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Assessment of Awareness and Understanding of Hemolytic Disease of the Fetus and Newborn in the Beninese Population

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Abstract

Background: Hemolytic Disease of the Fetus and Newborn (HDFN) arises from blood group incompatibility, especially the RhD antigen. In Benin, systematic ABO RhD blood grouping is poorly understood by many midwives and nurses. Nearly one in ten women risk having children with HDFN. This study aimed to determine the level of knowledge of the Beninese population on HDFN. **Methods:** Data were collected from June 2023 to March 2024. Participants completed a Kobotoolbox questionnaire on WhatsApp, with in-person assistance for illiterate participants. The study involved 521 participants from across Benin. Data were analyzed using SigmaPlot version 14.0. **Results:** Among the 521 participants, 298 were women (57.20%) aged 18 to 77 years. The majority (40.69%) were aged 26 - 35. Over a third (35.51%) did not know their RhD blood group. Most (59.12%) were unaware of the risks for RhD discordant couples. Among those with a partner, 25.16% were in at-risk couples for HDFN, and over half (59.12%) were unaware of this risk. There was no significant association between being in a high-risk union and knowledge of the risk or education level. **Conclusion:** Only 40.88% of the Beninese population are aware of HDFN, indicating a low level of knowledge.

Keywords

Hemolytic Disease of the Fetus and Newborn (HDFN), Risk Factor, Knowledge, Populations, Benin

1. Introduction

Hemolytic Disease of the Fetus and Newborn (HDFN) is a genetic condition

caused by blood group incompatibility, particularly the RhD antigen in the parental couple [1] [2]. Previously misunderstood and considered a curse until the 1940s [3], this disease results from a maternal-fetal antigen-antibody conflict. Before the 1970s, it was the leading cause of death for fetuses aged at least 22 weeks of amenorrhea and newborns under 7 days [4]. HDFN caused more than 50,000 deaths per year, especially in low-income countries in Asia and sub-Saharan Africa [5]. Clinical manifestations include fetal anemia, hyperbilirubinemia, kernicterus, and death [6].

The administration of anti-D immunoglobulin has substantially prevented this disease, particularly in developing countries [7]. However, post-delivery or post-event anti-D serum immunization prevention has shown limitations, not covering all anti-D immunization risks. This led researchers to use fetal RhD genotyping techniques on amniotic fluid or maternal plasma to predict fetal RhD and better prevent maternal immunization, thus reducing HDFN [8]. Despite these efforts, HDFN remains a major health problem in view of its high mortality and morbidity in the world, in Africa, particularly in Benin [9]. Our previous work showed that nearly one in ten women is at risk of giving birth to children with this condition [10]. Therapeutic management relies, almost exclusively, on transfusing concentrated red blood cells, a practice with infectious and immune-hematological risks [11].

Chanvillard (2012) reported that understanding a disease and its treatments improves adherence to hygienic-dietary recommendations and therapeutic compliance, as observed after a stroke. Similarly, a study by Balcha *et al.* (2023) determined that population adherence to preventive measures against anemia depends on mothers' understanding of the causes, manifestations, and risks of this disease [12]. Applied to HDFN, it is essential to examine the knowledge of the Beninese population on various aspects of this disease. It is fundamental to determine if they understand the causes and manifestations of HDFN and the consequences of RhD incompatibility between an RhD-negative woman and an RhD-positive man. It is also important to evaluate their knowledge of prevention, occurrence conditions, and history of this disease. In short, what do they know about HDFN? This article aims to answer this question. By assessing the levels of knowledge of this disease within the population, we can better prevent and manage it.

2. Methodology

2.1. Study Population

This cross-sectional exploratory study was conducted in Benin from June 2023 to March 2024. It involved 521 participants, including 223 men and 298 women, representing all 12 departments of Benin. Participants were selected using a multistage random sampling method to ensure a representative sample of the population based on key sociodemographic factors. Benin, a West African country, has an estimated population of 13.35 million (2022), distributed across the northern, central, southern, eastern, and western regions.

2.2. Sample Size Determination

The sample size was calculated using Schwartz's formula:

$$n = \frac{z^2 \times p \times (1-p)}{m^2}$$

where n is the required sample size, z is the confidence level (1.96 for a 95% confidence interval), p is the estimated proportion of the population exhibiting the characteristic of interest, which was conservatively set at 0.5 to maximize the sample size, and m is the margin of error. The resulting calculated sample size was 384 participants, with an increase to 521 to enhance precision and better account for variability within the population.

2.3. Data Collection

Data were collected using a structured questionnaire developed in the Kobotoolbox application. The questionnaire was designed by the authors, with input from experts in hematology and public health, to assess knowledge of RhD blood groups, awareness of HDFN, risk factors, and prevention strategies. It was pilot-tested on both educated and uneducated individuals to ensure clarity and appropriateness for diverse respondent groups. Based on the pilot results, adjustments were made to improve the questionnaire's clarity. Participants completed the questionnaire either independently via WhatsApp or with in-person assistance for illiterate individuals. Confidentiality was ensured by using a unique password for each submission on the application.

2.4. Variables

The primary variables of interest in this study included participants' knowledge of their own and their partner's RhD blood group, awareness of the risk of HDFN and understanding of prevention methods such as anti-D immunoprophylaxis. Sociodemographic data, including age, sex, education level, occupation, and marital status, were also collected. Knowledge levels were categorized into three groups: Good knowledge (participants who met all four criteria: knowledge of Rh incompatibility risk, understanding of HDFN, awareness of the conditions for its occurrence, and knowledge of a prevention method), Average knowledge (participants who met at least one of the four criteria), and No knowledge (participants who did not meet any of the criteria).

2.5. Data Analysis

Results are presented as proportions for variables such as sex, age, education level, marital status, knowledge of blood group, knowledge of HDFN, occurrence conditions, prevention means, and history. The frequencies of ABO and RhD blood group phenotypes were determined using Microsoft Excel 2019. Association measures were performed by calculating the odds ratio and its 95% confidence interval. The association between being in a high-risk union and factors such as knowledge of the risk and education level was examined in multivariate logistic

regression using SigmaPlot Version 14.0 (2017). A p-value < 0.05 was considered statistically significant.

2.6. Ethical Considerations

The study protocol was approved by the Local Ethics Committee for Biomedical Research (approval number N˚ 0578/CLERB-UP/P/SP/R/SA), dated May 3, 2023. Written informed consent was obtained from all participants prior to their participation in the study.

3. Results

Five hundred twenty-one (521) participants responded among the one thousand seven hundred thirty-five (1735) people to whom the questionnaire was submitted online or administered in person.

Table 1 shows that female participants dominate with a proportion of 57.20% compared to 42.80% for males. The age group of 26 to 35 years is the majority (40.69%), followed by the 18 to 25 years group (35.13%). Participants over 45 years are in the minority with a proportion of 5.76%. The study included all professional strata of society with artisans dominating (26.87%), followed by students (23.80%). Teachers are in the minority with 3.84%. In terms of education level, university graduates are in the lead (37.62%), followed by those with a secondary level (36.85%). Those with a primary level or less occupy 25.53% and are in the minority.

Table 1. Sociodemographic characteristics of participants.

Variables	Frequency (%)
Departments	
Atacora-Donga	24.57
Zou-Collines	20.92
Borgou-Alibori	16.89
Atlantique-Littoral	13.82
Mono-Couffo	12.67
Ouémé-Plateau	11.13
Sex	
Female	57.20
Male	42.80
Age Group	
18 to 25	35.13
26 to 35	40.69
36 to 45	18.43
>45	5.76

Continued

Profession	
Artisans	26.87
Students	23.80
Others	13.24
Medical personnel	9.98
Merchant	9.60
Housewife	7.68
Farmer	4.99
Teacher	3.84
Education Level	
University	37.62
Secondary	36.85
Primary or less	25.53

Results indicates that more than a third (35.51%) of participants do not know or have no idea about their RhD blood group despite the high representation of participants with a university or secondary level of education (Table 2). More than three out of four participants (79.27%) are married or have a partner, compared to 20.73% for those without a partner. Additionally, 53.27% of participants did not know their partner's blood group. Among participants, 25.16% were in at-risk unions for HDFN (RhD-negative woman and RhD-positive husband) (Table 2). More than half (59.12%) of the participants were unaware of this risk, and even among those who declared knowing the risk, 23.08% did not know it was HDFN. Finally, it was found that 36.29% of participants think HDFN could be caused by witchcraft (Table 2).

Table 2. Variables related to participants' knowledge of HDFN.

Variables	Frequency (%)
Knowledge of RhD Blood Group (n = 521)	
Yes	64.49
No	27.06
Yes but does not remember	8.45
Having a Partner (n = 521)	
Yes	79.27
No	20.73
Knowledge of Partner's RhD Blood Group (n = 413)	
No	53.27
Yes	36.56
Yes but does not remember	10.17

Continued

At-Risk Union H(Rh+) and F(Rh−) (n = 159)	
No	74.84
Yes	25.16
Knowledge of Risk (n = 159)	
No	59.12
Yes	40.88
Risk (n = 65)	
Hemolytic disease of the fetus and newborn	76.92
Others	23.08

The number of respondents for each variable is indicated by n.

Table 3 shows that blood group O was the most frequent (43.45%), followed by blood group B (26.49%). Blood group AB was the least frequent (5.95%). Participants with the D antigen were the majority (77.08%), while those without it were less represented (22.91%) (Table 3).

Table 3. Distribution of participants by blood group in the ABO and RhD System.

Blood Group	RhD		Total
	Positive	Negative	
O	74.66	25.34	43.45
A	81.48	18.52	24.11
B	79.78	20.22	26.49
AB	65.00	35.00	5.95
Total	77.08	22.91	100

There is no statistically significant association between being in an at-risk union and factors such as knowledge of the risk and education level (p-value of 0.896 and 0.679 respectively) (Table 4).

Table 4. Association between knowledge of risk, education level, and at-risk union.

Factors	At-Risk Union		RC (IC_{95})	p-value
	Yes	No		
Knowledge of Risk				
Yes	24 (25.53)	70 (74.47)	1.05 (0.51 - 2.18)	0.896
No	16 (24.61)	49 (75.38)	1	
Education level				
Secondary or less	20 (35.29)	55 (64.71)	1.16 (0.59 - 2.38)	0.679
University	20 (16.67)	64 (83.33)	1	

Age and gender do not show significant effects on knowledge, as their odds ratios are close to 1 with wide confidence intervals. Medical personnel, on the other hand, are far more likely to be knowledgeable about HDFN, with an odds ratio of 4.63, highlighting the impact of professional exposure on disease awareness. Similarly, university-level education is a strong predictor of HDFN knowledge, with an odds ratio of 10.67, indicating that higher education significantly improves awareness. Although being a student or teacher does not show a notable correlation with HDFN knowledge, knowing one's partner's RhD status is associated with a higher likelihood of understanding the disease, with an odds ratio of 3.30. Knowledge of one's own RhD status has a positive, though not statistically significant, association with HDFN awareness (Table 5).

Table 5. Correlation between participants' knowledge of HDFN and socio-demographic factors.

Variable	Odds Ratio	95% CI
Age	1.01	0.96 - 1.07
Male	0.99	0.46 - 2.12
Medical personnel	4.63	1.71 - 12.54
Student	1.01	0.31 - 3.27
Teacher	0.58	0.11 - 3.19
University-level education	10.67	4.10 - 27.76
Knowledge of own Rh status	1.39	0.33 - 5.84
Knowledge of partner's Rh status	3.30	1.36 - 8.01

4. Discussion

The results of this study reveal significant gaps in the awareness and understanding of HDFN among the Beninese population. Despite relatively high levels of education among participants, more than half were unaware of the risks associated with RhD incompatibility, and over one-third did not know their own RhD status. This insufficient knowledge is concerning, as it exposes a considerable portion of the population to avoidable fetal and neonatal complications. These findings are consistent with previous studies in sub-Saharan Africa, which have also reported low levels of awareness about maternal-fetal health issues related to blood group compatibility [12]-[15].

The lack of knowledge about RhD status and HDFN among both women and men presents a public health concern, particularly in a context where one in four participants were in at-risk unions. The absence of a significant association between education level and HDFN awareness further emphasizes the need for targeted public health interventions that go beyond formal education. Incorporating RhD blood group compatibility and HDFN education into routine antenatal care services, especially in rural areas, and ensuring both partners undergo RhD blood typing, could help mitigate the risks posed by Rh incompatibility.

Results in this study show that the distribution of blood groups within the Beninese population is comparable to that observed in other regions of Africa, notably in Guinea Conakry [16], Tunisia [17], and Cameroon [18]. Our findings support the need for healthcare worker training. Midwives and nurses, as frontline providers, play a critical role in educating couples about Rh incompatibility and ensuring appropriate preventive measures, such as anti-D immunoprophylaxis, are administered. Strengthening the knowledge of healthcare workers through continuous professional development programs would improve the management of at-risk pregnancies and reduce HDFN-related complications.

The relatively high frequency of Rh-negative individuals in Benin compared to other regions, such as Algeria [19] and France [20], underscores the need for increased vigilance in managing at-risk pregnancies. Pegoraro *et al.* (2020) showed that HDFN remains a preventable cause of significant morbidity and mortality in children [6]. The administration of anti-D antibodies has substantially reduced this disease's incidence, particularly in developing countries [7], though limitations remain in post-delivery or post-event immunization.

Addressing these issues requires not only strengthening healthcare workers' capabilities but also implementing awareness campaigns via radio, television, and social media to emphasize the importance of knowing one's RhD status. Furthermore, these campaigns should be culturally tailored to address the informational needs of both urban and rural populations. The integration of RhD and HDFN education into antenatal care, complemented by awareness campaigns and healthcare worker training, would help close the knowledge gap and improve prevention strategies.

While this study provides important insights, there are limitations to consider. The cross-sectional design offers only a snapshot of the population's knowledge, and the reliance on self-reported data may introduce recall bias. Additionally, the absence of qualitative data leaves questions about the underlying reasons for low awareness levels unanswered. Future research should explore these barriers through interviews and focus groups to gain deeper insights into the cultural and societal factors contributing to the knowledge gap.

This study highlights a low level of awareness and understanding of Hemolytic Disease of the Fetus and Newborn (HDFN) among the Beninese population. To reduce the risks associated with this condition, it is crucial to implement targeted measures that raise awareness through education and proactive health interventions. Continued efforts to inform and educate the public, especially with laboratory testing and personal health practices, are vital for improving maternal and child health outcomes. Key recommendations from this study include the development of focused educational programs, leveraging social media for widespread information dissemination, and integrating HDFN education into existing public health initiatives.

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Conflicts of Interest

The authors declare no conflicts of interest.

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