Rhesus Negativity Prevalence and Neonatal Outcomes among Pregnant Women Delivered at Bule Hora University Teaching Hospital, West Guji Zone, South Ethiopia

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ABSTRACT

BACKGROUND: Rh incompatibility has been an important cause of severe neonatal hyperbilirubinemia, hydrops fetalis, and stillbirth. Among those outcomes, neonatal jaundice is the most common problem.

OBJECTIVE: The study is assessed the prevalence of Rhesus (Rh) negativity and neonatal outcomes among pregnant women who delivered at Bule Hora University Teaching Hospital over a 5-year period from January 2017 to December 31, 2022.

METHODS: A retrospective study was conducted on 110 women who delivered at Bule Hora University Teaching Hospital (BHUTH) from January 2017 to December 31, 2021. The complete data of the mother's and neonates' status were extracted from the registration book of the hospital using checklists. The data were double entered using EpiData version 3 and exported to the Statistical Package for Social Sciences (SPSS) version 26 for analysis. Descriptive statistics to determine prevalence and frequencies were used to describe the study population in relation to relevant variables, and the results are presented in tables and charts.

RESULTS: The study shows that the prevalence of Rh D-negative among women who delivered was 6.4% [95% CI: 1.83,10.98]. Among Rh-negative women, 1 (25%) of blood group AB, 3 (6.5%) of blood group O, and 2 (6.1%) of blood group A were Rh-D negative. The distributions of O, A, B, and AB blood groups among pregnant women who delivered this hospital were 41.8%, 30%, 24.6%, and 3.6%, respectively. Out of neonates born to Rh-negative women, 1 (14.3%) was born with jaundice. Of women who delivered at BHUT hospital, 61 (55.5%) did not have a previous delivery, 7 (6.4%) had a previous abortion, 5 (4.5%) stillbirth, 1 (0.9) died after birth, 4 (3.6%) had a birth child weight less than 2.6 kg.

CONCLUSION: The study revealed that the prevalence of Rh-negative was comparable with finding of different similar studies. To reduce Rh incompatibility-related HDN, the government should educate mothers and encourage them as they follow ANC facilities and after delivery to health facilities.

KEYWORDS: Rh (D)—negativity, neonatal outcome, pregnant women, West Guji

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Background

The rhesus blood group system (Rh) is the second most important blood group system, as described by Landsteiner and Weiner in 1940, and the genes are located on the short arm of chromosome number 1.[1] At present, the Rh system comprises 110 antigens, but in routine blood bank practice, only 5 basic antigens are of importance (Rh (D), Rh (C), Rh (E), Rh (c), and Rh (e)), and among them, the Rh (D) antigen is the most immunogenic. In routine laboratory tests for the determination of the RH blood group, Rh positivity refers to the presence of Rh (D) antigen on red cells, while Rh (D) negativity is the absence of D antigen.[2]

Hemolytic disease of the newborn (HDN) (also known as erythroblastosis fetalis) is the disorder first described by French midwives in 1609; however, it was not clarified until the 1950s and primarily affects rhesus-positive (Rh+) fetuses and newborns born to rhesus-negative (Rh-) mothers.[3] It is a condition when the RhD-negative mother reacts to RhD-positive fetal blood cells in her circulation by developing anti-D antibodies, a process known as RhD sensitization. Sensitization is unlikely to affect the current fetus and may result in hemolytic disease of the fetus and newborn during a second RhD-positive pregnancy, which may result in jaundice, anemia, developmental problems, or intrauterine death.[4]

Rhesus incompatibility has been an important cause for severe HDN and has been estimated to affect 3 to 8 for every 100 000 patients yearly, and before developing anti-D prophylaxis, it was responsible for fetal loss in 1% of all pregnancies, including hyperbilirubinemia (jaundice), hydrops fetalis, and still births.[5] The number of newborns exposed to jaundice or unrecognized hyperbilirubinemia is 4 million infants born each year, and over 3.5 million are born at 35 or more weeks of gestation in the United States.[6] In sub-Saharan Africa, because of the unaffordability of anti-D immunoglobulin (Ig),

alloimmunization to RhD remains a major factor in perinatal morbidity and continues to compromise women's obstetric care.[7,8] In Ethiopia, neonatal jaundice was 26.45%.[9]

The distribution of Rh-negative blood groups in different countries is among Caucasians, and its prevalence is greater than 14%, 17% in Britain,[10] 15% in the United States,[11] and 4.44%, whereas among different ethnic groups of sub-Saharan Africa, its prevalence ranges between 2.4% and 4.5%,[12-15] 6% in Nigeria.[16] In Ethiopia, several studies reported prevalence rates of Rh negativity of 8.8% from Mekelle,[17] 7% from Sodo,[18] and 7.2% from Jimma.[19]

In Ethiopia, few studies have been conducted on the distribution of Rh-D negativity, but in several localities in the country, including the study area and West Guji, in which epidemiological information about the distribution of the Rh blood group and outcome of Rh incompatibility in neonates was not available. Therefore, this study aimed to assess the distribution of Rh-D-negative mothers and neonatal outcomes in pregnant women delivered at Bule Hora University Teaching Hospital during the study period.

Methods

Study area, period and design

This study was conducted in Bule Hora University Teaching Hospital, which is found in Bule Hora town. It is a town in the southern part of Ethiopia located on the paved Addis Ababa to Moyale highway in the West Guji Zone of the Oromia region, Ethiopia. It has a latitude and longitude of 5°35′N and 38°15′E, respectively, and an altitude of 1716 m above sea level.[20] As reported by 2018 Zonal Statistics, it has a total population of 263 780, among which 130 703 (49%) are males and 133 077 (51%) are females. Bule Hora University Teaching Hospital is the largest hospital in West Guji Zone. This year, data from human resources indicate that Bule Hora teaching hospital has a total of 346 staff members. Among 346 workers, 170 are administration/supportive workers, and 176 are health workers. This hospital provides annually a service for people who live around it of totally 1 568 547 and out of these people 768 325 are a male and 800 222 are female. Bule Hora Teaching Hospital provides health services for 1 389 821 populations. According to the 2019/20 Zonal Health Department Health Management Information System report, the hospital has an annual delivery of 3250.[21] A retrospective study was conducted among pregnant women delivered at Bule Hora University Teaching Hospital from January 2017 to December 31, 2021.

Study population and selection criteria

In total, 110 women who delivered at Bule Hora University Teaching Hospital from 2017 to 2021 with completed record data were randomly selected and included in the study. Incomplete medical records were excluded from the study.

Sample size and sampling techniques

The sample size was calculated by using a single population proportion formula by considering the assumption of a 95% confidence level (z_alpha/2 = 1.96), level of precision (d) = 5%, nonresponse rate 10% and the expected proportion of RH-women $P = .07$ (7%) from the study conducted in Woileta Sodo.[18]

The sample size $(n) = z\frac{\alpha^2}{2} \times p\left(\frac{1-p}{d^2}\right)$ $n = 1.96^2 \times 0.07\left(\frac{1-0.07}{0.05^2}\right) = 100$, By taking 10% of nonresponse rate, $n = 100 + 100 \times 10\% = 110$. Therefore, over all sample sizes, (n) = 110

From 16 455 women delivered between 2017 and 2021 at hospital, 876 complete data were extracted and listed with identification number. Out of extracted and listed data, 110 women's complete data were randomly selected until the intended sample size was achieved.

Data collection procedure and instrument

Data were obtained from the labor and delivery registers of the hospital registration ward by obtaining the name and identification number of pregnant women who delivered at the hospital. In the hospital, the blood group of pregnant women, outcome of the delivery, and neonatal health status were assessed through laboratory diagnosis, clinical findings, obstetric history, weight, and other measurements and then recorded in the registration book of the antenatal clinic, postnatal clinic, and delivery rooms. The laboratory diagnosis of blood grouping through a drop of blood from each woman was placed on a glass slide in 3 places. When antisera D containing antibody reacts with protein D present it forms agglutination. A drop of each of the monoclonal blood grouping antibodies A, B, and D was added and mixed with each blood sample with the aid of an applicator stick and then used to observe agglutination. The chemistry analysis for hyperbilirubinemia and a hematological analyzer (Complete Blood Count (CBC)) for hemolytic anemia were performed in the hospital according to the manufacturer's instructions.[22] The 2 trained BSc nurses and 2 midwives were involved in data extraction registration books under supervision by MSc in Hematology & Immunohematology.

Operational definition

- Rh-negativity-people without antigen D (dd genotype) in their red blood cells are called Rh-negative and produce antibodies to nonself D antigen, which can cause HDFN.[23,24]
- RhD sensitization-Rh sensitization is a process that occurs when Rh(D)-negative women develop anti-Rh(D) antibodies either during a previous pregnancy in which the fetus is Rh(D)-positive or by exposure to Rh(D) antigens from blood products/transfusion.[25]
- Ethnic variation is the inherited antigens of red cells.[26]

- Delivery outcomes are birth weight, premature delivery, neonatal death, neonatal anemia, neonatal jaundice etc.

Data quality control

Prior to data extraction from registration books, training was given to data collectors and supervisors for 1 day. Then, trained data collectors and supervisors checked the data for completeness and consistency. The complete, accurate, and fulfilled all necessary requirements documents were extracted for the study.

Data processing and analysis

The data were double entered, and all completeness and appropriateness were checked before analysis. Statistical Package for Social Sciences (SPSS) version 26 software (SPSS Inc. Chicago, IL, USA) application for analysis. Descriptive statistical analysis was performed to show the frequency distribution and percentage of the Rh blood group and neonatal outcome. The results are presented in tables and charts.

Results

Sociodemographic result

A total of 16 455 women delivered at the hospital between 2017 and 2021, and of these, 876 had complete data. Out of the extracted data, 110 women's data were selected for present study. The women's mean age was 27 (±13.4), with a minimum of 14 years and a maximum of 41 years. Out of 110 study participants, the majority of 85 (77.3%) were 15 to 24 years old, 92 (83.6%) lived in urban areas, and 76 (69.1%) were of Oromo ethnicity. Regarding the occupational status of women delivered at the hospital, the majority (45, 40.9%) were housewives (Table 1).

Table 1. Sociodemographic characteristics of women attended to Bule Hora University Teaching Hospital from 2017 to 2021.

VARIABLES	CATEGORIES	FREQUENCY	PERCENTAGE (%)
Age	15-24	85	77.3
	25-34	20	18.2
	35-44	5	4.5
Residence	Urban	92	83.6
	Rural	18	16.4
Ethnicity	Oromo	76	69.1
	Burji	13	11.8
	Amhara	9	8.2
	Silte	5	4.5
	Others	7	6.4
Marital status	Single	2	1.8
	Married	104	94.5
	Divorced	4	3.6
Occupation	Farmer	17	15.5
	Employed	15	13.6
	Housewife	47	42.7
	Student	3	2.7
	Merchant	28	25.5

Rh and ABO blood group distributions

In the present study, out of 110 women who attended the hospital, approximately 7 (6.4%) [95% CI: 1.83-10.98] were Rh-negative. Based on the distribution of ABO blood groups, blood group O was 46 (41.8%) the highest among women who attended the Bule hora University teaching hospital, followed by A and B with 30% and 24.6%, respectively. Regarding Rh-negativity, 1 (25%) of blood group AB, 3 (6.5%) of blood group O, and 2 (6.1%) of blood group A were Rh-D negative (Table 2).

Delivery characteristics of pregnant women

Among 110 pregnant women whose antenatal care (ANC) history was studied, approximately half of 61 (55.5%) did not have a previous delivery, 7 (6.4%) had a previous abortion, 5 (4.5%) stillbirth, and one died, which may be because of another case. Among 110 children delivered by ANC clinic-follower women, based on their birth weight, 4 (3.6%) had <2.6 kg, and 106 (94.6%) had ⩾2.6 kg (Table 3).

Rh-negative neonatal outcome

Out of neonates delivered from Rh-negative women, 1 (14.3%) was found to be jaundiced. This finding showed that one-fourth (25%) of neonates born from previously delivered women were affected with jaundice. In the present study, neither hospital-delivered women nor never previously delivered women developed HDN (Table 4).

Discussion

Rhesus incompatibility refers to the mismatch of maternal and fetal Rh types, which is associated with the development of maternal Rh sensitization and hemolytic disease of the neonate (HDN).[27] It received little attention or was often neglected in different parts of the world, including developing countries such as Ethiopia. Therefore, the main purpose of this study was to assess the Rh D-negative and neonatal outcomes among pregnant women who were delivered to the hospital from 2017 to 2021 and fulfilled the selection criteria.

The findings of the present study show that the Rh-negative blood group among pregnant women delivered at BHUTH was 6.4% [95% CI: 1.83, 10.98]. This finding is consistent with a study conducted in Nigeria of 6% in Nigeria,[16] 7% from Woleita Sodo[18] and 7.2% from Jimma.[19] This finding was lower than a study conducted in Turkey showing that the

Table 2. Rh and ABO blood group distribution of pregnant women who delivered at BHUTH from 2017 to 2021.

BLOOD GROUPS	RH-D POSITIVE (%)	RH-D NEGATIVE (%)	TOTAL (%)
A	31 (93.9)	2 (6.1)	33 (30)
B	26 (96.3)	1 (3.7)	27 (24.6)
AB	3 (75)	1 (25)	4 (3.6)
O	43 (93.5)	3 (6.5)	46 (41.8)
Overall	103 (93.6)	7 (6.4)	110 (100)

Table 3. Delivery characteristics of pregnant women delivered at BHUTH from 2017 to 2021.

VARIABLES	CATEGORY	FREQUENCY	PERCENTAGE (%)
Delivery history	Previous normal neonate deliver	36	32.7
	Never deliver before	61	55.5
	Abortion	7	6.4
	Stillbirth	5	4.5
	Died afterbirth	1	0.91
Child weight	<2.6 kg	4	3.6
	⩾2.6 kg	106	94.6

Table 4. Rh blood groups of pregnant mothers of ANC followers at BHUTH from 2017 to 2021.

	PREVIOUS DELIVERED	NO OF NEONATES	JAUNDICE	NORMAL
Neonatal outcome	Yes	4	1 (14.3%)	3 (42.8%)
	No	3	-	3 (42.8%)
Total			1 (14.3%)	6 (85.7%)

prevalence was 10.4% negative,[28] 7.94% in the Silte zone,[29] and 8.8% from Mekelle.[17] However, this finding was higher than those of studies conducted in Nigeria, where 5.5% women were Rh D-negative,[30] 4.29% in India,[31] 1.68% in Nepal,[32] 0.31% from Rajavithi Hospital,[33] and 2.9% in Bangalore India.[34] The variations among the studies might be due to the difference in sample size, laboratory method applied for Rh-negative determination, and difference in ethnicity.

In the current study, the distribution of blood groups among Rh-negative women out of 7 (6.4%) was 42.8% in blood group O, 28.6% in blood group A, and 14.3% in blood group B and AB. This finding agreed with a study from Bangalore India reporting that the most common blood group among Rh-negative women was O-negative.[34] However, this finding was lower than that previously reported from India, blood group B 33.96% and blood group O 32.62%, but much higher than blood group A and AB reported 24.35% and 9.05%, respectively.[31] The difference could be due to blood group O being the predominant blood group among the African population compared to other continents.

Jaundice was the outcome seen in Rh D-negative mother-born neonates, with a prevalence of 14.3%. The neonatal outcome was found to be similar to that in a study conducted in Mekelle Ethiopia, which reported that 15% of cases were found to be physiological jaundice.[35] The current finding is higher than that of a study performed in Bangalore India, which reported 8.33%.[34] On the other hand, the result of the study was much lower than that of neonatal jaundice, which was 37.2% in Rajavithi Hospital.[33] In hospital medical records, the absence of different risk factors may contribute to the appearance of jaundice, such as ABO incompatibility, obstructive jaundice or physiologic jaundice; hence, it is difficult to assess the causes of neonatal jaundice.

Limitations of the study

The weakness of our study was that a small sample size was used, rather than conducting other study designs, such as observational and cross-sectional designs, prospectively following ANC follower pregnant mothers. Another limitation of the

present study was the lack of a week D-antigen detection technique in the hospital, and HDN may develop after discharge from the hospital and is not assessed. The risk factors may cause jaundice to be unavailable in the medical records of the hospital.

Conclusion

This study shows that the prevalence of Rh-negative was 6.4%. Blood group O is the majority among Rh D-negative. Jaundice was found in neonates born Rh D-negative. To reduce Rh incompatibility that may cause HDN, the government should encourage pregnant women through health education as they follow ANC to screen Rh-D type. Health professionals should give anti-d prophylaxis in RH- mothers deliver at health facilities. Community based identification of the Rh D antigen should be launch to protect pregnant women since the majority of them do not follow ANC and deliver at health facilities in the country.

Declarations

Ethics approval and consent to participate

Ethical consideration was obtained from Bule Hora University, Institute of Health Review Committee with approval number IHRC02/2022. After approval of ethics, an official letter was written from the health institute to the Bule Hora University Teaching Hospital laboratory for permission. Data were gathered from hospital units using an identification number (ID No.) on registration books, therefore consent for participation was not applicable.

Consent for publication

Not applicable.

Author contribution(s)

Alqeer Aliyo: Conceptualization; Formal analysis; Project administration; Resources; Software; Writing – original draft; Writing – review & editing.**Girma Ashenafi:** Data curation; Formal analysis; Methodology; Software; Supervision; Writing – original draft; Writing – review & editing.**Mohammedzen Abduselam:** Formal analysis; Methodology; Supervision; Validation; Visualization; Writing – original draft; Writing – review & editing. All authors approved the final draft of manuscript.

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Availability of data and materials

Data essential for the conclusion are included in this manuscript. Additional data can be obtained from the corresponding author upon reasonable request.

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