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*Original Research Article*

# Effect and Association of ABO & Rh Incompatibility on Maternal Outcome

**Mehar Preet Singh[1], Dr. Kulbir Kaur[2]**

[1]Research Scholar, Ph.D. - M.L.T (I.K Gujral Punjab Technical University)
[2]Director Principal & Professor Pathology, Punjab Institute of Medical Sciences (PIMS), Jalandhar

Corresponding Author: Mehar Preet Singh

## ABSTRACT

**Background:** Incompatibility affects those pregnancies in which maternal antibodies when cross the placental barrier and enters the fetal circulation, reacts and damage the fetal red cells, thus causing their premature destruction and results into HDN, Hydrops and even still birth.
**Objective:** To find the effect and association of incompatibility on maternal outcome.
**Material and Methods:** This was a prospective, observational study performed on 550 couples having female partners of 18 to 50 yrs. of age. ABO and Rh grouping was performed and compatibility was detected within each couple. The maternal record of couples was observed for fertility, reproductive outcome, live birth status, history of HDN and mortality of infants.
**Results:** The overall distribution of ABO & Rh among the compatible and incompatible group was not significantly different. Fertility, reproductive outcome, gender wise child birth and infant mortality were found independent with compatibility ($p>0.050$) but significant association was found with HDN ($p=0.005$), with gender of infant mortality ($p=0.001$). Compatible mating types were also found associated with gender of child birth and HDN ($p<0.050$).
**Conclusion:** It was concluded that incompatibility has no qualitative effect on the fertility, reproductive outcome and on infant mortality except HDN. But on the other hand, different mating types were found associated with gender of the born child, HDN and in some cases gender of the deceased infant. The data generated in this study will be useful for anticipatory management of the manifestations of incompatibility.

***Key words:*** ABO & Rh Incompatibility, Fertility, Maternal Outcome, HDN, Infant mortality

## INTRODUCTION

Human Red cell membrane contains different antigenic determinants, the molecular structure of which are determined either by a single genetic locus or very closely linked loci. Blood groups are a system of genetically determined antigens located on the surface of erythrocytes and are determined either by carbohydrate structures or protein structures expressed in series depending upon the blood group system. [(1)] The development of these antigens is genetically controlled; they appear early in fetal life and remain unchanged until death except very rarely an individual's blood type changes through addition or suppression of an antigen in infection, malignancy or autoimmune diseases. [(2-5)]

Clinical importance of blood group system depends on the capacity of alloantibodies to cause destruction of transfused red cells or to cross the placenta and give rise to hemolytic disease in the fetus or newborn. This in turn depends upon the frequency of antigens and the

alloantibodies and more over characteristics of the latter: thermal range, immunoglobulin class and ability to fix complement. On these criteria, the ABO and Rh systems are of major clinical importance. Anti-A and anti-B are naturally occurring antibodies and are capable of causing severe intravascular hemolysis after an incompatible transfusion. The Rh-D antigen is the most immunogenic red cell antigen after A and B, being capable of stimulating anti-D production after transfusion or pregnancy in the majority of Rh-D negative individuals. [(6)]

**ABO & Rh Incompatibility in Couples**

In transfusion practices, incompatibility is defined as the condition when blood of two individuals does not match due to the presence of particular blood group antigens on the RBCs of one (donor) and complimentary antibodies in the plasma of other (recipient). Usually this phenomenon is applied at every step in the routine blood banking and is very important for safe transfusion. But on the other hand, incompatibility of ABO & Rh blood groups also matters in the reproductive activity of couples when fetus of different blood group is nourished in the womb of a mother having different blood group.

ABO incompatibility occurs when the mother has complimentary antibodies of IgG type in her serum corresponding to ABO genotype of fetus. Usually it happens when mother is of group O and fetus is of group A or group B. Naturally occurring anti-A and anti-B antibodies are of IgM type and cannot cross the placental barrier however immune anti-A and anti-B antibodies of IgG type, mostly present in persons transfused with blood of incompatible ABO group and in pregnancy, will cross the placental barrier and enters into the circulation of fetus, where they react and damage the fetal red cells, causing their premature destruction thus resulting in Hemolytic Disease of Newborn (HDN) which leads to Jaundice, anemia, hydrops fetalis and sometimes intrauterine death (still birth). IgG type immune anti-A & anti–B antibodies are found more commonly in group 'O' individuals and these antibodies readily bind complement hence are potent hemolysins. ABO HDN occurs almost exclusively in the offspring of woman of blood group O, although reports exist of occasional cases in group A mothers with high-titer (anti-B) IgG. [(7)]

Rh incompatibility usually arises when mother is Rh negative (dd) and carries Rh positive (DD or Dd) fetus, who has derived D antigen from father. The chances of Rh negative mother becoming sensitized to the Rh antigen increases, if significant hemorrhage leading to immunization occur at delivery or in association with other intra-partum episodes such as amniocentesis, external version or abortion and thus having children affected with hemolytic disease in the succeeding pregnancies. If the husband is homozygous for D antigen (DD), all infants will be Rh positive but if he is heterozygous (Dd), any pregnancy has 50% probability of producing Rh negative child. Phenotype (blood group) and zygosity of the male partner (husband) and antibody titer of female partner (wife) are important determinant of the maternal sensitization.

So, compatible couple may be defined as a couple in whom male partner is able to donate his blood to his wife and vice versa in the incompatible couple. As a general approach, there must be fifty percent probability of having incompatible couples in this diverse universe. How and does the incompatibility matters in the maternal outcome which is the measure of the reproductive activity including fertility, conceptions, live births, abortions and still births of the couples? To answer this question and to further evaluate the qualitative effect of incompatibility on these attributes in the population, this study was planned in Punjab Institute of Medical Sciences (PIMS), Jalandhar, the only teaching hospital in the central region (Doaba) of Punjab. Population in this area may be considered as the representation population of the whole Punjab as many people migrated here from other regions

also i.e. Majha and Malwa and moreover many patients are routinely referred to this teaching hospital from the surrounding areas also.

## MATERIALS & METHODS

This was a prospective, observational study, performed on 550 couples, having female partners ranging 18 to 50 yrs. of age, selected at random, whom male partners were also available for blood sampling, attended the outdoor and indoor departments of Obs. and Gynae (OBG) of Punjab Institute of Medical Sciences (PIMS), Jalandhar from Nov 2016 to June 2017. Couples above or below age limits were excluded from this study. ABO & Rh Blood grouping was performed by microplate Hem-agglutination method on fully automatic Immunohematology analyzer Galileo-Echo (Immucor, USA). All discrepant and further advance immune-hematological investigations were performed using conventional tube technique (CTT) and ID-Gel technology. All the Rh-D Negative groups were retested for weak D antigen. All these investigations were performed in the dept. of Immuno-Hematology (Blood Bank), PIMS and samples for subgroup typing were sent to Immucor's reference lab. The maternal record of all the couples was recorded for fertility, reproductive output/wastage (Conception, live birth, abortion, still birth), gender wise live birth, history of hemolytic disease of newborn (HDN) and mortality of infants (child under 28 days of age) through a questionnaire. Those infants were labeled as sufferer of HDN which had history of hospital stay for five or more days for the reason of unconjugated hyperbilirubinemia at the time of birth. Fertile couples were divided into three groups:

1. Those females who were experiencing pregnancy for the 1st time.
2. Those who were pregnant at the time of study and had been experienced pregnancy earlier also and have had history of reproductive outcome i.e. live birth/abortions/still birth/twin pregnancy etc.
3. Those who were not pregnant at the time of study but experienced the conceptions with positive or negative outcome.

Fertility percentage was recorded and tabulated against all the groups but reproductive outcome (conceptions, live births, abortions, still birth), gender wise birth, incidence of HDN and infant mortality like attributes were tabulated and calculated only from group 2 and 3 fertile females who had successful outcome from one or more conceptions into live births of both gender in single or twin pregnancy or might have experienced the reproductive loss.

**Statistical Analysis:**

The tabulated data was analyzed for frequencies of these attributes among and within groups of different mating types using software IBM SPSS Statistics 23. All the observed attributes were also tested for significance of association with compatibility and incompatibility and its types with statistical technique using Chi-square.

## OBSERVATIONS & RESULTS

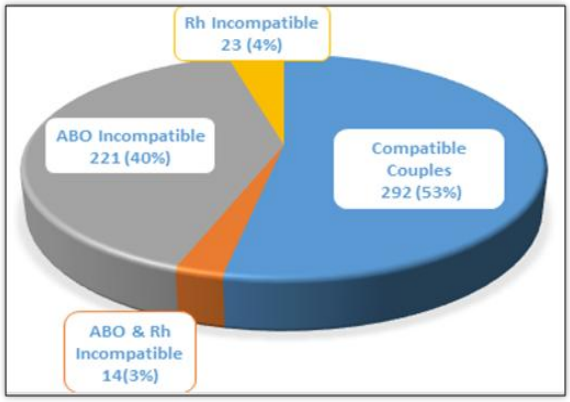


**Fig.1 Incidence of Incompatibility in Couples (n=550)**

Among the total selected 550 couples, 292 (53.1%) were found compatible and 258 (46.9 %) incompatible. Among the incompatible couples, 14 (2.55%) couples were ABO & Rh-IC, 221 (40.18%) ABO-IC and 23 (4.18%) couples were Rh-IC (Table: 1 & 2).

**Fertility Status:** Among the 550 couples in the study population, 478 (86.91%) were fertile, 64 (11.6 %) infertile and 8 (1.5%) were others. The frequency of fertility was 85.96% (251) in the compatible couples (C) and 87.98% (227) in the incompatible couples (IC) (Table:1). Within the Incompatible couples (IC), although with small difference, fertility rate was highest in ABO-IC (88.2%) and lowest in ABO & Rh-IC (85.7%) (Table: 2).

Fertility was also observed in the different mating types of all the groups. So, within the compatible group fertility was highest in AB wife with O husband mating and lowest in AB wife with AB husband mating. In ABO & Rh-IC, fertility was lowest in O-B mating and in ABO-IC lowest in A-AB and highest in B-AB. In Rh-IC it was lowest in A-O mating type. In Rh-IC, all the female partners (wife) were Rh-Negative and male partners (Husband) were Rh-Positive. Infertility was vice versa in all these mating combinations (Table: 3). The collected qualitative data when tested with Chi-square at different levels to check the significance of association between fertility and compatibility in different groups and mating types, found insignificant ($p>0.050$) So, it was concluded that fertility has no association with compatibility, type of incompatibility and its mating types i.e. all are independent or we can say that fertility is not dependent on compatibility, type of incompatibility and its mating types.

**Table:1 Maternal Outcome of the Couples in the study population (n=550)**

| | Fertility | | | | Reproductive Outcome | | | | Child Birth | | HDN | Infant Mortality | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Type of couples** | **No.** | **Fertile** | **Inf.** | **Others** | **No.** | **Concp.** | **Rep. loss** | **Live Births** | **Male** | **Female** | **No. of Child** | **No.** | **M** | **F** |
| **Comp (C )** | 292 | 251 (85.96) | 36 (12.3) | 5 (1.7) | 198 | 384 (1.94) | 97 (25.26) | 287 (74.74) (1.45) | 133 (46.34) (0.67) | 154 (53.66) (0.78) | 8 (2.79) | 9 (3.14) | 3 (33) | 6 (67) |
| **Incomp. (IC)** | 258 | 227 (87.98) | 28 (10.9) | 3 (1.2) | 182 | 364 (2.00) | 96 (26.37) | 268 (73.63) (1.47) | 143 (53.36) (0.79) | 125 (46.64) (0.69) | 22 (8.21) | 6 (2.24) | 2 (33) | 4 (67) |
| **Total** | 550 | 478 (86.91) | 64 (11.6) | 8 (1.5) | 380 | 748 (1.97) | 193 (25.80) | 555 (74.20) (1.46) | 276 (49.73) (0.73) | 279 (50.27) (0.73) | 30 (5.41) | 15 (3.1) | 5 (33) | 10 (67) |
| **p value** | 0.482 | | | | 0.728 | | | | 0.099 | | 0.005* Phi= 0.120 | 0.809 | | |
| * Significant | | | | | | | | | | | | | | |

**Reproductive Outcome:**

Total 550 couples experienced 971 conceptions in which 506 (1.7 conceptions/mating) were contributed by 292 (53.1%) compatibles and 465 conceptions (1.8 con/mating) by 258 (46.9%) incompatible couples. 223 (23%) females were pregnant at the time of study (antenatal patients) including 122 (24.1%) from compatible and 101 (21.7%) from incompatible couples. From total 971 conceptions, 555 were resulted into 287 (56.7%) successful births of 133 (46.3%) males and 154 (53.7%) female child from the compatible mating and 268 (57.6%) live births including 143 (53.4%) male and 125 (46.6%) female child from the incompatible couples. Three couples had twin pregnancies, two from compatible and one from incompatible couples (Table: 1). Among the 478 fertile couples, 98 females (53/C,45/IC) were pregnant for the 1$^{st}$ time (1$^{st}$ group) and remaining 380 (198/C and 182/IC) couples had reproductive outcome in the form of 748 (384/C & 364/IC) conceptions which matured into 555 Live births (287/C & 268/IC) and 193 (97/C and 96/IC) reproductive losses in the form of abortions/IUD/still births (Table: 1). Considering the fertility performance in the compatible group, the average conception per mating type was 1.9, AB-B mating type experienced maximum outcome of 2.1 and AB-AB had least 1.5. On the contrary this type of mating was successful in converting all the conceptions into live births having

2/3 of male child with zero reproductive loss. AB-O combination experienced maximum reproductive loss (35.3%) moreover B-B and AB-B had twin pregnancies of one each (Table:3)

**Table: 2 Maternal Outcome of Incompatible Couples in the study Population (n=258)**

| | Fertility | | | | Reproductive Outcome | | | | Child Birth | | HDN | Infant Mortality | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Type** | **No.** | **Fertile** | **Inf.** | **Oth.** | **No.** | **Concp.** | **Rep. Loss** | **Live Births** | **Male** | **Female** | **No. of Child** | **No.** | **Male** | **Female** |
| **ABO & Rh** | 14 | 12 (85.7) | 2 (14.3) | 0 | 9 | 15 (1.7) | 5 (33.3) | 10 (66.67) (1.11) | 6 (60) (0.67) | 4 (40) (0.44) | 2 (20) | 0 | 0 | 0 |
| **ABO** | 221 | 195 (88.2) | 23 (10.4) | 3 (1.4) | 157 | 316 (2.0) | 85 (26.9) | 231 (73.1) (1.47) | 122 (52.8) (0.78) | 109 (47.2) (0.69) | 18 (7.79) | 4 (1.7) | 0 | 4 (100) |
| **Rh** | 23 | 20 (87.0) | 3 (13.0) | 0 | 16 | 33 (2.1) | 6 (18.2) | 27 (81.82) (1.69) | 15 (55.56) (0.94) | 12 (44.4) (0.75) | 2 (7.41) | 2 (7.4) | 2 (100) | 0 |
| **Total** | 258 | 227 (88.0) | 28 (10.9) | 3 (1.2) | 182 | 364 (2.0) | 96 (26.4) | 268 (73.63) (1.47 | 143 (53.36) (0.79) | 125 (46.6) (0.69) | 22 (8.21) | 6 (2.2) | 2 (33) | 4 (67) |
| **P value** | 0.949 | | | | 0.459 | | | | 0.879 | | 0.383 | 0.001* phi= 0.263 | | |
| | *Highly Significant | | | | | | | | | | | | | |

In ABO-IC, the average conception rate par mating was 2.0 with 73.1% of live birth and 26.9% of reproductive wastage (Table No, 2). Among this group A-AB and B-AB combinations had maximum birth rate of 77.8% and O-AB had maximum reproductive loss i.e. 40% including still births and contrary to that, this combination had maximum conception per mating i.e. 2.5. A-AB had max. Male child ratio and O-AB had maximum female child ratio (Table: 5).

Among the incompatibles, ABO & Rh experienced minimum birth rate (66.67%) and maximum reproductive loss (33.33%) (Table: 2), in which A-B and B-AB combinations contributed the most, (50%) while average conception per mating was 1.7 with highest in B-AB and A-AB (2.0) and O-A remained the leader in converting the maximum conception into live births. Male child ratio was highest in A-B and female in B-AB (Table: 4)

In Rh-ICs, the conception par mating was 2.1 with 81.82% (maximum among the incompatibles) of live birth and 18.18% (minimum among the incompatibles) of reproductive loss (Table: 2). Among this group AB-B and A-A combinations were able to convert all the conceptions into live birth with zero reproductive loss which was maximum in B-O i.e. 40%. O-O had max. Male fertility and B-O had female (Table: 6).

On testing the hypothesis that compatibility and reproductive outcome are independent attributes then it was found that reproductive outcome in the form of conceptions, live births or reproductive loss (abortions and still births) were not associated with compatibility, types of incompatibility and its mating types ($p>0.050$).

Child Birth Status: About 74.2 % of conceptions were matured into live birth from both the groups with equal percentage productivity from the total no. of effective conceptions (748) i.e. 74.74% (compatible) and 73.63% (incompatible). Average conception per mating was also found to be 1.46 including 1.45 of compatibles and 1.47 of incompatibles. In view of gender distribution among the live births, compatible group had 46.3% of male child and 53.7 % of female child and incompatible group had just opposite to it i.e. 53.4 % of male and 46.6 % of female child from the total population of 555 live births. Two couples from compatible group and one couple from ABO incompatible group had twins (Table: 1).

**Table:3 Maternal outcome of the Compatible couples among different mating types (n=292)**

| Mating types | | Fertility | | Reproductive Outcome | | | | Child Birth | | HDN | Infant mortality | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Wife ABO** | **Hus. ABO** | **No.** | **Fertile** | **No.** | **Concp.** | **Rep. Loss** | **Live Birth** | **Male** | **Female** | **No. of Child suffered** | **No.** | **Male** | **Female** |
| **O** | **O** | 41 | 35 (85.4) | 28 | 55 (2.0) | 17 (30.91) | 38 (69.09) (1.36) | 10 (26.32) (0.36) | 28 (73.68) (1.0) | 0 | 0 | 0 | 0 |
| **A** | **A** | 26 | 24 (92.3) | 18 | 36 (2.0) | 12 (33.33) | 24 (66.67) (1.33) | 6 (25.0) (0.33) | 18 (75.0) (1.0) | 0 | 2 (8.33) | 1 (50.0) | 1 (50.0) |
| | **O** | 37 | 32 (86.5) | 25 | 46 (1.8) | 13 (28.26) | 33 (71.74) (1.32) | 17 (51.52) (0.68) | 16 (48.48) (0.64) | 0 | 3 (9.09) | 1 (33.3) | 2 (66.7) |
| **B** | **B** | 81 | 72 (88.9) | 61 | 123 (2.0) | 24 (19.51) | 99 (80.49) (1.62) | 51 (51.52) (0.84) | 48 (48.48) (0.79) | 8 (8.08) | 1 (1.01) | 0 | 1 (100) |
| | **O** | 55 | 46 (83.6) | 35 | 65 (1.9) | 15 (23.08) | 50 (76.92) (1.43) | 23 (46.0) (0.66) | 27 (54.0) (0.77) | 0 | 0 | 0 | 0 |
| **AB** | **A** | 9 | 8 (88.9) | 7 | 12 (1.7) | 3 (25.0) | 9 (75.0) (1.29) | 5 (55.56) (0.71) | 4 (44.44) (0.57) | 0 | 1 (11.11) | 1 (100) | 0 |
| | **B** | 26 | 20 (76.9) | 13 | 27 (2.1) | 7 (25.93) | 20 (74.07) (1.54) | 11 (55.0) (0.85) | 9 (45.0) (0.69) | 0 | 2 (10.0) | 0 | 2 (100) |
| | **O** | 11 | 11 (100) | 9 | 17 (1.9) | 6 (35.29) | 11 (64.71) (1.22) | 8 (72.73) (0.89) | 3 (27.27) (0.33) | 0 | 0 | 0 | 0 |
| | **AB** | 6 | 3 (50) | 2 | 3 (1.5) | 0 | 3 (100) (1.5) | 2 (66.67) (1.0) | 1 (33.33) (0.50) | 0 | 0 | 0 | 0 |
| **Total** | | 292 | 251 (86) | 198 | 384 (1.9) | 97 (25.26) | 287 (74.74) (1.45) | 133 (46.34) (0.67) | 154 (53.66) (0.78) | 8 (2.79) | 9 (3.14) | 3 (33.0) | 6 (67.0) |
| **p value** | | 0.162 | | 0.576 | | | | 0.037*phi=0.239 | | 0.048* Phi=0.233 | 0.138 | | |
| *Significant | | | | | | | | | | | | | |

Male child incidence was maximum in AB-O mating and female child incidence in A-A mating and twins in B-B and AB-B among the compatibles (Table: 3). Among the incompatibles, male child incidence was observed maximum in ABO & Rh-IC in which A-B mating had dominated over A-AB from ABO –IC and O-O from Rh-IC. Female child incidence was maximum in ABO-IC in which O-A mating had gained and in ABO &Rh-IC, B-AB and in Rh-IC, B-O mating had maximum female child births (Table: 4,5,6)

All these results of child Birth when statistically tested with compatibility then it was found that live birth was not associated with compatibility but as far as its mating types were concerned, it was found that among the compatibles, association was established with gender of the child as some of the combinations were found significant in deciding the gender of child (p=0.037). The phi-value indicated that association of the attributes was mild (Table: 3). So, we can say that gender of the child is mildly associated with the mating type.

**Hemolytic Disease of Newborn (HDN):** This is very important marker to measure the qualitative outcome of incompatibility. The data of incidence of HDN in the livebirths of compatible and incompatible group was determined from the past obstetrical history of couples participated in the study. It was observed that incompatibles had predominantly high incidence of HDN (8.2%) than the compatibles (2.8%) and ABO & Rh-IC contributed more (20%) out of live births (Table:1,2)

Among the compatibles, only B-B type mating was experienced the incidence of HDN i.e. 8.1%. Among the ABO & Rh-IC, B-A and O-A mating had 50% and 33% of incidence respectively. It was noteworthy

that the percentage incidence was more in ABO & Rh-ICs but ABO-ICs had incidence in all the mating types and maximum of 33.3% in O-AB mating. In Rh-IC, only A-A mating resulted into 33% and B-B into 11% of HDN cases (Table: 3,4,5,6).

**Table: 4 Maternal Outcome of ABO & Rh Incompatible Couples among different mating types (n=14)**

| Mating Type | | Fertility | | Reproductive Outcome | | | | Child Birth | | HDN | Infant mortality |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Wife ABO | Hus. ABO | No. of Couples | Fertile | No. | Concp. | Rep. Loss | Live Births | Male | Female | No. of Child suffered | |
| O | A | 3 | 3 (100) | 2 | 3 (1.5) | 0 | 3 (100) (1.5) | 2 (66.7) (1.0) | 1 (33.3) (0.50) | 1 (33.3) | 0 |
| | B | 4 | 2 (50) | 2 | 3 (1.5) | 1 (33.3) | 2 (66.7) (1.0) | 1 (50) (0.50) | 1 (50) (0.5) | 0 | 0 |
| A | B | 2 | 2 (100) | 2 | 4 (2.0) | 2 (50) | 2 (50) (1.0) | 2 (100) (1.0) | 0 | 0 | 0 |
| | AB | 1 | 1 (100) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| B | A | 3 | 3 (100) | 2 | 3 (1.5) | 1 (33.3) | 2 (66.7) (1.0) | 1 (50) (0.50) | 1 (50) (0.5) | 1 (50) | 0 |
| | AB | 1 | 1 (100) | 1 | 2 (2.0) | 1 (50) | 1 (50) (1.0) | 0 | 1 (100) (1.0) | 0 | 0 |
| Total | | 14 | 12 (85.7) | 9 | 15 (1.7) | 5 (33.3) | 10 (66.7) (1.1) | 6 (60) (0.67) | 4 (40) (0.4) | 2 (20) | 0 |
| p Value | | 0.323 | | 0.690 | | | | 0.549 | | 0.608 | 0 |

**Table: 5 Effect of ABO Incompatibility on Maternal Outcome(n=221)**

| Mating Type | | Fertility | | Reproductive Outcome | | | | Child Birth | | HDN | Infant Mortality | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wife ABO | Hus. ABO | No. | Fertile | No. | Concep s. | Rep. Loss | Live Births | Male | Female | No. of Child suffered | Infant mortality | Male | Female |
| O | A | 31 | 27 (87.1) | 22 | 44 (2.0) | 12 (27.3) | 32 (72.7) (1.5) | 14 (43.75) (0.64) | 18 (56.25) (0.82) | 2 (6.25) | 0 | 0 | 0 |
| | B | 75 | 67 (89.3) | 57 | 110 (1.9) | 31 (28.2) | 79 (71.8) (1.4) | 41 (51.90) (0.72) | 38 (48.10) (0.67) | 7 (8.86) | 1 (1.3) | 0 | 1 (100) |
| | AB | 6 | 5 (83.3) | 4 | 10 (2.5) | 4 (40.0) | 6 (60.0) (1.5) | 4 (66.67) (1.00) | 2 (33.33) (0.50) | 2 (33.3) | 1 (16.7) | 0 | 1 (100) |
| A | B | 44 | 38 (86.4) | 30 | 64 (2.1) | 18 (28.1) | 46(71.9) (1.5) | 24 (52.17) (0.80) | 22 (47.83) (0.73) | 5 (10.9) | 1 (2.2) | 0 | 1 (100) |
| | AB | 9 | 6 (66.7) | 5 | 9 (1.8) | 2 (22.2) | 7 (77.8) (1.4) | 5 (71.43) (1.00) | 2 (28.57) (0.40) | 1 (14.3) | 0 | 0 | 0 |
| B | A | 38 | 35 (92.1) | 25 | 52 (2.1) | 12 (23.1) | 40 (76.9) (1.6) | 24 (60.00) (0.96) | 16 (40.00) (0.64) | 1 (2.50) | 1 (2.5) | 0 | 1 (100) |
| | AB | 18 | 17 (94.4) | 14 | 27 (1.9) | 6 (22.2) | 21 (77.8) (1.5) | 10(47.62) (0.71) | 11 (52.38) (0.79) | 0 | 0 | 0 | 0 |
| Total | | 221 | 195 (88.2) | 157 | 316 (2.0) | 85 (26.9) | 231 (73.1) (1.5) | 122 (52.81) (0.78). | 109 (47.19) (0.69) | 18 (7.79) | 4 (1.7) | 0 | 4 (100) |
| p Value | | 0.462 | | 0.937 | | | | 0.733 | | 0.123 | 0.162 | | |

As described earlier in the findings, incidence of HDN was significant (p=0.005) in the incompatibles and different mating types of compatibles (p=0.048) although association was mild as indicated by phi value (Table: 2,3), not significant among the different types of incompatibles (p=0.383), and even not significant among the different mating types of ABO & Rh-IC (p=0.608), ABO-IC (p=0.123) and Rh-IC (p=0.504).

**Infant mortality:** Infant mortality was more in compatibles (3.14%) than in incompatibles (2.24%) out of 2.7% of total infant mortality against live births. The ratio of male/female mortality in both the groups was 33-67.

Among the compatibles, the mortality rate was max. in AB-A (11.1%) in total as well in male infants and in females it was max in AB-B (10%). Among ICs, the

infant mortality rate was max. in Rh Incompatible Couples (7.4%) out of 2.2% of total incidence. In ABO-IC, O-AB mating types had maximum rate of infant mortality against live birth than the other mating types and moreover mortality observed in all the mating types except O-A, A-AB and B-AB. Most effected gender was female. Only A-A and A-O combinations had male child mortality in Rh-IC. No mortality was observed in the ABO & Rh-ICs.

It was observed that type of incompatibility effects the gender of infant mortality (p=0.001) i.e. gender of infant mortality and type of incompatibility (ABO & Rh – IC, ABO – IC and Rh-IC) are not independent attributes but mildly associated.

**Table 6: Effect of Rh-Incompatibilityon the maternal outcome (n=23)**

| Mating Type | | Fertility | | Reproductive Outcome | | | | Child Birth | | HDN | Infant mortality | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wife ABO | Hus. ABO | No. | Fertile | No. | Concp. | Rep. Loss | Live Births | Male | Female | NO. | No. | Male | Female |
| O | O | 4 | 4 (100) | 3 | 8 (2.7) | 1 (12.5) | 7 (87.5) (2.33) | 5 (71.4) (1.7) | 2 (28.6) (0.67) | 0 | 0 | 0 | 0 |
| A | A | 2 | 2 (100) | 2 | 3 (1.5) | 0 | 3 (100) (1.5) | 2 (66.7) (1.0) | 1 (33.3) (0.50) | 1 (33.3) | 1 (33.3) | 1 (100) | 0 |
| | O | 2 | 1 (50) | 1 | 3 (3.0) | 1 (33.3) | 2 (66.7) (2.0) | 1 (50) (1.0) | 1 (50) (1.0) | 0 | 1 (50) | 1 (100) | 0 |
| B | B | 8 | 7 (87.5) | 5 | 11 (2.2) | 2 (18.2) | 9 (81.8) (1.8) | 6 (66.7) (1.2) | 3 (33.3) (0.60) | 1 (11.1) | 0 | 0 | 0 |
| | O | 5 | 4 (80) | 4 | 5 (1.3) | 2 (40) | 3 (60) (0.75) | 0 | 3 (100) (0.75) | 0 | 0 | 0 | 0 |
| AB | A | 1 | 1 (100) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | B | 1 | 1 (100) | 1 | 3 (3.0) | 0 | 3 (100) (3.0) | 1 (33.3) (1.0) | 2 (66.7) (2.0) | 0 | 0 | 0 | 0 |
| Total | | 23 | 20 (87) | 16 | 33 (2.1) | 6 (18.2) | 27 (81.8) (1.69) | 15 (55.6) (0.94) | 12 (44.4) (0.75) | 2 (7.41) | 2 (7.41) | 2 (100) | 0 |
| p value | | 0.701 | | 0.613 | | | | 0.075 | | 0.504 | 0.076 | | |

## DISCUSSION

As far as the issue of compatibility and fertility is concerned this study is in accordance with the studies conducted by G. Ganitha et al, [8] in which the researchers concluded that ABO blood group or ABO incompatibility is not directly associated with infertility, Sigler et al [9] also found that difference in A, B, AB and O phenotype distribution was not statistically different between the fertile and infertile groups. Moreover, some of the studies like Alexander et.al,[10] Ogbimi et.al, [11] Schwimmer et.al [12] and Cantuaria [13] also found that ABO blood group antigens do not significantly contribute to antisperm antibodies formation or infertility and also did not find any relation between ABO blood group distribution between husband and wives of fertile and infertile groups.

In case of reproductive outcome, the results of this study are notin accordance with the findings of Nilesh Soni and B.M. Mukherjee [14] and Ghasemi. N, et al, [15] in which the researchers revealed that the incidence of stillbirths and abortions are higher in case of incompatible couples. In a study conducted on Bengali Muslims by A. F. Gulenurand Rekha Das, [16] found that average number of reproductive wastage per mating couple is found to be more among the incompatibles as compared to compatible couples. In a study conducted in Iraq by Khalid GataWasheel Al-Fartosi, [17] the researchers also found association between ABO blood group and spontaneous abortion.

On analyzing the results of incidence of HDN in the live births, this study is in accordance with the results of Faris B. Swaf et al, [18] in which the researchers concluded that the ABO incompatibility is the most common cause of hemolytic disease of newborn. Neil A. Murray and Irene A. G. Roberts, [19] also revealed that Rh-D allo-immunization and its sequelae have greatly been diminished. As a result, ABO incompatibility is now the single largest cause of HDN in the western world. Maura McDonnell et al [20] also described that only

three cases of hydrops fetalis with neonatal survival have been described in association with ABO incompatibility. In another study Ashutosh Kumar et al, [(21)] concluded that ABO incompatibility was the leading cause of hemolysis followed by Rh incompatibility. Gender of the baby and gravidity of the mother does not affect the outcome of disease process. Direct Antiglobulin Test (DAT) of baby has a strong predictive value determining the outcome of allo-immune hemolytic disease of newborn but it does not predict the severity of disease.

No sufficient literature is available to compare this study to establish association of compatibility of the parents with gender of the child. Issue of infant mortality may be overlapped by the other more gravid complications related to survival crisis of the child. More extensive research is required to access the incompatibility related mortality. So, these issues are to be looked up for further more oriented research on this topic.

## CONCLUSIONS

It was concluded from the findings that incompatibility had no qualitative effect on the fertility, reproductive outcome in the form of conception, live birth, abortions or still birth and on infant mortality except on the hemolytic disease of new born (HDN). But on the other hand, it was also revealed that different types of incompatibilities with respect to different mating types had association with gender of the born child, hemolytic disease of new born and in some cases gender of the deceased infant.

Manifestations of incompatibility are still significant in the population although much emphasis has been given on its management. Upgradation of the medical facility at primary level and awareness at mass level is the need of the hour to tackle these manifestations. Rh-immunophylaxis should be reviewed at different levels of medical services. Rh-Phenotyping and Antibody Screening with different panels should be done in all the antenatal cases for the anticipatory management of the manifestations of incompatibility. More molecular studies are required to establish the relations/associations found in this study and also which can measure the quantitative effect of incompatibility in the population. Incompatibility in different ethnic groups should also be ruled out. Pre-marriage counselling should be carried out at the primary levels with context to the social fabric.

So, we can say that although we can't control the incidences of incompatibility in this diverse universe as it is part of the nature but we can regulate its manifestations by developing our research and innovation tools in the medical services.

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