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Frequency of Rh Incompatibility Among Primigravida Women Attending Primary Health Care Centers for Antenatal Care in Basra City: Frekuensi Ketidakcocokan Rh pada Wanita Hamil Pertama Kali yang Menjalani Pemeriksaan Kehamilan di Pusat Pelayanan Kesehatan Primer di Kota Basra

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Abstract

General Background Fetomaternal Rhesus incompatibility remains a significant clinical concern due to its association with hemolytic disease of the newborn and adverse pregnancy outcomes. **Specific Background** Understanding the distribution of Rh-negative mothers and incompatible pregnancies in healthcare settings is essential for early detection and management. **Knowledge Gap** Limited localized epidemiological data restricts the ability to design targeted prevention strategies in tertiary care environments. **Aims** This study aims to determine the prevalence of fetomaternal Rhesus incompatibility and describe associated blood group distributions among pregnant women in a tertiary hospital. **Results** The findings indicate a measurable prevalence of Rh incompatibility, with identifiable patterns in ABO and Rh blood group distribution, highlighting potential risk for alloimmunization and neonatal complications. **Novelty** The study provides updated, context-specific prevalence data that contributes to localized clinical understanding of Rh incompatibility**. Implications** The results support the importance of routine antenatal screening, timely diagnosis, and appropriate prophylactic interventions to reduce maternal and neonatal risks

Keywords: Fetomaternal Incompatibility, Rhesus Factor, Alloimmunization, Pregnancy Screening, Neonatal Risk

Key Findings Highlights
Detectable proportion of Rh-negative pregnancies indicates ongoing clinical risk
Blood group distribution patterns reveal potential exposure to antigen mismatch
Screening practices remain essential for early identification and management

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1. Introduction

A medical disorder known as fetomaternal rhesus incompatibility affects both the fetus (of positive rhesus) and the pregnant woman (of blood group A, B, AB, or O with a negative rhesus). Anti-Rhesus antibodies develop only after the first delivery or miscarriage; hence, they do not affect the first pregnancy. (1) Significant neonatal morbidity and mortality can result from maternal alloimmunization. (2)

A major issue that makes choosing suitable units for upcoming transfusions difficult is RBC alloimmunization. More significantly, it may make patient care more difficult and raise the possibility of hemolytic disease of the fetus and newborn (HDFN) or immediate and delayed hemolytic transfusion responses. (3)

When a person is exposed to non-self-antigens, this happens through sensitizing events such as fetomaternal hemorrhage during pregnancy or childbirth, blood transfusion, or organ transplantation. Alloimmunization of red blood cells (RBCs) occurs. A history of such exposures influences the risk of alloimmunization. The transplacental passage of fetal erythrocytes, which can result from delivery, trauma, miscarriage, ectopic pregnancy, or invasive procedures like amniocentesis, might promote maternal sensitization in the prenatal environment. Additionally, RBC transfusion during the prenatal or postnatal period may aid in the formation of alloantibodies. Maternal alloimmunization may create clinically significant IgG antibodies that can cross the placenta and cause hemolytic disease of the fetus and newborn (HDFN), which is a severe clinical concern. (4) Globally, many approaches are used to test for and treat alloimmunization. (5) In India, antibody screening during pregnancy is typically performed only in RhD-negative women, with universal screening regardless of Rh status practiced in only a few centers. Alloimmunization rates among pregnant women in India have been assessed in separate studies, but no systematic review or meta-analysis has been done on the subject. (6) When a person is exposed to non-self-antigens, such as through sensitizing events like fetomaternal bleeding during pregnancy or childbirth, blood transfusion, or organ transplantation, red blood cell (RBC) alloimmunization takes place. A history of such exposures influences the risk of alloimmunization. Maternal sensitization in the prenatal context can be caused by the transplacental passage of fetal erythrocytes, which can be brought on by delivery, trauma, miscarriage, ectopic pregnancy, or invasive treatments like amniocentesis. Additionally, the production of alloantibodies may be facilitated by RBC transfusion during the prenatal or postnatal period. Maternal alloimmunization may produce clinically significant IgG antibodies that might cross the placenta and cause hemolytic illness of the fetus and newborn (HDFN), which is a major clinical problem. (4)

Globally, many approaches are used to test for and treat alloimmunization. (5) Only RhD-negative women are usually screened for antibodies during pregnancy in India; only a small number of institutes provide universal screening regardless of Rh status. Alloantibodies that target antigens like c, E, and K can make obstetric and newborn care more difficult, even though antibodies against antigens like Lewis are typically regarded as clinically inconsequential. Alloimmunization rates among pregnant women in India have been evaluated in individual studies, but no systematic review or meta-analysis has been done on this subject. (6)

Epidemiology

One significant contributor to severe HDN is rhesus incompatibility. Three to eight out of every 100,000 patients are thought to be affected each year. Before the development of anti-D prophylaxis, it caused fetal loss in 1% of pregnancies, including stillbirths, hydrops fetalis, and hyperbilirubinemia (jaundice). (7) Race and ethnicity have an impact on the prevalence of rhesus (Rh) negative. Rh-negative people make up about 15% of Caucasians, 5-8% of African Americans, 1-2% of Asians and Native Americans, 17% of Britons, and 15% of Americans. (8) According to local population-based research conducted on male and female volunteers in Saudi Arabia, the prevalence of the Rh-negative blood group is 7.2% in Southwest Saudi Arabia and 8% in Eastern Saudi Arabia. (9) Recent research on blood group distribution throughout Iraqi villages found that the Rh-negative blood type represents a significant minority of the total population. In a major community-based study in Southern Babylon, Rh-positive individuals comprised 89.8% of the sample, whereas Rh-negative individuals comprised approximately 10.2%. Women of reproductive age may potentially be affected by this discovery. (10) Rh negativity was less frequent than Rh positivity, exists at levels relevant to obstetric care and justifies systematic prenatal screening, as evidenced by the nearly 8.27% of participants in another study of volunteer blood donors in various parts of Iraq who were Rh negative. Although prevalence estimates of Rh incompatibility among pregnant women are not frequently published in Iraq, the frequency of Rh negativity at the population level shows that a significant minority of pregnant women are at risk of receiving Rh-alloimmunization if appropriate prenatal protective measures are not put in place. Routine prenatal blood grouping is still crucial to identify Rh-negative women early in pregnancy and provide prophylaxis to prevent alloimmunization and adverse fetal outcomes. (11)

Antenatal Booking Visit

Primigravida women constitute a significant group for evaluating Rh incompatibility, as sensitization most commonly occurs during the first pregnancy following delivery, miscarriage, or invasive obstetric procedures. Although severe fetal effects are uncommon in the first pregnancy, failure to identify Rh-negative women and administer anti-D immunoglobulin can result in long-term maternal sensitization and serious complications in subsequent pregnancies. (12)

Antenatal booking visits are a critical component of maternal health care, providing the first opportunity to identify maternal risk factors, including blood group and Rh status, early in pregnancy through laboratory screening, risk stratification, and the initiation of appropriate preventive measures, such as anti-D immunoglobulin prophylaxis for Rh-negative women. Women who delay or miss booking visits are more likely to remain undiagnosed and consequently face an increased risk of preventable complications, including Rh alloimmunization and adverse maternal and neonatal outcomes. (13)

Therefore, promoting early and regular antenatal booking visits at the primary health care level is essential for improving pregnancy outcomes and reducing preventable obstetric complications. (13)

During the initial booking visit, maternal blood grouping and Rh typing are routinely performed. Delayed or absent antenatal booking may result in a missed opportunity for appropriate counseling and close follow-up, increasing the risk of maternal sensitization and hemolytic disease of the fetus and newborn. Therefore, promoting early antenatal visits at the primary health care center is a key preventive strategy for reducing the burden of Rh incompatibility and improving maternal and neonatal outcomes. (14)

- ✓ Laboratory Tests performed at the Antenatal Booking visit.
- ✓ At the antenatal booking visit, a set of essential laboratory investigations is routinely performed to assess maternal health and to prevent pregnancy-related complications. (15) These tests include: (13)
- ✓ blood group and Rh typing, which are critical for identifying women at risk of Rh incompatibility and enabling timely Ant-D prophylaxis.
- ✓ Complete Blood Count (CBC) is conducted to detect anemia and other hematological abnormalities.

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- ✓ Screening for infectious diseases, such as Hepatitis B, HIV, and syphilis performed to reduce the risk of maternal and vertical transmission.
- ✓ Urinalysis is used to identify urinary tract infection, proteinuria, and glycosuria, which may indicate preeclampsia or gestational diabetes.
- ✓ Blood glucose testing may be included to screen for pre-existing or early gestational diabetes.

Clinical Practice of Rh Incompatibility

Early detection and prevention are the main goals of clinical care of Rh incompatibility. During the antenatal booking visit, all pregnant women should be screened for ABO and Rh blood group and antibody screening. (13)
Rh-negative women with no existing anti-D antibodies are managed with anti-D immunoglobulin prophylaxis, It is usually given at about 28 weeks of prgnancy and within 72 hours after a Rh-positive baby's birth. Anti-D is also indicated after potentially sensitizing events such as miscarriage, vaginal bleeding, abdominal trauma, or invasive procedures (e.g., amniocentesis). (16)

Complication of Rh Incompatibility

Rh incompatibility mainly affects the fetus and newborn rather than the mother. If a mother is Rh-negative and becomes sensitized to Rh-positive red blood cells, maternal antibodies (anti-D) can cross the placenta and destroy fetal red blood cells, leading to Hemolytic Disease of the Fetus and Newborn (HDFN). (17)

-Fetal and Neonatal Complications:
- **Fetal anemia** due to immune-mediated hemolysis
- **Hyperbilirubinemia and neonatal jaundice,** which in severe cases may progress to kernicterus and permanent neurological damage.
- **Hydrops fetalis**, characterized by severe anemia, cardiac failure, generalized edema, ascites, and pleural or pericardial effusions.
- **Preterm birth and low birth weight.**
- **Intrauterine fetal death or neonatal mortality** in severe, untreated cases.

-Maternal Effects: The mother is usually asymptomatic, and the main consequence is Rh sensitization, increasing the risk of severe hemolytic disease in subsequent Rh- positive pregnancies. (14)

Prevention

Routine antenatal blood group and antibody screening, combined with timely administration of anti-D immunoglobulin during pregnancy and after delivery or other sensitizing events, is highly effective in preventing Rh alloimmunization and its associated fetal and neonatal complications. (14)

2. Materials and Methods

During the study period, which ran from February 1 to the end of June 2023, a record-based descriptive retrospective cross-sectional study was conducted. The study had 1066 participants.
Inclusion criteria: we included all primigravid women and their husbands who attended the primary health centers for the antenatal booking visit.

Exclusion criteria: None
The data was gathered from the laboratory records of eight basic healthcare centers in the Basra Governorate. Antenatal registration forms and laboratory results reports were the two sources from which the data was gathered. These include their age, gender, occupation, consanguinity (blood relation), and the findings of the laboratory examinations normally performed at the first prenatal visit for the women and their husbands (where available), including maternal and paternal ABO/Rh blood grouping.

The statistical data analysis was performed using IBM SPSS Statistics version 26.0. Qualitative data expressed as frequencies and percentages (%) are examined using the Pearson Chi-squared test. Differences are deemed statistically significant at $p < 0.05$.

3. Results

1. Socio-demographic characteristics of the sample.

The most common age of persons examined (47.1%) was 20-29 years, and the mean age was (22.8±7.78) years old, as shown in Table 1, which also indicates that the percentage of females in the sample is more than that for males (52.6%) and (47.6%), respectively, as shown in Figure 1. Over two-thirds (83.2%) of females were housewives, with the lowest percentage (4.2%) being governmental employees.

About one third (35.6%) are residents of the Basra center.

Table 1: Socio-demographic characteristics of the sample.

Age (years)	Male	Female	Total (%)	p-value
	Number (%)	Number (%)		
< 20	114 (10.7)	305(28.6)	419(39.3)	
20-29	288(27.0)	213(20)	501(47.0)	

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30-39	57(5.3)	44(4.1)	101(9.4)	< 0.001
40-49	23(2.1)	9(0.9)	32(3)	
50-59	5(0.5)	1(0.1)	6(0.6)	
60-69	4(0.4)	0(0)	4(0.4)	
70-79	3(0.3)	0(0)	3(0.3)	
Occupation				
Housewife	- -	476(83.2)	476(44.6)	0.011
Self-employed	370(74.8)	- -	370(34.7)	
Governmental	64(12.6)	24(4.2)	88(8.3)	
Student	60(12.6)	72(12.6)	132(12.4)	
Total	**494(100)**	**572(100)**	**1066(100)**	
Residence	Number	%		0.002
Basra center	380	35.6		
Basra Periphery	686	64.4		
Total	**1066**	**100.0**		

*Chi-square test

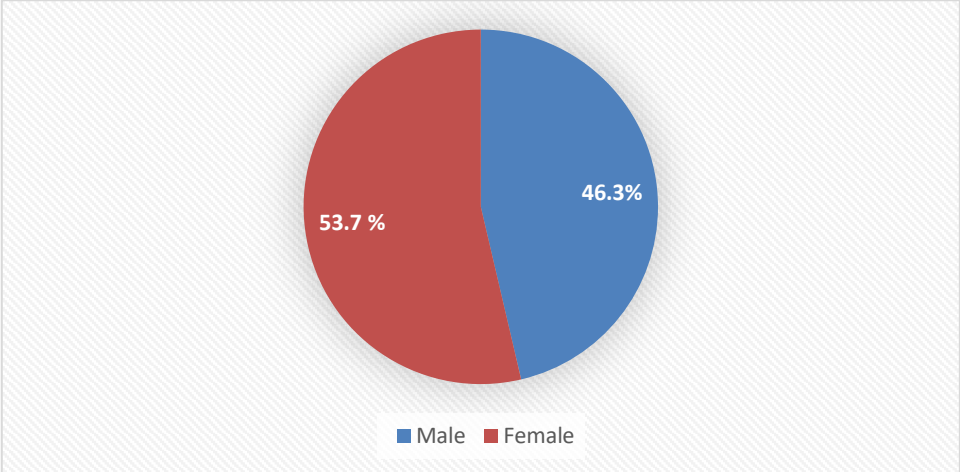

Figure 1: Pie chart of sex distribution of study population.

2. Gestational age of Primigravids

Figure 2 shows the gestational age at the time of the first (booking) antenatal visit for primigravid women. The majority of women booked their antenatal care in the second trimester, accounting for 66.4% of all women. While only 7.4% presented their first visit in the third trimester.

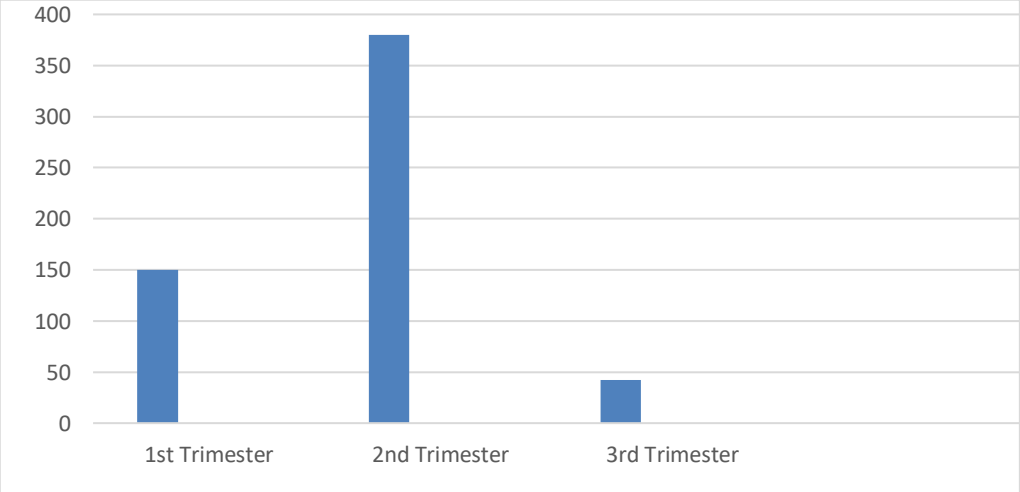

Figure 1: Distribution of Gestational age of Primigravids.

3. Blood Groups and Rhesus Factor.

Table 2 shows that the majority of primigravids were Rh-positive (86.9%) across all blood groups, with the highest counts in blood group A (36.4%) and the lowest in blood group AB (14.7%).

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Rh-negative primigravids were fewer in number (13.1%) but present in all blood groups, with the highest count in blood group B (27%), followed by blood group O (21%), while the least common negative blood group was AB (9%). There was no statistical significance (p > 0.05).

Table 2: Distribution of the primigravids by blood groups and Rhesus factor.

Blood group	Primigravids				Total	P-value
	Rh positive	%	Rh negative	%		
A	181	36.4	18	24.0	199	0.660
B	91	18.3	27	36.0	118	
AB	73	14.7	9	12.0	82	
O	152	30.6	21	28.0	173	
Total	497	100	75	100	572	

*Chi-square test

On the other hand, the husband's blood group was mostly positive (92.3%), and the most common blood group was O (31.2%), followed by A (29.6%), as shown in Table 3. Among Rh-negative husbands, blood group B has the highest percentage (34.2%), and the least was the AB blood group (15.8%). This was not statistically significant (p>0.05).

Table 3: Distribution of husbands by blood groups and Rhesus factor.

Blood group	Husbands				Total	P-value
	Rh Positive	%	Rh negative	%		
A	135	29.6	10	26.3	145	0.381
B	101	22.1	13	34.2	114	
AB	78	17.1	6	15.8	84	
O	142	31.2	9	23.7	151	
Total	456	100	38	100	494	

*Chi-square test

4. Degree of consanguinity

The table below shows that most of the sample (66.3%) were non-consanguineous with their relatives, one-third (33.7%) showed a positive history of consanguinity, mostly of the second degree (40.6%).

Table 4: The distribution of the sample according to the degree of consanguinity with their partners.

Degree of consanguinity	Number	%
None	707	66.3
2nd	146	13.7
3rd	110	10.3
Far	103	9.7
Total	**1066**	**100**

4. Discussion

The present study describes the frequency of Rh incompatibility among primigravid women and their partners at antenatal booking.

The most common age group was 20-29 years (47.1%), with a mean age of 22.8±7.78, indicating a young adult population. This pattern is consistent with a recent cross-sectional Indian health study, in which the majority of participants were between 21 and 30 years old, reflecting a typical reproductive-age distribution in health research settings. (18) Furthermore, the high proportion of housewives among female participants (76.7%) reflects socio-cultural and occupational patterns seen in regional studies, where employment rates among women remain low. Similar trends of a high percentage of housewives in community based study, with over 70%. (19)

The finding that about one third (35.6%) of participants were residents of the Basra center is important for public health planning, as urban residents may have different access to services compared to the rural population, which is associated with distinct barriers to health care utilization. (20)

The pattern of antenatal booking observed in this study, where the majority of primigravida women attended their first antenatal visit during their second trimester (66.4%) and a minority (7.4%) booked in the third trimester aligns with findings from a study in Ethiopia found that only one third of pregnant women booked within the recommended early period (first trimester), with most initiating care later in the second trimester, despite global recommendations for booking before 12-16 weeks of gestation to maximize preventive care benefits. (21)

The majority of primigravids were Rh-positive across all ABO blood groups, with less frequent Rh-negative. These findings are consistent with patterns seen in a retrospective study in Jordan in which the overall Rh-positive frequency was 90.2% vs

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9.8% Rh-negative. (22) Similar studies from other regions also report high Rh-positive frequency among pregnant women, often exceeding 85-90 %, regardless of ABO grouping, as in South-Western Uganda, Rh-positive was reported at approximately 94.3%. (23) Lack of statistical significance between the ABO blood groups and Rh status ($p>0.05$) aligns with findings from such population studies, where the two systems are largely independent in distribution among pregnant women. (22)

The pattern of high frequency of the Rh-positive status of husbands (92.3%) with blood group O is more common, consistent with a study from Ghana that reported that 92.2% of the donor population were Rh-positive and only 7.8% were Rh-negative, with type O the dominant ABO blood group. (24)

The current study found that approximately one-third reported a history of consanguinity with their partners, with the majority of the sample being second-degree relatives (13.7%), followed by third-degree (10.3%) and more distant relationships (9.7%). This is consistent with patterns observed in many Middle Eastern and Arab populations, where consanguineous marriage remains a socially established practice. (25)

Although Rh incompatibility is primarily determined by the parental Rh blood group status, consanguinity may indirectly increase the risk of Rh incompatibility and its clinical consequences. (13) In populations with a high prevalence of consanguineous marriage, genetic homogeneity is increased, leading to a higher frequency of certain inherited blood group patterns within families. This clustering effect can increase the likelihood of repeated Rh-negative mothers marrying Rh-positive partners across generations, thereby raising the cumulative risk of Rh alloimmunization and hemolytic disease of the fetus and newborn (HDFN). Recent studies highlight how varying Rh antigen distributions and repeated antigen exposure contribute to increased alloimmunization risk among women at risk. (26)

5. Conclusion

- Rh incompatibility remains a significant public health concern among primigravida women in Basra.
- Most participants were young adults, with a predominance of Rh-positive status among both women and their partners.
- Antenatal booking was frequently delayed to the second trimester.
- Consanguinity was common and may contribute to the increased long-term risk of Rh-related complications.

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