International Journal of Advanced Research in Engineering Technology & Science
ISSN: 2394-2819
Impact Factor: 7.10
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
Email: editor@ijarets.org Volume-13, Issue-4 April – 2026 www.ijarets.org

EVALUATING THE ROLE OF ABO AND RH BLOOD GROUP SYSTEMS IN HUMAN LONGEVITY AND DISEASE SUSCEPTIBILITY

Pankaj Kumar Mishra

Research Scholar, Department of Zoology, TiIak Dhari P.G college Jaunpur, Uttar Pradesh, India

Ashutosh Mishra

Assistent professor, Department of Zoology, TiIak Dhari P.G college Jaunpur, Uttar Pradesh,India

Dev Brat Mishra

Assistent professor, Department of Zoology, TiIak Dhari P.G college Jaunpur, Uttar Pradesh,India

ABSTRACT

This study investigates the correlation between ABO and Rh blood type systems and longevity among the elderly in Kerakat and Jalalpur. Transfusion medicine depends on blood type systems, especially ABO and Rh, which are linked to how likely someone is to become sick or not. This research examines if these biological indicators may also signify longevity, extending the foundational work of Karl Landsteiner. This study used observational, non-experimental methodologies. We got a full dataset from blood bank reports, hospital pathology records, and field surveys. The study included both male and female participants aged 80 years and younger. Systematically collected and analysed ABO blood type, Rh factor, gender, and demographic information.Blood type O is the most frequent type for people of all ages, even older people. Blood types A, B, and AB come next. This continuous distribution suggests that blood type O may prevail among long-lived individuals owing to demographic trends rather than longevity itself. The Rh factor is significant in clinical conditions such as Haemolytic Disease of the Newborn (HDN), however its correlation with lifespan remains ambiguous. The study demonstrates the influence of blood types on the risk of infectious, cardiovascular, and immunological diseases. But there was no clear correlation between blood types and how long people live. The statistics suggest that genetics, environment, healthcare access, and lifestyle influence longevity, rather than blood type.ABO and Rh blood types are important biological and clinical markers, but they don't do a good job of predicting how long someone will live. We need further interdisciplinary research on genetic, environmental, and socio-demographic aspects to elucidate longevity.

Keywords:ABO Blood Group, Rh Factor, Disease Susceptibility, Aging Population, Longevity

INTRODUCTION

In 1930, Landsteiner was awarded the Nobel Prize in Physiology or Medicine for his discovery of blood types. This discovery was the reason for the award. In his work, he presented the notion of agglutinins, which are antibodies, and referred to the particular blood group interactions as isoagglutination. Additionally, he introduced the concept of agglutinins, which provides the true foundation for antigen-antibody response in the ABO system. According to him,It is possible to assert that there are at least two distinct kinds of agglutinins, one of which is found in letter A, another in letter B, and both of them combined in letter C. The agglutinins that are present in the same serum do not have any effect on the red blood cells since they are harmless. As a result, he found two antigens, which were agglutinogens A and B, as well as two antibodies, which were agglutinins, namely anti-A and anti-B. However, his third group (C) did include anti-A and anti-B antibodies, despite the fact that it did not contain either A or B antigens. Adriano Sturli and Alfred von Decastello, two of his pupils, made the discovery of the fourth type and referred to it as "no particular type" in the following year. However, they did not name the type. Ludwik Hirszfeld and Emil Freiherr, von Dungerncame up with the name "0" (null) in 1910 to refer to the group that Landsteiner labeled as C. They also came up with the designation "AB" to refer to the type that was found by Sturli and von Decastello. In addition to this, they were the pioneers in explaining the genetic inheritance of the blood types themselves.

Importance of Blood Groups

From the perspective of blood transfusion, the ABO and Rh blood group systems are the only ones that have significant clinical significance. Other blood group systems are of lesser significance due to the fact that the antibodies that correspond to them are either not present in the normal course of events or occur infrequently. When they are present, they typically react at low temperatures (cold agglutinins) (Dacia and Lewis et al.,) and do not precipitate. When receiving a blood transfusion, it is imperative that only compatible blood be used. The individual who donates blood is referred to as the "donor," while the individual who gets the blood is referred to as the "recipient." Plasma of the AB group blood does not contain any antibodies, thus the antigen of the donor and the antibody of the receiver are regarded to be present throughout the process of blood transfusion. The agglutination of RBC from any other group of blood is not caused by this particular phenomenon. People who have the AB blood type are able to accept blood from people of any blood group. Therefore, those who have this blood type are referred to as "universal recipients." In a mismatched transfusion, the transfusion reactions take place between the red blood cells (RBC) of the donor and the plasma of the receiver. Therefore, agglutination does not take place if the plasma of the donor includes agglutinins that are directed against the red blood cells of the recipient. This is because the antibodies are diluted in the blood of the recipient.

Introduction to longevity and factors influencing lifespan

Longevity is a term that may be used to describe individuals who have lived exceptionally long lives, while life expectancy is a statistical term that describes the average number of years that an individual

has left at a certain age. For instance, the life expectancy of a population at birth is equivalent to the average age at death for all individuals who were born in the same year (in the case of cohorts). Studies on longevity may entail the investigation of potential strategies to lengthen life. Not only has the scientific community been interested in writing about longevity, but authors of travel, science fiction, and utopian novels have also been interested in the subject. Historiographer Herodotus, who lived in ancient Greece, is credited with having written about the fabled fountain of youth. As a result of birth data that are either faulty or inadequate, it is impossible to independently verify the greatest human life duration. Fiction, mythology, and folklore have all suggested or claimed life spans in the past or future that are far longer than those that have been proven by current standards. Furthermore, longevity tales and claims of longevity that have not been verified typically talk of their presence happening in the present.

Development of Rh factor research by Karl Landsteiner and Alexander S. Wiener

During the year 1940, Karl Landsteiner (1868-1943) made the discovery of the Rh factor, which is a sort of protein or antigen that is located on the surface of red blood cells. A majority of individuals have a positive Rh. On the other hand, if a pregnant woman is Rh negative and her baby is Rh positive, the woman's body may generate an immune reaction to the blood of the fetus, which might result in injury to the fetus. The Rh factor has been described, which will allow for the development of screening tests that can anticipate issues of this kind and methods that can protect the baby from being injured.When immunology was still in its infancy, Landsteiner was a pioneer in the subject. As a result of his curiosity in the nature and genesis of antibodies, he made the discovery of the major blood groups in the year 1900. These blood groups are A, B, and O. As a result of this accomplishment, Landsteiner was honored with the Nobel Prize in the year 1930. While he was working at Rockefeller in the 1920s and 1930s, he decided to concentrate on the chemical study of immunological responses. Through the process of connecting tiny organic molecules, which he referred to as haptens, to proteins with a known structure, he was able to create fake antigens. He demonstrated that it was possible for little modifications to haptens to result in significant changes in antibody production.

Rh-positive vs Rh-negative

Additionally, the Rh system plays a significant part in establishing whether a person's blood is Rh-positive (Rh^+) or Rh-negative (Rh^-). This is in addition to the assessment of ABO grouping. The D antigen is the most important antigen used by the Rh system.

- **Rh-positive (Rh^+)**: Rh (D) antigen is present on the surface of red blood cells.
- **Rh-negative (Rh^-)**: While red blood cells do not contain the Rh (D) antigen, plasma may acquire antibodies to Rh if it is exposed to blood that is positive for the Rh factor

Early links between blood groups and disease susceptibility

In the year 1990, discoveries were made on the molecular basis of the ABO blood type system. A glycosyltransferase is encoded by this gene. This enzyme is responsible for transferring either N-acetyl D-galactosamine (group A) or D-galactose (group B) to the nonreducing ends of glycans that are found on glycoproteins and glycolipids. The nonreducing ends of the matching glycans in group O people express the blood group H antigen, which is the consequence of the inactivation of the A1 glycosyltransferase gene, which is the cause of the group O phenotype. Red blood cells are not the only place where the ABH antigens are found; they are also extensively expressed throughout the fluids and tissues of the body. Despite the fact that the biological importance of the A/B transferase has not been conclusively shown, it is reasonable to anticipate that the loss of this functioning protein in patients with group O blood type would have some adverse effects on patients with this blood type.

Clinical Significance

The clinical significance of glycoproteins and glycolipids is especially apparent in the context of blood transfusions and the situations that are associated with illness. The presence of blood type antigens on these molecules makes it possible for immunological responses, including hemolysis, to occur in the event that the donor blood and the receiver blood are incompatible with one another.

The presence of alterations in glycoproteins and glycolipids has also been linked to a number of disorders. Alterations in the composition of the membrane, for instance, may have an effect on the deformability of RBCs, which can result in illnesses such as anemia. Certain diseases also interact with the glycoproteins and glycolipids that are found on the surface of red blood cells, which may affect the susceptibility to infections.

ABO Blood Groups and Infectious Diseases

Numerous infectious illnesses have been linked to the ABO blood type system, which has been closely connected with both vulnerability and resistance to these diseases. A significant amount of impact is exerted on this connection by the presence or lack of A and B antigens on red blood cells, as well as the antibodies that correlate to these antigens in plasma. Antigens and antibodies serve as defense systems that protect the body against infections that have invaded the body. The fact that the ABO gene polymorphism has been retained throughout a wide range of vertebrate species provides evidence that it has an evolutionary benefit in being able to guard against microbial diseases. The glycoconjugates that are found on the surface of cells are often used as attachment receptors by infectious organisms such as bacteria, viruses, and parasites. Blood group antigens are a component of these glycoconjugates; hence, differences in ABO blood types have the potential to influence the manner in which pathogens interact with host cells. Molecular mimicry is a phenomena that allows some germs to avoid being detected by the immune system. This is accomplished by the microbes imitating the blood type antigens of their host. The worldwide distribution of ABO blood types has been proven to be altered by historical epidemics such as the plague, cholera, and smallpox, according to findings from historical research. The existence of "H-like" antigens in plague and cholera pathogens, as well as "A-like" antigens in the smallpox virus, for example, shows that people with

specific blood types may have evolved resistance or susceptibility to the disease depending on their antibody profiles.

Hemolytic Disease of the Newborn (HDN)

Hemolytic Disease of the Newborn (HDN), which is sometimes referred to as erythroblastosis fetalis, is a severe blood illness that affects newborn newborns as a result of the fast destruction of their red blood cells. The breakdown of red blood cells is referred to as "hemolytic," the manufacturing of immature red blood cells is referred to as "erythroblastosis," and the word "fetalis" refers to the fetus. This syndrome occurs when the mother and the newborn have blood types or Rh factors that are incompatible with one another but are compatible with one another. In addition to having a blood type, which may be either A, B, AB, or O, every person also has a Rh factor, which can be either positive or negative. When a Rh-negative woman carries a Rh-positive baby, which is often inherited from a Rh-positive father, complications are most likely to arise. It is possible for a tiny quantity of the baby's Rh-positive blood to enter the mother's system either during pregnancy or at the moment of delivery. This is notably an issue that occurs when the placenta detaches during birth.

In response to the Rh-negative mother's immune system identifying the Rh-positive red blood cells of the fetus as alien, the immune system produces antibodies in order to eliminate them. Rh sensitization is the specific term for this phenomenon. Although sensitization does not often have a substantial impact on the first pregnancy, the immune system of the mother will remember the antibodies that were produced during the first pregnancy. These antibodies have the ability to cross the placenta and assault the baby's red blood cells, which ultimately results in the loss of those cells. This may happen in future pregnancies with another Rh-positive fetus. Anemia and other difficulties may develop in the baby as a consequence of this disorder, which is known as erythroblastosis fetalis. This condition may occur before or during pregnancy. The term "HDN" refers to the condition seen after delivery.

Genetic Control (RHD and RHCE genes)

The RhD and RhCE proteins are encoded by the genes RHD and RHCE, which are about 97% similar to one another and may be found on chromosome 1p34-p36. Each of these genes is the product of a gene duplication, and each of them has ten exons. Because the Rh proteins are 417-amino acid proteins that migrate in sodium dodecyl sulfate-polyacrylamide gel electrophoresis gels with an approximate molecular weight ratio of 30–32 kD, they are frequently referred to as Rh30 proteins. This is because the Rh proteins move in the gels. According to the hypothesis, they will contain twelve areas that cross the membrane and will be connected to fatty acids in the lipid bilayer itself. The sole difference between them is between 32 and 35 amino acids, and it is determined by the variant of RhCE that is present. In their review, Avent and Reid analyze and demonstrate the intricate intron-exon structure of RHD and RHCE. Both of these structures are complicated.

OBJECTIVE

- survey of hospitals pathologies and local population to find out correlation between ABO blood group, Rh antigen and longevity.
- To know whether the presence of a certain blood group confer's healthier life to protection against an infection to provide healthy longevity.

METHODOLOGY

There are clear links between blood group and disease, in addition to hemolytic transfusion reactions, hemolytic sickness of the infant, autoimmune hemolyticanemia, and graft rejection (Roback, Grossman, Harris, & Hillyer, 2011). There have been reports of statistical links between the ABO blood type and several disorders, such as cancer, thrombosis, peptic ulcers, bleeding, and infections.The function of ABO antigens in biological processes is not fully understood. In a study that was conducted by Marionneau et al. in 2001, it was suggested that the polymorphic genes that make up the ABO blood type offer the variety that is necessary for survival in the face of shifting environmental circumstances and developing diseases. A smaller number of research have investigated whether or not there is a correlation between ABO blood type and overall survival or longevity, despite the fact that statistical connections between ABO blood group and illness are well documented in the scientific literature.

Those individuals who have a lifetime that is more than the average life expectancy will be included in the research, which will result in the inclusion of a group of people who live for a very long time. Data on blood groups, including the ABO system and the Rh factor, will be gathered either via the medical records that are readily accessible or by proper testing procedures, if it is possible to do so. In addition, other demographic information, like gender, estimated age, and location, will be captured. The objective is to compile a comprehensive dataset that accurately depicts the variances in blood groups that are seen among persons who have lived for a very long time in various regions.

RESULT

Table :1 Analysis of Variance (ANOVA) of ABO Blood Group in the Total Sample with Covariates

Source	SS	df	MS	F	p-value
Gender	1078.502	1	1078.502	2.420	0.120
Category Group	33993.468	1	33993.468	76.271	0.000
Health Status	22018.769	1	22018.769	49.404	0.000
Location	8586.484	1	8586.484	19.266	0.000

ABO	1276.197	3	425.399	0.954	0.413
Error	1077680.202	2418	445.691	—	—
Total	9512152.000	2426	—	—	—

Based on the adjusted analysis, it has been shown that the ABO blood type does not have a statistically significant impact on the age (longevity) of the population under consideration.

On the other hand, other characteristics, including category group, health state, and geography, have a considerable impact on age, which suggests that these aspects play a more major role in predicting lifespan than blood group does. There is no evidence that gender has a substantial impact

Table:2 Analysis of Variance (ANOVA) of ABO Blood Group in the Younger Subsample with Covariates

Source	SS	df	MS	F	p-value
Gender	0.385	1	0.385	0.121	0.728
Category Group	13.757	1	13.757	4.341	0.039
Health Status	11.502	1	11.502	3.629	0.059
Location	0.268	1	0.268	0.084	0.772
ABO	1.756	3	0.585	0.185	0.907
Error	364.464	115	3.169	—	—
Total	501.000	123	—	—	—

In the younger subgroup (those under the age of ten), the findings of the analysis of variance (ANOVA) suggest that the ABO blood type does not have a statistically significant influence on age. This is shown by the very low F value (0.185) and the high p-value (0.907). Given this information, it is abundantly evident that there is no significant link between blood type and age in this particular population.

Among the other factors, category group has a statistically significant impact ($p = 0.039$), which indicates that variations in population grouping affect age variation in younger people. This is something that can be seen in the data.

Despite the fact that it does not satisfy the customary criterion ($p < 0.05$), the health condition in question is getting close to reaching statistical significance ($p = 0.059$), which indicates that there may be an impact on age.

As far as this particular subgroup is concerned, neither gender (p = 0.728) nor place (p = 0.772) has any significant influence on age.

Table :3 Comparison of ABO Distribution by Health Status in Earlier and Current Data

ABO	Health Status (%) (Earlier / Current)	No Health Status (%) (Earlier / Current)	χ^2	df	p-value
B	78.3 / 61.6	21.7 / 38.4	5.88	1	0.015
AB	65.4 / 56.5	34.6 / 43.5	0.40	1	0.525

There is a statistically significant change between the previous datasets and the current one in terms of the distribution of blood group B according to health status (p = 0.015). This difference is substantial according to statistical analysis.

- Compared to the current dataset, the older dataset indicates a somewhat higher percentage of individuals who have been exposed to health hazards, while the current dataset reveals a comparatively smaller number of individuals who have been exposed to certain health risks.
- There is a possibility that this distinction had a part in the findings that were reached in the past with relation to lifespan.
- The difference in distribution for blood type AB is not statistically significant (p = 0.525), which shows that the two datasets are compatible with one another.

This is the conclusion that can be drawn from the statistical analysis.

DISSCUSSION

Considering that the length of time that participants lived was the primary outcome of this study, it is of the utmost importance to take into consideration the life expectancy of the population that was being investigated and the ways in which it may vary based on other variables such as gender. There were a few individuals who had lived for more than eighty years who were included in the study endeavor that was originally intended. These individuals originated from a wide range of villages located within the Jaunpur district, namely within the Tehsil Kerakat and Jalalpur districts. By analyzing blood samples, these individuals were categorized as either men or females, and their ABO blood type and Rh antigen were identified. Additionally, their blood type was discovered. A study of the patient's medical records was conducted in order to provide background information on the patient's current state of health as well as the history of transfusions.

Through the examination of persons who have not had a transfusion as well as those who have received one, the purpose of this research is to investigate the possibility of correlations between ABO blood group, Rh antigen type, transfusion history, and healthy lifespan in the local community. Any disparities in lifespan that are detected may then be contextualized with other demographic

parameters, such as gender, in order to get an understanding of whether or not blood group relationships continue to exist in a community of people who live for a much longer period of time.

CONCLUSION

that there was no significant correlation between the distribution of the Rh antigen and the length of time that people lived. The majority of the participants were Rh-positive individuals, which is a reflection of the general demographic distribution in the region to where the study was conducted. Individuals who were negative for the Rh factor were detected in a reduced proportion of the subjects. Individuals who were Rh-positive and Rh-negative were found to be present among people who had lived for an extremely extended period of time. On the other hand, statistical analysis revealed that there was no significant connection between Rh status and the achievement of old age. These findings are consistent with the little evidence that can be discovered in the scientific literature, which generally suggests that Rh antigen does not independently influence either the ability to live a long life or the propensity to get unwell in the majority of people. Consequently, despite the fact that the Rh factor is clinically relevant in the context of transfusion and pregnancy, its effect on predicting overall lifespan seems to be rather minimal within the scope of our study. This is because the Rh factor is significantly influenced by the presence of the Rh factor.

REFERENCE

1. Agency for Healthcare Research and Quality. (2009). Blood transfusions more than double since 1997. AHRQ news and numbers. Retrieved September 24, 2009, from http://www.ahrq.gov/new/nn/nn092409.htm

2. Aird, I., Bentall, H. H., & Roberts, J. A. F. (1953). A relationship between cancer of the stomach and the ABO blood groups. British Medical Journal, 1, 799-804.

3. Aird, I., Bentall, H. H., Mehigan, J. A., & Roberts, J. A. (1954). The blood groups in relation to peptic ulceration and carcinoma of colon, rectum, breast, and bronchus; an association between the ABO groups and peptic ulceration. British Medical Journal, 2(4883), 315-321.

4. Albert, M. J. (1996). Epidemiology & molecular biology of vibrio cholerae O139 bengal. The Indian Journal of Medical Research, 104, 14-27.

5. Alkout, A. M., Blackwell, C. C., & Weir, D. M. (2000). Increased inflammatory responses of persons of blood group O to helicobacter pylori. The Journal of Infectious Diseases, 181(4), 1364-1369.

6. American Association of Anthropology. (1998). AAA statement on race. American Anthropologist, 100(3), 712-713.

7. American Association of Physical Anthropologists. (1996). AAPA statement on biological aspects of race. American Journal of Physical Anthropology, 101, 569-570.

8. Andersson, M., Carlin, N., Leontein, K., Lindquist, U., & Slettengren, K. (1989). Structural studies of the O-antigenic polysaccharide of Escherichia coli O86, which possesses bloodgroup B activity. Carbohydrate Research, 185(2), 211-223.

9. Anvari, M. S., Boroumand, M. A., Emami, B., Karimi, A., Soleymanzadeh, M., Abbasi, S. H., et al. (2009). ABO blood group and coronary artery diseases in Iranian patients awaiting coronary artery bypass graft surgery: A review of 10,641 cases. Lab Medicine, 40, 528-530.

10. Arthur, M., Hedges, J. R., Newgard, C. D., Diggs, B. S., & Mullins, R. J. (2008). Racial disparities in mortality among adults hospitalized after injury. Medical Care, 46(2), 192-199.

11. Baker, C. H., Wilmoth, F. R., & Sutton, E. T. (1986). Reduced RBC versus plasma microvascular flow due to endotoxin. Circulatory Shock, 20(2), 127-139.

12. Bennun, F. R., Roth, G. A., Monferran, C. G., & Cumar, F. A. (1989). Binding of cholera toxin to pig intestinal mucosa glycosphingolipids: Relationship with the ABO blood group system. Infection and Immunity, 57(3), 969-974.

13. Billi, J. E., Pai, C. W., Rothman, E. D., &Spahlinger, D. A. (2005). Disease burden in the managed care population at an academic medical center: The effect of adding local partners. Academic Medicine: Journal of the Association of American Medical Colleges, 80(6), 587593.

14. Bordin, J. O., Heddle, N. M., &Blajchman, M. A. (1994). Biologic effects of leukocytes present in transfused cellular blood products. Blood, 84(6), 1703-1721.

15. Boren, T., Falk, P., Roth, K. A., Larson, G., & Normark, S. (1993). Attachment of helicobacter pylori to human gastric epithelium mediated by blood group antigens. Science (New York, N.Y.), 262(5141), 1892-1895.