

## ORIGINAL RESEARCH ARTICLE

# AFRINA model: An innovative network-based strategy to prevent anemia and promote maternal well-being among brides-to-be

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## Abstract

This study aimed to develop and evaluate the AFRINA Model (Anemia Free Integrative Network Approach) as a preventive strategy to reduce pregnancy and childbirth complications through increased awareness and education on anemia prevention among prospective brides. A cross-sectional design was used to identify determinants influencing anemia prevention in Bengkulu City. Variables included knowledge, attitudes, perceptions, beliefs, motivation, information exposure, facility access, family support, and health worker attitudes, along with sociodemographic factors such as age, education, occupation, income, and family history. Most participants (90.5%) were aged 21–30 years, with higher education (97.3%) and employment (85.1%). Factors significantly associated with anemia prevention ( $p < 0.05$ ) were income, information exposure, attitude, perception, family support, facility availability, belief, health worker attitude, and motivation. Multivariate analysis identified motivation (OR 29.837), information exposure (OR 5.358), and family support (OR 5.045) as the strongest predictors. The AFRINA Model showed predictive accuracy between 79.9% and 93.4%, with an 86.6% accuracy rate in identifying at-risk individuals. Motivation, information exposure, and family support are key determinants of anemia prevention among prospective brides. The AFRINA Model demonstrates strong predictive validity and provides an effective framework for public health interventions addressing anemia prevention before marriage. (*Afr J Reprod Health 2026; 30 [10]: 35-48*).

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**Keywords:** Anemia, Primary Health Care, Relative Risk

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## Résumé

Cette étude visait à développer et à évaluer le Modèle AFRINA (Approche Réseau Intégratif Sans Anémie) comme stratégie préventive pour réduire les complications liées à la grossesse et à l'accouchement par une sensibilisation accrue à la prévention de l'anémie chez les futures mariées. Une étude transversale a été menée afin d'identifier les déterminants influençant la prévention de l'anémie dans la ville de Bengkulu. Les variables étudiées comprenaient les connaissances, les attitudes, les perceptions, les croyances, la motivation, l'exposition à l'information, l'accès aux établissements de santé, le soutien familial et l'attitude des professionnels de santé, ainsi que des facteurs sociodémographiques tels que l'âge, le niveau d'études, la profession et le revenu. La majorité des participantes (90,5 %) étaient âgées de 21 à 30 ans, avec un niveau d'études supérieur (97,3 %) et un emploi (85,1 %). Les facteurs significativement associés à la prévention de l'anémie ( $p < 0,05$ ) comprenaient le revenu, l'exposition à l'information, l'attitude, la perception, le soutien familial, la disponibilité des installations, les croyances, l'attitude des professionnels de santé et la motivation. L'analyse multivariée a identifié la motivation (OR 29,837), l'exposition à l'information (OR 5,358) et le soutien familial (OR 5,045) comme principaux prédicteurs. Le Modèle AFRINA a montré une précision prédictive de 79,9 % à 93,4 %, indiquant son potentiel pour orienter les interventions de santé publique dans la prévention de l'anémie avant le mariage. (*Afr J Reprod Health 2026; 30 [10]:35-48*).

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Mots-clés : Anémie, Soins de santé primaires, Risque relatif

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## Introduction

Anemia is a medical condition characterized by a reduction in the number of red blood cells or a

decrease in the concentration of hemoglobin within the blood, falling below normal physiological levels.<sup>1</sup> Hemoglobin is a protein found in red blood cells that transports oxygen throughout the body.

When someone experiences anemia, the tissues and organs in the body may not receive enough oxygen, which can result in symptoms such as fatigue, shortness of breath, dizziness, and pale skin.<sup>2</sup> Factors that can increase the risk of anemia include nutritional deficiencies, especially iron, vitamin A, vitamin B, folic acid, chronic inflammation, parasitic infections, and congenital conditions.<sup>3</sup> The main causes of iron deficiency anemia include low iron intake, poor iron absorption, and increased iron requirements during periods of growth, pregnancy, and lactation.<sup>4</sup>

Anemia among women of reproductive age remains a major public health concern both globally and in Indonesia. The World Health Organization (WHO) estimates that approximately 30% of women of reproductive age are affected by anemia. This condition contributes to a range of adverse maternal and fetal outcomes, including low birth weight, preterm birth, and increased risk of maternal mortality.<sup>5</sup>

One of the groups most vulnerable to the effects of anaemia is Women of Reproductive Age (WRA). Women in this group, especially prospective mothers, require special attention regarding their health status. The quality of the next generation will be determined by the condition of the mother before and during pregnancy. Efforts to create a quality generation through family health, by preparing prospective brides and grooms, are expected to result in a good level of health, especially for prospective brides who will later become pregnant and give birth.<sup>6</sup>

The prevalence of anaemia among adolescent girls and women of reproductive age (WRA) in Indonesia remains high and varies by province. According to the 2018 Riskesdas data, the prevalence of anaemia among WRA (ages 15-49) is 27.2%. The provinces with the highest prevalence of anaemia in WRA are West Papua (48.9%), North Maluku (47.5%), and West Sulawesi (44.2%), while the lowest prevalence is found in Bali (15.8%), Bangka Belitung (16.7%), and the Riau Islands (17.2%).<sup>6</sup>

The province of Bengkulu is also facing the issue of a high prevalence of anaemia among women of reproductive age. According to the 2018 Riskesdas data, the prevalence of anaemia among women of reproductive age in Bengkulu was 31.9%,

which is higher than the national figure of 27.2%.<sup>7</sup> This figure places Bengkulu at 16th out of 34 provinces with the highest prevalence of anemia among women of reproductive age in Indonesia.

The high prevalence of anaemia among women of reproductive age also contributes to an increased risk of complications during pregnancy and delivery. The Bengkulu City Health Office has recorded a surge in postpartum haemorrhage cases, with a 25% increase over the past three years among pregnant women with anemia. The incidence of premature births among mothers with anaemia in Bengkulu City has increased significantly, accounting for 18% of all hospital births. The latest data show that haemorrhaging, worsened by anaemia, is the leading cause of maternal death, accounting for 40% of all maternal mortality cases. This condition not only endangers the health of mothers but also increases the risk of infant mortality and growth problems, such as low birth weight (LBW), which affects 30% of babies born to mothers with anemia.<sup>8</sup>

African countries, such as Tanzania and Ethiopia, have implemented food fortification programs with iron. These programs have proven effective in increasing iron intake but face challenges related to funding sustainability and the uneven distribution of fortified foods.<sup>9</sup> In Bangladesh, there was also an anaemia prevention program for prospective brides and grooms that involved the Office of Religious Affairs and local health institutions. Evaluations showed that this program was partial and lacked broad community participation.<sup>10</sup>

Based on Presidential Regulation Number 72 of 2021 concerning the Acceleration of Stunting Reduction, BKKBN has been appointed as the national implementing coordinator. One of the strategies developed is the Electronic Ready for Marriage and Pregnancy Application (ELSIMIL), which is intended for prospective brides and grooms and the Family Assistance Team. This application is available in two versions: via a web browser ([elsimil.bkkbn.go.id](http://elsimil.bkkbn.go.id)) for TPK and via the Playstore for prospective brides and grooms.<sup>11</sup>

According to Winarni and I'tiskom (2023), the implementation of the ELSIMIL application faces a number of obstacles, including: the application certificate has not yet been fully

recognised as a requirement for marriage registration at the KUA, the application's features for the Family Assistance Team (FAT) are too complex, the application for prospective brides and grooms often experiences errors, as well as the habit of catin registering for marriage close to the wedding date, which does not comply with the rule of three months' of accompaniment before marriage. In addition, many catin work outside the city, making it difficult for them to be accompanied, and some FAT members still have difficulty operating the application. However, the supporting factors are that most catin are still young, making it relatively easy for them to use the application, and there are a sufficient number of FAT cadres in each village.<sup>12</sup>

Therefore, the development of an integrated model involving multiple sectors is essential, with a focus on preventing anaemia before marriage. This model is expected to reduce the risk of pregnancy and childbirth complications by increasing public awareness and education on the importance of anaemia prevention among prospective brides and grooms.<sup>13</sup> Thus, the researcher developed an innovative approach, the AFRINA Model, as the novelty of this study, which has the potential to make a significant global impact on improving women's health, not only in Indonesia but worldwide.

The AFRINA Model (Anemia Free Integrative Network Approach) provides an alternative solution to address the issue of anaemia among prospective brides and grooms in Bengkulu City. This model involves the Ministry of Health, the Ministry of Religious Affairs, and the Women's Empowerment Agency in forming a cross-ministerial team. The Ministry of Health will expand the reach of the program, the Ministry of Religious Affairs will establish health examinations as a requirement for marriage registration, and the Women's Empowerment Agency will assist prospective brides and grooms in consuming iron tablets according to the recommended dosages, preparing them for healthy pregnancies and improving both maternal and infant health outcomes. Therefore, this study aims to evaluate the effectiveness of the AFRINA Model in preventing anaemia and improving maternal well-being among brides-to-be in Bengkulu City.

## Methods

### *Study design and setting*

This study employed a cross-sectional design to identify determinants influencing anemia prevention among prospective brides in Bengkulu City, Indonesia. The study was conducted among women of reproductive age who were preparing for marriage and registered at the Offices of Religious Affairs (KUA) in Bengkulu City. The determinants examined in this study included knowledge, attitudes, perceptions, beliefs, motivation, exposure to health information, access to health facilities, family support, and the attitudes of health workers. Sociodemographic characteristics such as age, education, occupation, income, and family history were also assessed to provide a comprehensive understanding of factors related to anemia prevention among prospective brides.

### *Study population and sample size*

The study population consisted of 240 prospective brides of reproductive age registered at the Offices of Religious Affairs (KUA) in Bengkulu City. The sample size was determined using the Lemeshow sample size calculation formula, resulting in a total sample of 148 respondents. The inclusion criteria were prospective brides who were willing to participate in the study, able to read and write, capable of communicating effectively, and not suffering from chronic illnesses. Prospective brides who were not present during the data collection period were excluded from the study.

### *Sampling technique and recruitment*

A multistage random sampling technique was used to select respondents from the study population. Prospective brides were identified through premarital registration records obtained from the Offices of Religious Affairs (KUA) in Bengkulu City, where couples are required to register prior to marriage. These records were used as the sampling frame for selecting eligible participants. The selected respondents were approached during premarital health programs and administrative

activities at the Offices of Religious Affairs. The researchers explained the purpose of the study and invited eligible prospective brides to participate voluntarily.

### **Data collection and instruments**

Data were collected using a structured questionnaire developed by the researchers based on indicators derived from relevant literature. The questionnaire consisted of several components, including respondents' socio-demographic characteristics, knowledge about anemia, attitudes toward anemia prevention, and adherence to iron tablet consumption.

Before completing the questionnaire, respondents received an explanation about the objectives of the study and instructions on how to complete the questionnaire. After providing informed consent, respondents completed the questionnaire independently under the supervision of the researcher. The researcher remained available to clarify any questions and waited until the respondents completed the questionnaire.

In this study, the AFRINA (Anemia Free Integrative Network Approach) concept was incorporated as a framework to support anemia prevention among prospective brides. The AFRINA model emphasizes collaboration between the health sector and related institutions, including the Offices of Religious Affairs and women's empowerment agencies, to strengthen anemia prevention through health education, promotion of iron tablet consumption, and coordination among institutions involved in premarital health services.

### **Data analysis**

Data analysis in this study included univariate, bivariate, and multivariate analyses. Univariate analysis was conducted descriptively to describe the characteristics of each variable. Bivariate analysis was performed using the chi-square test at a 95% confidence level to examine the relationship between independent variables and the dependent variable.

Multivariate analysis was conducted using logistic regression because the dependent variable was categorical. The results of the multivariate

analysis were used to identify variables that significantly influenced anemia prevention. These significant variables were then selected as key components in the development of the Anemia Free Integrative Network Approach (AFRINA) model. A diagnostic test was subsequently conducted to plot the true positive rate against the false positive rate in classifying the risk level of anemia among prospective brides.

### **Ethical considerations**

This research was conducted after obtaining written permission from the Agency for National Unity and Politics of Bengkulu City, the Health Office, and the Ministry of Religious Affairs of Bengkulu City. Each respondent also agreed to participate as a research subject (informed consent). Meanwhile, ethical clearance was obtained from the Research Ethics Committee of the Faculty of Medicine, Andalas University, Padang, with Number: 468/UN.16.2/KEP-FK/2024.

## **Results**

### **Validity and reliability testing of the questionnaire**

Before the questionnaire was distributed, validity and reliability tests were conducted first. The results of the validity and reliability tests are presented in Table 1. Based on Table 1, the results of the validity and reliability tests show that all items for eight of the 8 variables are declared valid, while for one variable, namely knowledge, five statement items are not valid. The reliability test indicated that all nine variables were reliable, with a Cronbach's alpha >0.6.

### **Univariate analysis**

Univariate analysis is carried out at this stage to gain an overview of the characteristics of prospective brides. The number of prospective brides in this stage of the research was 148. The characteristics of the prospective brides who participated as respondents are presented in Table 2. As shown in Table 2, a substantial majority (90.5%) of prospective brides fall within the age bracket of 21–

**Table 1:** Validity and reliability test results

Variable	Validity Result	Hasil Reliabilitas
Prevention	10 out of 10 items valid	Reliabel(Cronbach Alpha: 0,85)
Attitude	10 out of 10 items valid	Reliabel (Cronbach Alpha: 0,94)
Perception	10 out of 10 items valid	Reliabel (Cronbach Alpha: 0,94)
Family Support	10 out of 10 items valid	Reliabel(Cronbach Alpha: 0,91)
Belief	10 out of 10 items valid	Reliabel(Cronbach Alpha: 0,92)
Availability of Facilities	10 out of 10 items valid	Reliabel(Cronbach Alpha: 0,93)
Health Workers' Attitude	10 out of 10 items valid	Reliabel(Cronbach Alpha: 0,95)
Motivation	10 out of 10 items valid	Reliabel(Cronbach Alpha: 0,95)
Knowledge	9 out of 14 items valid	Reliabel(Cronbach Alpha: 0,74)

30 years. Regarding educational attainment, a predominant proportion (97.3%) possess higher education qualifications. In terms of employment, a significant majority (85.1%) are employed, although most earn below the minimum wage (63.5%). Access to healthcare services is generally not challenging for most (68.9%). Additionally, nearly all individuals lack a family history of anemia (87.2%), and exposure to information is evenly distributed, with 50% having received information and 50% not. At the time of data collection, the majority of prospective brides exhibited an unsupportive attitude (66.2%), followed by negative perceptions (65.5%) and insufficient family support (67.6%). Furthermore, most facilities were deemed unsupportive (69.6%), with poor beliefs reported at 71.6%, unsupportive attitudes from healthcare workers at 68.2%, inadequate motivation at 71.6%, limited knowledge about anemia among prospective brides at 54.1%, and suboptimal anemia prevention practices at 64.9%.

### ***Bivariate analysis***

At this stage, the variables that had a significant influence on anaemia prevention among prospective brides and grooms can be seen, as shown in Table 3. Table 3 shows that the variables which have a statistically significant relationship with anaemia prevention among prospective brides and grooms ( $p < 0.05$ ) are income (0.048), exposure to information (0.000), attitude (0.000), perception (0.000), family support (0.000), availability of facilities (0.000), belief (0.000), health officer's attitude (0.000), and motivation (0.000). In the bivariate analysis, data were analysed using the chi-square test. This test was used to determine which variables could be included

in the multivariate modelling stage, using a tolerance threshold of  $p$ -value  $\leq 0.25$ , which means that if the resulting  $p$ -value is greater than 0.25, then that variable does not need to be included in the multivariate model. Therefore, the variables that can be included in the modelling are Income, Exposure to Information, Access to Health Facilities, Family History, Attitude, Perception, Family Support, Availability of Facilities, Health Officer's Attitude, Belief, Motivation, and Knowledge. Of the 15 independent variables, 11 met the criteria for inclusion in the multivariate model.

### ***Multivariate analysis***

At this stage, an analysis was carried out to determine which determinants were most closely related to anaemia prevention among prospective brides using multiple logistic regression analysis, as shown in Table 4. As shown in Table 4, modelling was conducted three times, starting with 11 variables in the initial model, then 10 variables in the second model, and 9 variables in the third model. The final model consisted of three variables with  $p$ -values less than 0.05 and changes in OR less than 10% (as shown in Tables 5.12 – 5.15), namely the variables of Exposure to Information (0.005), Family Support (0.041), and Motivation (0.012), while the other six variables had  $p$ -values greater than 0.05 and changes in OR greater than 10%. Based on the analysis results, six confounding variables were identified: Access, Attitude, Perception, Facility Availability, Belief, and Officer attitude. Based on the OR values of the nine analysed variables, it is evident that not all variables can be used as a basis for intervention, as some do not have a statistically significant relationship ( $p > 0.05$ ), namely Attitude, Perception,

**Table 2:** Characteristics of respondents (prospective Brides)

Variable (n=148)	Frequency	Percentage
<b>Age</b>		
< 21 years or > 35 years	14	9.5
21–35 years	134	90.5
<b>Education</b>		
Low	4	2.7
High	144	97.3
<b>Occupation</b>		
Unemployed	22	14.9
Employed	126	85.1
<b>Income</b>		
< Regional Minimum Wage (RMW)	94	63.5
≥ Regional Minimum Wage (RMW)	54	36.5
<b>Access to Health Services</b>		
Difficult	46	31.1
Not Difficult	102	68.9
<b>Family History of Anemia</b>		
Present	19	12.8
Not Present	129	87.2
<b>Exposure to Information</b>		
Never	74	50.0
Ever	74	50.0
<b>Attitude</b>		
Not Supportive	98	66.2
Supportive	50	33.8
<b>Perception</b>		
Negative	97	65.5
Positive	51	34.5
<b>Family Support</b>		
Not Supportive	100	67.6
Supportive	48	32.4
<b>Availability of Facilities</b>		
Not Supportive	103	69.6
Supportive	45	30.4
<b>Belief</b>		
Poor	106	71.6
Good	42	28.4
<b>Health Workers' Attitude</b>		
Not Supportive	101	68.2
Supportive	47	31.8
<b>Motivation</b>		
Poor	106	71.6
Good	42	28.4
<b>Knowledge</b>		
Poor	80	54.1
Good	68	45.9
<b>Prevention</b>		
Poor	96	64.9
Good	52	35.1

Facility Availability, Belief, and Officer's attitude. Therefore, the variables most suitable for intervention are those that show a significant relationship and have high OR values, which are motivation (OR 29.837), Exposure to Information (OR 5.358), and Family Support (OR 5.045).

### Diagnostic test

This test was conducted to display a plot of the true positive rate against the false positive rate in classifying the risk level of anaemia in prospective brides. The measurement was performed based on the scores of the questionnaire items and the condition of the respondents in anaemia prevention, as shown in Figure 1. As shown in Figure 1, the area under the curve (AUC) was 86.6% (95% CI 79.9% - 93.4%), with a p-value of 0.000 (<0.05). This confidence interval indicates that the model can predict the category of respondents likely at risk of anaemia with an accuracy of 79.9%–93.4%. The predictive scale for anaemia risk, developed for brides-to-be, identified the risk of anaemia in 86.6% of the total respondents. The optimal cutoff score for identifying anaemia risk was 13 (Figure 2), with a score of 80.5, sensitivity of 78.8%, and specificity of 76%. Furthermore, the results demonstrate that a score threshold greater than 80 predicts that respondents are not at risk of anaemia, whereas a score threshold below 80 predicts that respondents are at risk of anaemia.

$$\begin{aligned}
 \text{Accuracy} &= \frac{\text{True positive} + \text{True Negative}}{\text{Total}} \\
 &= \frac{73 + 41}{148} = 0,77
 \end{aligned}$$

The accuracy of the category in classifying the testing data was 0.77, which means that 77% of the testing data could be properly classified by the established category. Table 6 shows that the respondents who accurately predicted the risk of anaemia in brides-to-be (true positive rate) reached 76%. The response accurately predicting brides-to-be as not being at risk of anaemia was 79%. This finding also showed a p-value of 0.000, indicating a

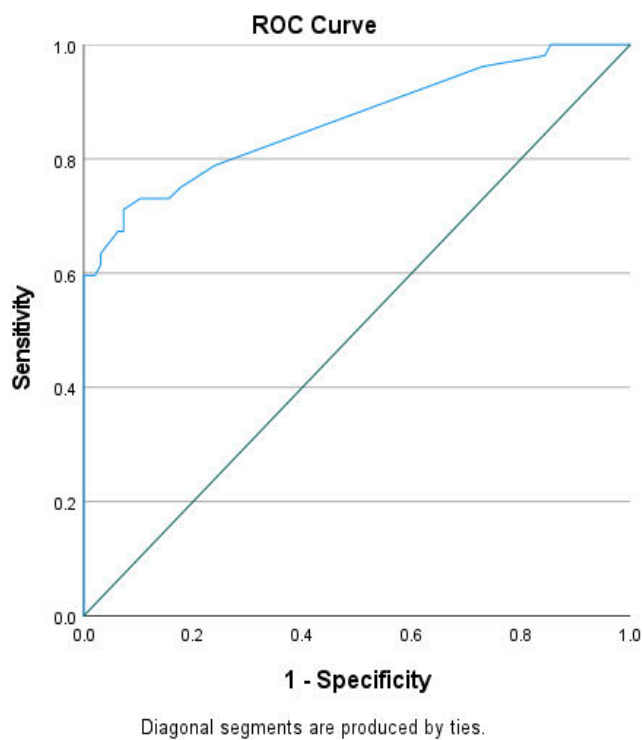
**Table 3:** Bivariate analysis of independent variables and anemia prevention

Independent Variable	Category	Anemia Prevention Poor (f, %)	Anemia Prevention Good (f, %)	Total (f, %)	p-value	OR (95% CI)
<b>Age</b>	< 21 years or > 35 years	9 (64.3)	5 (35.7)	14 (100)	1.000	0.972 (0.308–3.069)
	21–35 years	87 (64.9)	47 (35.1)	134 (100)		
<b>Education</b>	Low	4 (100.0)	0 (0.0)	4 (100)	0.336	1
	High	92 (63.9)	52 (36.1)	144 (100)		
<b>Occupation</b>	Unemployed	17 (77.3)	5 (22.7)	22 (100)	0.280	2.023 (0.700–5.841)
	Employed	79 (62.7)	47 (37.3)	126 (100)		
<b>Income</b>	< Regional Minimum Wage (RMW)	67 (71.3)	27 (28.7)	94 (100)	0.048	2.139 (1.066–4.295)
	≥ Regional Minimum Wage (RMW)	29 (53.7)	25 (46.3)	54 (100)		
<b>Access to Health Services</b>	Difficult	35 (76.1)	11 (23.9)	46 (100)	0.088	2.139 (0.976–4.687)
	Not difficult	61 (59.8)	41 (40.2)	102 (100)		
<b>Family History of Anemia</b>	Present	15 (78.9)	4 (21.1)	19 (100)	0.263	0.450 (0.141–1.434)
	Absent	81 (62.8)	48 (37.2)	129 (100)		
<b>Exposure to Information</b>	Never	61 (82.4)	13 (17.6)	74 (100)	0.000	5.229 (2.463–11.100)
	Ever	35 (47.3)	39 (52.7)	74 (100)		
<b>Attitude</b>	Not Supportive	82 (83.7)	16 (16.3)	98 (100)	0.000	13.179 (5.820–29.842)
	Supportive	14 (28.0)	36 (72.0)	50 (100)		
<b>Perception</b>	Negative	84 (86.6)	13 (13.4)	97 (100)	0.000	21.000 (8.783–50.210)
	Positive	12 (23.5)	39 (76.5)	51 (100)		
<b>Family Support</b>	Not Supportive	85 (85.0)	15 (15.0)	100 (100)	0.000	19.061 (7.997–45.429)
	Supportive	11 (22.9)	37 (77.1)	48 (100)		
<b>Availability of Facilities</b>	Not Supportive	85 (82.5)	18 (17.5)	103 (100)	0.000	14.596 (6.245–34.116)
	Supportive	11 (24.4)	34 (75.6)	45 (100)		
<b>Belief</b>	Poor	89 (84.0)	17 (16.0)	106 (100)	0.000	26.176 (9.991–68.581)
	Good	7 (16.7)	35 (83.3)	42 (100)		
<b>Health Workers' Attitude</b>	Not Supportive	84 (83.2)	17 (16.8)	101 (100)	0.000	14.412 (6.237–33.303)
	Supportive	12 (25.5)	35 (74.5)	47 (100)		
<b>Motivation</b>	Poor	90 (84.9)	16 (15.1)	106 (100)	0.000	33.750 (12.234–93.106)
	Good	6 (14.3)	36 (85.7)	42 (100)		
<b>Knowledge</b>	Poor	38 (55.9)	30 (44.1)	68 (100)	0.053	2.081 (1.049–4.131)
	Good	51 (60.0)	34 (40.0)	85 (100)		

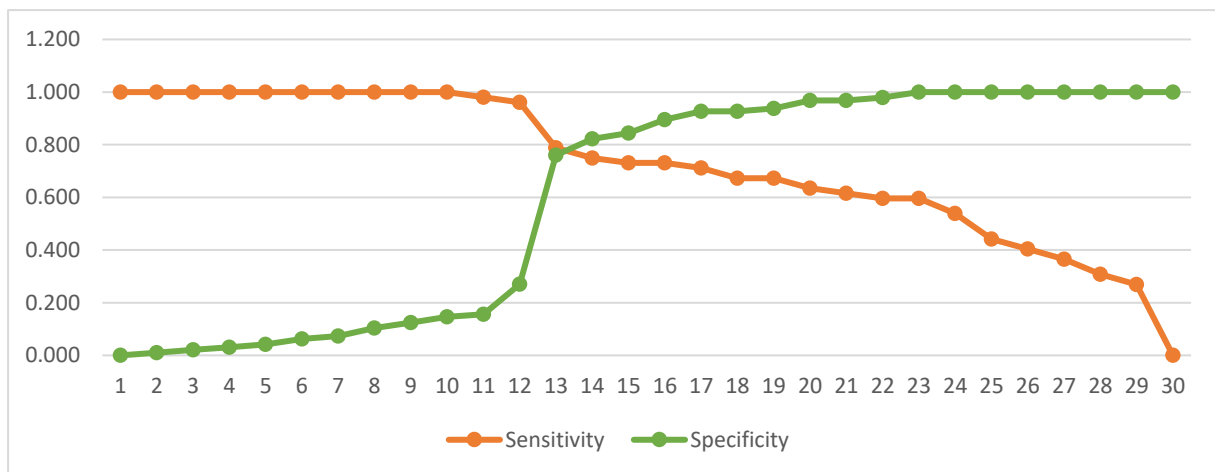
**Table 4:** Modeling in multivariate analysis

Model I	Model II	Model III	Final Model
Income (0.744)	Access (0.056)	Access (0.054)	Exposure to Information (0.005)
Access (0.054)	Exposure to Information (0.009)	Exposure to Information (0.005)	Family Support (0.041)
Exposure to Information (0.008)	Attitude (0.346)	Attitude (0.360)	Motivation (0.012)
Attitude (0.349)	Perception (0.144)	Perception (0.123)	
Perception (0.144)	Family Support (0.053)	Family Support (0.041)	
Family Support (0.053)	Availability of Facilities (0.157)	Availability of Facilities (0.141)	
Availability of Facilities (0.156)	Belief (0.379)	Belief (0.346)	
Belief (0.379)	Health Workers' Attitude (0.412)	Health Workers' Attitude (0.451)	
Health Workers' Attitude (0.399)	Motivation (0.011)	Motivation (0.012)	
Motivation (0.013)	Knowledge (0.536)		
Knowledge (0.612)			

*Note: The numbers in parentheses represent the p-values of each variable.*



**Figure 1:** ROC curve of anemia prevention score



**Figure 2:** Cut-off point of anemia prevention

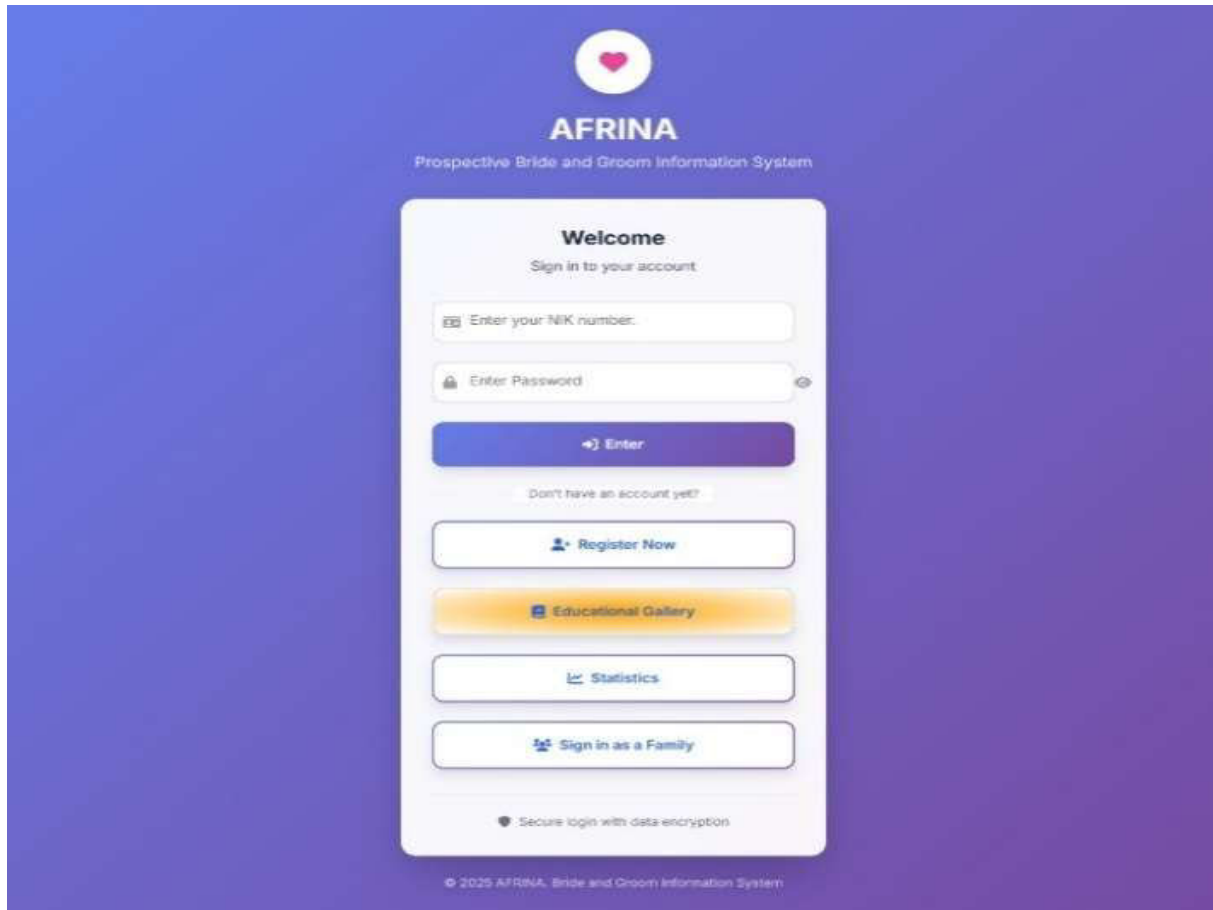
significant level in predicting the risk of anaemia in brides-to-be. In addition, the Odds Ratio (OR) value indicates that respondents with a high threshold score (>80) are 11.8 times more likely to not be at risk of anaemia than respondents in the lower score category.

### ***AFRINA Model application (anemia free integrative network approach)***

Based on the results of multivariate and diagnostic tests, the variables suitable for intervention within the AFRINA model application are motivation and family support, as shown in Figure 3, which illustrates the AFRINA Model Application (Anemia Free Integrative Network Approach) website: <https://afrina.site/login.php>. This model serves as an alternative solution to address the issue of anaemia among prospective brides and grooms in Bengkulu. The model involves the Ministry of Health, Ministry of Religious Affairs, and Women's Empowerment Office in forming a cross-ministerial team. The Ministry of Health will expand the program's reach, and the Ministry of Religious Affairs will set marriage registration requirements that include health examinations. The Women's Empowerment Office will assist prospective brides and grooms in consuming iron tablets according to the recommended dosages. Figure 3 illustrates the interface of the AFRINA (Anemia Free Integrative

Network Approach) information system, a digital platform developed to support the prevention and monitoring of anemia among prospective brides and grooms in Bengkulu City. The system serves as an integrated information platform that connects multiple stakeholders involved in premarital health services. The interface displayed in the figure represents the login page of the AFRINA website, where users can access the system by entering their national identification number (NIK) and password. Through this portal, prospective brides, families, and related stakeholders can access several key features designed to support anemia prevention programs.

The platform provides a registration feature that allows prospective brides to create an account and input their personal data before participating in the program. It also includes an educational gallery, which contains health education materials related to anemia prevention, balanced nutrition, and the importance of iron supplementation prior to pregnancy. In addition, the system provides a statistics feature that presents summarized data on program participation and anemia screening results. Another feature allows users to sign in as a family member, enabling family involvement in supporting prospective brides to maintain adherence to iron tablet consumption and healthy lifestyle practices. Within the AFRINA model, this digital system functions as a monitoring and coordination



**Figure 3:** Application of the AFRINA model (Anemia free integrative network approach)

tool that supports collaboration between multiple sectors, including health offices, religious affairs offices, community health centers, and community health cadres. Through the platform, data related to anemia screening, iron tablet consumption, and questionnaire results can be recorded and monitored digitally, ensuring that the intervention process is systematic and well documented. The use of this technology strengthens the implementation of the AFRINA model by facilitating communication, monitoring adherence to anemia prevention interventions, and providing accessible health education for prospective brides and their families.

## Discussion

Based on the results of the bivariate analysis using the chi-square test, the variables significantly

associated with anaemia prevention among prospective brides and grooms ( $p < 0.05$ ) included income, exposure to information, attitude, perception, family support, availability of facilities, beliefs, attitude of healthcare workers, and motivation. These findings emphasise that psychosocial factors, environmental support, and individual motivation play a dominant role in the prevention of anaemia among prospective brides and grooms.

This study diverges from the findings of Osborn (2021), who reported no significant association between anaemia and factors such as family support, age, and education. The determinants of anaemia in women of reproductive age are primarily influenced by socioeconomic status, nutritional status, and the prevalence of infectious diseases.<sup>14</sup>

Anaemia is the most prevalent health issue affecting women of reproductive age, leading to weakness and reduced productivity in this population. During pregnancy, anaemia significantly increases the risk of maternal and infant mortality. A study conducted in Udupi District, Karnataka, revealed a notably high prevalence of anaemia in pregnant women. The incidence was particularly elevated among younger women, those with a lower socioeconomic status, those with a greater number of pregnancies, and those with shorter intervals between pregnancies.<sup>15</sup> Physiologically, anaemia most commonly caused by iron deficiency reduces the blood's capacity to transport oxygen, resulting in fatigue, weakened immune function, and an increased susceptibility to infections. In pregnant women, this condition is associated with serious adverse outcomes, including maternal mortality, preterm birth, low birth weight, and delays in child development. Even prior to pregnancy, anaemia in women can negatively affect their nutritional status and reproductive health. Therefore, these conditions highlight the importance of effective preconception interventions aimed at improving women's nutritional status and reducing the risk of anaemia before pregnancy occurs.<sup>16</sup>

Empirical evidence underscores the pivotal role of family involvement and support in mitigating anaemia in women of reproductive age. Prior research has demonstrated that interventions at the family and household levels can positively influence the nutritional status of mothers. Engaging in household food production initiatives has been associated with increased intake of nutritious foods, such as eggs, by mothers. Furthermore, communities engaged in analogous programs have reported a notable reduction in the prevalence of anaemia among mothers. These findings align with those of Kinyoki et al. (2021), who identified robust family support as a crucial factor in promoting consistent anaemia prevention practices.<sup>17</sup> These findings highlight the importance of implementing comprehensive health interventions aimed at improving maternal health and the well-being of future generations. Health policies that integrate iron supplementation programs, nutrition education, and high-quality antenatal care are strongly recommended as strategic approaches to reduce the prevalence of anaemia and to promote healthier and more resilient future generations.<sup>18</sup>

The multivariate analysis of this study identified variables with significant influence, specifically those that have a significant association and a high OR, namely motivation (OR 29.837), Exposure to Information (OR 5.358), and Family Support (OR 5.045). These variables are the most feasible for interventions. Diagnostic testing of these variables showed that the risk prediction model for anaemia in prospective brides and grooms had high accuracy, with an AUC of 86.6% (95% CI 79.9–93.4%;  $p < 0.05$ ). This model can distinguish between at-risk and not-at-risk categories for anaemia, with a sensitivity of 78.8% and a specificity of 76%.

Iron supplementation has been demonstrated to effectively prevent and reduce the prevalence of anaemia. The consumption of iron supplements facilitates the accumulation of iron reserves within the body, thereby interrupting the cycle of anaemia. Iron is an essential mineral required for the formation of red blood cells (hemoglobin). Additionally, this mineral serves as a crucial component in the formation of myoglobin (a protein responsible for oxygen transport to the brain), collagen (a protein present in bones, cartilage, and connective tissue), and various enzymes. Furthermore, iron plays a significant role in the immune system. Empirical research has also indicated that respondents' haemoglobin levels increased following the administration of nutrition education and Iron Supplement Tablets.<sup>19</sup>

Iron deficiency in mothers can have significant adverse effects on pregnancy and neonatal outcomes, including stillbirths, low birth weights, and elevated infant mortality rates. Anaemia during pregnancy is also acknowledged as a predictor of an increased risk of severe haemorrhage and is a major risk factor for maternal mortality. Women of reproductive age (15–49 years) are more vulnerable to iron deficiency and anaemia than men due to physiological changes such as menstruation (a pathway for blood loss), pregnancy (increased unmet nutritional needs), and haemorrhage during childbirth. Furthermore, inequitable food distribution within households can exacerbate this condition, as women often lack adequate access to iron-rich food.<sup>20</sup> The use of technology has proven to play an important role in improving nutritional literacy and preventing anaemia, with telemedicine having the greatest

impact, as it enables direct interaction with healthcare professionals. These findings affirm that technology-based nutrition education is essential for reducing the incidence of anaemia, even though most respondents were already in relatively ideal socio-demographic conditions.<sup>21</sup>

## Strengths and limitations

The limitation of this study is that the respondents were only drawn from a single small city in Indonesia, namely Bengkulu City, which may limit the generalizability of the findings to other regions. In addition, the AFRINA model is currently available only in the form of a web-based platform, as the mobile application version is still under review on the Google Play Store. Therefore, the implementation and testing of the model among respondents were conducted only through the website version.

Despite these limitations, this study has several strengths. First, it integrates a multisectoral approach involving collaboration between the health sector, the Ministry of Religious Affairs, and the Women's Empowerment Office in addressing anemia prevention among prospective brides. Second, the study combines epidemiological analysis with the development of a digital intervention model, allowing the determinants identified through statistical analysis to be directly translated into a practical program through the AFRINA platform. Third, the involvement of families in the intervention highlights the importance of social support systems in improving adherence to anemia prevention behaviors.

The findings of this study also have important implications for policy and practice. The results suggest that strengthening motivation and family support can play a significant role in improving anemia prevention behaviors among prospective brides. Therefore, integrating anemia screening, health education, and iron supplementation programs into premarital health services may be an effective strategy to reduce anemia prevalence among women of reproductive age. Furthermore, the AFRINA model can serve as a digital support tool for public health programs, enabling better monitoring, coordination, and delivery of anemia prevention interventions. These findings may inform

policymakers in developing integrated preconception health programs aimed at improving maternal and child health outcomes.

## Conclusion

Most brides-to-be were aged 21–30 years, highly educated, and employed; however, many still had poor attitudes, perceptions, motivation, and family support regarding anaemia prevention. Multivariate analysis showed that the most influential and modifiable factors were motivation, exposure to information, and family support. The AFRINA model has proven to have high accuracy (AUC 86.6%) in predicting the risk of anaemia, with a sensitivity of 78.8% and a specificity of 76%. The development of the AFRINA application presents an alternative solution that involves cross-ministerial collaboration to strengthen anaemia prevention among brides. The recommendation in this study is to expand the AFRINA model trial to various regions to produce more representative results and to develop an easily accessible mobile application so that interventions can reach more brides-to-be. In addition, strengthening health education, family involvement, and cross-sector collaboration must continue to enhance the effectiveness of anaemia prevention.

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## References

- Crielaard BJ, Lammers T, Rivella S. Targeting iron metabolism in drug discovery and delivery. *Nat Rev Drug Discov* [Internet]. 2017 Jun 3;16(6):400–23. Available from: <https://www.nature.com/articles/nrd.2016.248>
- Masfiah S, Ayu Maqfiroch AF, Rubai WL, Mars Wijayanti SP, Anandari D, Kurniawan A. Prevalence and Determinants of Anemia among Adolescent Girls: A School-Based Survey in Central Java, Indonesia. *Glob J Health Sci* [Internet]. 2021 Feb 15;13(3):37. Available from: <http://www.ccsenet.org/journal/index.php/gjhs/article/view/0/44611>
- Abu-Baker NN, Eyadat AM, Khamaiseh AM. The impact of nutrition education on knowledge, attitude, and practice regarding iron deficiency anemia among female adolescent students in Jordan. *Heliyon* [Internet]. 2021 Feb;7(2):e06348. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S2405844021004539>
- Milman N. Anemia still a major health problem in many parts of the world! *Ann Hematol* [Internet]. 2011 Apr 8;90(4):369–77. Available from: <http://link.springer.com/10.1007/s00277-010-1144-5>
- Mizawati A, Effendi N, Sulastri D, Sastra Purna R. Improving Anemia Prevention Behavior Through the Anemia-Free Integrated Network Approach (AFRINA) Among Prospective Brides in Bengkulu, Indonesi. *Nutr Clínica y Dietética Hosp* [Internet]. 2025 Dec 10;45(4). Available from: <https://revista.nutricion.org/index.php/ncdh/article/view/1160>
- Ministry of Health of the Republic of Indonesia. *Pocket Book for Planning a Healthy Pregnancy*. Jakarta: Ministry of Health of the Republic of Indonesia; 2018. p. 37.
- Ministry of Health of the Republic of Indonesia. *Basic Health Research (Riskesdas) 2018 Results*. Jakarta: Ministry of Health of the Republic of Indonesia; 2019. Vol. 53. p. 1689–1699.
- Bengkulu City Health Office. *Bengkulu City Health Profile 2020*. Bengkulu: Bengkulu City Health Office; 2021. p. 1–4.
- Fischer F, Lange K, Klose K, Greiner W, Kraemer A. Barriers and Strategies in Guideline Implementation—A Scoping Review. *Healthcare* [Internet]. 2016 Jun 29;4(3):36. Available from: <https://www.mdpi.com/2227-9032/4/3/36>
- Hossain MJ, Das M, Akter MM, Maruf MFI, Towhid ST. Safe Marriage for Thalassemia Prevention: The Gap Between Knowledge and Practices among Bangladeshi University Students [Internet]. 2023. Available from: <https://www.researchsquare.com/article/rs-3801245/v1>
- President of the Republic of Indonesia. Presidential Regulation No. 72 of 2021 on the Acceleration of Stunting Reduction. Jakarta: Government of Indonesia; 2021. p. 72.
- Aris Toening Winarni, Nova Munif I'tiskom. Inovasi Pelayanan (ELSIMIL) Pada Pelayanan Program Keluarga Berencana di Kecamatan Kradenan Kabupaten Grobogan. *Public Serv Gov J* [Internet]. 2023 Jul 18;4(2):150–66. Available from: <https://jurnal2.untagsmg.ac.id/index.php/psgj/article/view/942>
- Kaimudin, Marni. Analisis Profil Protein Ikan Dengan Metode SDS-PAGE. *Indones J Ind Res*. 2020;16(1):13–20.
- Osborn AJ, Muhammad GM, Ravishankar SL, Mathew AC. Prevalence and correlates of anemia among women in the reproductive age (15–49 years) in a rural area of Tamil Nadu: An exploratory study. *J Educ Health Promot* [Internet]. 2021 Sep;10(1). Available from: [https://journals.lww.com/10.4103/jehp.jehp\\_1526\\_20](https://journals.lww.com/10.4103/jehp.jehp_1526_20)
- Tashara IF, Achen RK, Quadras R, Valencia M, D'Souza, D'Souza PJJ. Knowledge and self-reported practices on prevention of iron deficiency anemia among women of reproductive age in rural area. *Int J Adv Sci Res*. 2015;1(7):289–92.
- Mizawati A, Effendi N, Sulastri D, Sastra Purna R. Developing an integrated model for anemia prevention in prospective brides: A qualitative exploration of multisectoral collaboration in Bengkulu city of Indonesia. *Clin Epidemiol Glob Heal* [Internet]. 2026 Jan;37:102252. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S2213398425003422>
- Owais A, Merritt C, Lee C, Bhutta ZA. Anemia among Women of Reproductive Age: An Overview of Global Burden, Trends, Determinants, and Drivers of Progress in Low- and Middle-Income Countries. *Nutrients* [Internet]. 2021 Aug 10;13(8):2745. Available from: <https://www.mdpi.com/2072-6643/13/8/2745>
- Mizawati A, Effendi N, Sulastri D, and Purna RS. Anemia-free strategies and antenatal care services in stunting prevention. *BKM Public Heal Community Med* [Internet]. 2024 Jul 30;e6806. Available from: <https://jurnal.ugm.ac.id/v3/BKM/article/view/6806>
- Aldriana, Nana. Determinan Pemberian Imunisasi Tt Catin Di Puskesmas Rambah Hilir I Tahun 2021. *Matern Neonatal J Kebidanan*. 2022;10(1):62–8.
- Kinyoki D, Osgood-Zimmerman AE, Bhattacharjee N V., Schaeffer LE, Lazzar-Atwood A, and Lu D. Anemia

- prevalence in women of reproductive age in low- and middle-income countries between 2000 and 2018. *Nat Med* [Internet]. 2021 Oct 12;27(10):1761–82. Available from: <https://www.nature.com/articles/s41591-021-01498-0>
21. Angrainy R. Hubungan Pengetahuan dengan Sikap Ibu Hamil dalam Pencegahan Anemia Pada Kehamilan Di Puskesmas Rumbai Bukit Tahun 2016. *J Endur* [Internet]. 2017 Feb 9;2(1):62. Available from: <http://ejournal.kopertis10.or.id/index.php/endurance/article/view/1654>.