Male 00 Female 00	Male 00 Female 00	Male 02 Female 00
11	11 th Family (A+/B-)	Male 00 Female 00	Male 00 Female 00	Male 01 Female 00
12	12 th Family (AB+/B+)	Male 00 Female 00	Male 00 Female 01	Male 00 Female 00
13	13 th Family (AB+/O+)	Male 00 Female 00	Male 00 Female 00	Male 01 Female 01
14	14 th Family (A+/B+)	Male 00 Female 00	Male 00 Female 00	Male 02 Female 00
	Total	Male 11 Female 04	Male 10 Female 06	Male 08 Female 04

Gender-wise Parental matching of Blood group between the Parents and Children was analyzed. Father's blood group matched with 11 male and 4 female children, Mother's blood group matched with 10 male and 6 female children, while 8 male and 4 female children's blood group are neutral and did not match with Father or Mother's blood group.

Table 9: Gender wise parental matching of blood group between the parent and children among maternal relatives

No.	Families Blood Group	Fathers Blood Group matching	Mother Blood Group matching	Unmatched Father and Mother Blood Group
1	1 st Family (AB+/A+)	Male 01 Female 00	Male 01 Female 01	Male 00 Female 00
2	2 nd Family (A+/A+)	Male 02 Female 00	Male 02 Female 00	Male 00 Female 00
3	3 rd Family (AB+/B+)	Male 01 Female 00	Male 01 Female 02	Male 00 Female 00
4	4 th Family (A+/AB+)	Male 02 Female 00	Male 00 Female 01	Male 00 Female 00
5	5 th Family (AB+/B+)	Male 00 Female 00	Male 00 Female 01	Male 00 Female 00
6	6 th Family (O+/B+)	Male 00 Female 00	Male 00 Female 01	Male 00 Female 00
	Total	Male 06 Female 00	Male 04 Female 06	Male 00 Female 00

Gender-wise Parental matching of Blood group between the Parents and Children was analyzed. Father's blood group matched with 6 male and none of the female children, Mother's blood group matched with 4 male and 6 female children, while none of the children's blood group are neutral and did not match with Father or Mother's blood group.

Conclusion

From this present survey, we concluded that:

1. Among the eight Blood groups, maximum recorded Blood group among both maternal and paternal relatives was "A+".
2. Positive Rh Typing of Blood group was observed more among the relatives when compared to the Negative Rh Typing Blood groups in both males and females.
3. Among the surveyed, family-wise, the trend is towards children's blood group matching almost equally with either the mother's blood group or the father's blood group.
4. Even, gender-wise, the tendency is towards children's blood group matching almost equally with either the mother's blood group or the father's blood group.
5. Since the grandparents were both A+ve, both paternal and maternal families predominantly display A+ve blood group. But, wherever any other blood group (A+ve, B+ve, AB+ve, O+ve and B-ve) was introduced through marriage, those blood groups appeared in the next generation.

Among similar contemporary researches conducted, the results also found Rh positive type blood groups to be more prevalent. But, unlike the equal gender-wise blood group matching with parents as found in the present study, it was found that the blood group of daughter was more likely to match with her father and that of the son with his mother [11]. The difference in the results could be attributed to the fact that, that research focused on a random selection of population samples while the present study analyzed pedigree from the same family.

Conflicts of interest: The authors stated that no conflicts of interest.

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