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Prevalence of Iron deficiency anemia and associated risk factors among women of reproductive age attending Ruhengeri Referral Hospital

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Abstract
Iron deficiency anemia (IDA) is a major cause of anemia and is more prevalent in Rwanda, posing additional burden on health care systems. The high-risk group consists of females and children but comparatively it is higher in Women of reproductive age (WRA) due to physiological reasonsand has long-term consequences to health, social and economic developmentif not addressed.Iron deficiency anemia is a matter of concern as it causes fatigue, decreased motor abilities, impaired memory and can also cause delays in mental development in addition to this, in pregnancy can increase the risk of having a preterm delivery and preterm babies have other health concerns ranging from low birth weight and neural tube defects to death. The general objective for this study was to determine a prevalence of iron deficiency anemia and associated risk factors among women of reproductive age attending Ruhengeri referral hospital. This cross-sectional study was conducted and included 94 women of reproductive age for period of three months from October to December 2021 and those who met the selection criteria was asked to complete a self-administered questionnaire. The Sample was obtained by collecting venous blood and testing red blood cells indices and serum ferritin in both hematology and biochemistry services respectively. The results obtained were analyzed by statistical package of social science (SPSS) software version of 20. Variables with p value less than 0.05 were considered as statistically significant. Among 94 women of reproductive age participated in study, 25.5% were iron deficiency anemic, participants aged between 25-29 years, economic status (category D), women with malnutrition (underweight), women delay in menstruation period and women using Intrauterine device were found to have statistically significant association with p value of 0.047, 0.037, 0.017, 0.026 and 0.029 respectively. Government policy are recommended toemphasize programs aiming to improve nutrition and economic status of women.

Keywords: *Nutrition, Haemoglobin, Anaemia.*

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I. Introduction

Anemia is a condition in which the number of healthy red blood cells/ hemoglobin level (and consequently their oxygen-carrying capacity) is insufficient to meet the body's physiologic needs. Iron deficiency anemia is a common type of anemia a condition in which blood lacks adequate healthy red blood cells. Red blood cells carry oxygen to the body's tissues. As the name implies, iron deficiency anemia is due to insufficient iron. Without enough iron, your body can't produce enough of a substance in red blood cells that enables them to carry oxygen (hemoglobin). As a result, iron deficiency anemia may leave you tired and short of breath (Osungbade&Oladunjoye, 2012). Iron deficiency anemia affects more than 500 million women of reproductive age globally and it is a major public health challenge for low- and middle-income countries (LMICs) with a long-term negative effect on the health of women, their children, and the economic growth.

Anemia in women of reproductive age has a tremendous effect on the women such as; loss of productivity due to reduced work capacity, cognitive impairment, increased susceptibility to infections due to its effect in immunity, stillbirth/miscarriage, and maternal mortality. Besides, anemia in women of reproductive age can result in poor feto-neonatal outcomes such as preterm birth, low birth weight, depletion of the iron stores of the newborn, and in general, it may end up with infant/child mortality (Teshale*et al*, 2020).

Causes of anemia are multiple and complex, but iron deficiency (ID) is considered to be the major cause of anemia, especially among women of reproductive age due to limited intake of iron-rich foods along with poor bioavailability, and increased requirement associated with menstruation. While iron supplementation is widely practiced to control anemia, especially among women of reproductive age, the current evidence suggests that there has been a limited impact of iron supplementation, under the programmatic condition, on reducing the anemia in most of the developing countries. Therefore, identifying the underlying causes of anemia is crucial for developing an effective anemia control program. Among other factors that contribute to anemia include malaria, hookworm infestation, chronic infection, thalassemia and hemoglobinopathies, and other nutritional deficiencies such as folic acid, vitamin B_{12} and vitamin A (Horton & Ross, 2003). Globally, in 2011, the prevalence of anemia in pregnant women was 38% and in non-pregnant women was 29%. Even though anemia affects all countries, it mostly affects LMICs especially Asian and Sub-Saharan African countries which accounts for 89% of the anemia burden. In eastern Africa, the prevalence of anemia in women of reproductive age is higher, which ranges from 19.2% in Rwanda to 49% in Zambia. According to different studies done worldwide; age, educational level, occupation, marital status, wealth status, sex of household head, media exposure, body mass index, type of toilet facility and source of drinking water, parity, household size, modern contraceptive use, current pregnancy status, currently breastfeeding, residence, and menorrhagia are associated with anemia in women of reproductive age (Hakizimana*et al*., 2019).

II. Materials and methods

2.1. Study area

This research was conducted in Ruhengeri referral hospital which is located in Northern Province, Musanze district. Collection and testing of blood specimen was carried out on hospital premises on women of reproductive age in the hematology and biochemistry which met the relevant criteria related to the research topic of interest.

3.2. Study design

This cross-sectional study was performed from October to December 2021. The women of reproductive age, who were attending Ruhengeri referral hospital, were approached and requested to give a voluntary consent form to register in the study.

2.3. Study population

Women of reproductive aged between 15and 49 years who attended at Ruhengeri referral hospital was targeted by the study. However, only patients who was fulfilled inclusion criteria was selected for the study participation.

2.4. Sample size

Total populations of 94 women of reproductive age patients were involved in the research corresponding to sample size. The subject of the study was to collect blood samples from WRA and processed in both hematology and biochemistry services during the period of the study.

2.5. Inclusion and exclusion

All women of reproductive aged between 15 and 49 years who attended at Ruhengeri referral hospital fulfilling criteria was selected for study. The subjects who were male, had any sign of chronic diseases, had a surgery or blood loss from an accident, and who took iron tablets within 3 months preceding the data collection and women who were pregnant at 2-3 trimesters was excluded from the study.

2.6. Ethical consideration

The permission to conduct the research was granted by both Ruhengeri referral hospital and INES Ruhengeri ethical committees. Women of reproductive ages was informed about the study and its benefits. Patients who was eligible and who was voluntarily consent to participate was enrolled in the study. The right to privacy and confidentiality was respected. Collected data was assigned anonymous codes and data generated was solely used for the purpose of the study.

2.7. Sample collection and processing

Participants who met the selection criteria was asked to complete a self-administered questionnaire. Blood samples were collected in both EDTA tube and non EDTA tube for each participant and EDTA tubes were taken to hematology services for testing full blood account by using sysmex machine and samples that showed that had decreased red cells indices was considered as having anemia and non EDTA tube corresponded to that had anemia in biochemistry lab ware tested for serum ferritin by Abbott architect machine.

2.8. Statistical analysis

Data obtained was analyzed by using a Statistical Package for Social Science (SPSS) version 20. The significance was considered when the p-value was less than 0.05. And Microsoft excel was used for data presentation by finding frequency, percentage and establishment of tables which summarizing data from logistic regression.

III. Results

3.1. Results of descriptive analysis and iron deficiency anemia prevalence

Different characteristics were used to describe the study participants according to the anemiastatus. Study participants with iron deficiency anemia were described in general as well as the proportions of thosewho were not anemic or having anemia of other cause.

Table 1: prevalence of iron deficiency anemia

Participants	Frequency	Percent
Participants with IDA	24	25.5
Participant without IDA	70	74.5
Total	94	100.0

A total of 94 women were included in the analysis. As described in table 1, thegeneral prevalence of iron deficiency anemia among WRA was 24(25.5%) and most of those who are not iron deficiency anemic were 74(74.5%) as shown on chart below

Figure 1 shows prevalence of iron deficiency anemia among WRA attending Ruhengeri Referral Hospital

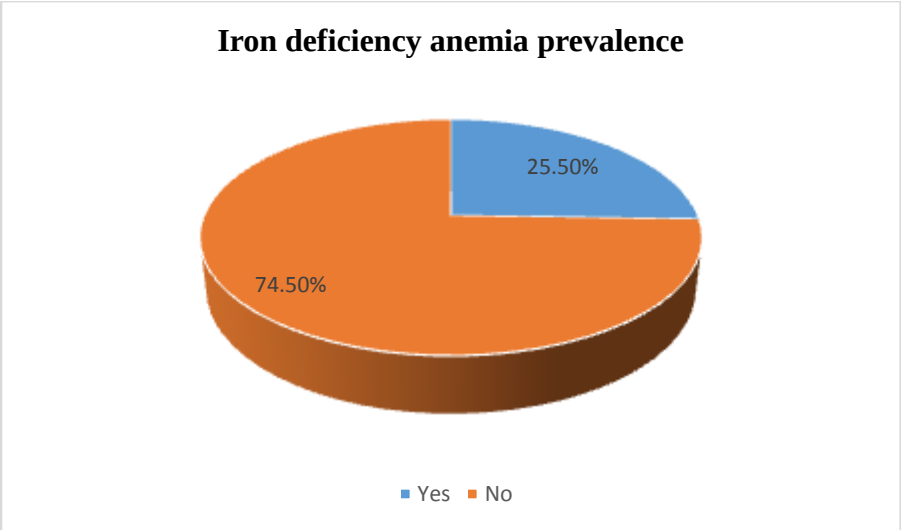

Figure 1: Prevalence iron deficiency anemia among WRA attending RRH.

Table 2: Socio demographic characteristics of respondents and anemia levels

Social demographics	**Frequencies (%)**	**Category of anemia identified in labs**		
age of participant		Iron deficiency anemia (Positive to ferritin) (%)	Anemia of other cause (negative to ferritin) (%).	Not anemic (%)
[15-19]	22(23.4)	9(37.5)	3(13.6)	10(20.8)
[20-24]	15(16.0)	3(12.5)	4 (18.2)	8(16.7)
[25-29]	24(25.5)	7 (29.2)	4(18.2)	13(27.1)
[30-34]	13(13.8)	2(8.3)	5(22.7)	6(12.5)
[35-39]	10(10.6)	1(4.2)	2(9.1)	7(14.5)

[40-44]	7(7.5)	2(8.3)	3(13.6)	2(4.2)
[45-49]	3(3.2)	0(0.0)	1(4.6)	2(4.2)
Type of place of residence				
Urban	39(41.5)	10(41.7)	8(36.4)	21(43.8)
Rural	55(58.5)	14(58.3)	14(63.6)	27 (56.2)
Educational attainment				
None	15(16.0)	4(16.7)	3(13.6)	8(16.6)
complete primary	29(30.9)	9(37.5)	8(36.3)	12(25)
complete secondary	46(48.9)	11(45.8)	9 (41)	26(54.2)
University	4(4.3)	0(0.0)	2(9.1)	2(4.2)
Wealth index/ economic status				
Category A	2(2.1)	0(0.0)	1(4.6)	1(2.1)
Category B	8(8.5)	0(0.0)	3(13.6)	5(10.4)
Category C	54(57.4)	18 (75)	11(50)	25(52)
Category D	26(27.7)	5(20.8)	6(27.2)	15(31.3)
Category E	4(4.3)	1(4.2)	1(4.6)	2(4.2)
Marital status				
Single	28(29.8)	9(37.5)	8(36.7)	11(22.9)
Married	57(60.6)	10(41.6)	13(59.1)	34(70.8)
Divorced	6(6.4)	4(16.7)	1(4.6)	1(2.1)
Widows	3(3.2)	1(4.2)	0(0.0)	2(4.2)

As shown in table 2, 22 (23.4%) of the study participants were aged 15-19 years old; 24(25.5%) were aged 25-29 and around 29(30.9%) did complete primary school and only 15(16%) had no education at all.Furthermore, 57 (60.6%) were married or living together with their husbands, and regarding theeconomic status, 54 (57.4%) and26 (27.7%) were Category C and Category D respectively.Regarding the IDA status, the proportion of anemia prevalence varies with age categories whereit varies between 37.5% and 29.2% in WRA aged from 15-19 years, up to those aged 25 – 29 years. The IDA prevalence is lower among old WRA where it is 4.2% and 0.0% in WRA aged 35-39 years and 45 – 49 years respectively. The proportions of general anemiaaccording to age categories follow that trend of variations between age groups. In addition to that, the table 2 also shows a slight variation of IDA prevalence among WRA according to the area of residence where the prevalence is higher in rural area at 58.3% comparedto the urban area where the prevalence is 41.7%.

Furthermore, IDA prevalence is higher among WRA with secondary education where the prevalence is 45.8%. The prevalenceis relatively low among those who are at university with the level of (0%). Besides that, IDA prevalence also varies with the wealth index of WRA where aprevalence of 20.8% is observed among the poor WRA and those considered as poorest with the prevalence of 23.8%. Moreover, the high prevalence of 75% was found among those considered as being middlecategory and there is no prevalence among the richer and richest. In general, the same trends of decrease with the increase of economic level is also observedaccording to different anemia levels. Regarding the marital status, IDA is more prevalent among those WRA who are married followed by those who are single with the prevalence of 41.6% and 37.5% respectively.

3.2. Association between risk factors and iron deficiency anemia

Table 3:Bivariate analysis for socio demographic characteristics factors

Demographics	IDA prevalence	Df	95% Confidence Interval		P value
Age in five years group			Lower Bound	Upper Bound	sig.
15-19	7(31.3)	1	-97417.004	97548.84	0.999
20-24	3(13.63)	1	-119379.148	120073.903	0.995
25-29	7(31.3)	1	-97176.952	97586.268	0.047
30-34	2(9.09)	1	-87968.217	88309.167	0.997
35-39	1(4.54)	1	-113220.007	114139.723	0.994
40-44	2(9.09)	1	-124080.781	123732.737	0.998
45-49	0(0.0)	0			
Type of place of residence					
urban	9(23.68)	1	-3627.087	3862.528	0.995
rural	12(21.42)	1			
Educational attainment					
none	3(20.0)	1	-54546.495	54752.032	0.997
complete primary	8(27.58)	1	-28226.129	28512.298	0.992
complete secondary	10(21.73)	1	-87957.651	87799.161	0.999
university	0(0.0)	0			
Wealth index/ exonomic status					
Category A	0(0.0)	1	-106099.56	105782.237	0.998
Category B	0(0.0)	1	-111930.526	113009.721	0.992
Category C	14(25.92)	1	-21230.055	21021.235	0.992
Category D	5(19.2)	1	-71903.195	67201.318	0.037
Category E	1(50.0)	0			
Martial status					
single	9(32.14)	1	-49494.248	48832.396	0.989
married	9(15.8)	1	-51071.325	50508.568	0.991
divorced	2(66.67)	1	-59007.99	57477.186	0.979
widows	1(16.67)	0			

A shown in table 3, the bivariate analysis showed that age category of 25 – 29 years was associated with Iron deficiency anemia with p value: 0.047 compared to 15-19 years old category and when compared wealth index levels to poorest, wealth index was also associated with anemia withp value :0.037 for poorer (category D). Moreover, education attainment in WRA was also not associated to the anemia, wherethose completing primary school (p value: 0.992), completing secondary school (p value: 0.999) and not educated was (p value: 0.997) were not associated to anemia in WRAcompared to those with no education.Moreover,marriage status was also among the independent variables which were not significantly associated withanemia with p value of 0.991 for separated andWRA who are single was 0. 989.Furthermore, type of residence was not associated with dependent variable where their p value was 0.995 for urban in bivariate analysis.

Table 4*:*Associated risk factors of iron deficiency anemia among women of reproductive age.

Risk factors	**Frequency (%)**	**IDA frequency (%)**	**Chi-Square(X^2)**	**Df**	**P value**
current pregnant			1.176	1	0.278
Yes	7(7.4)	3(42.86)			

No or unsure	87(92.6)	4(20.68)			
Number of children ever born					
had no children	32(34)	10(31.25	0.023	1	0.991
1-3 children	48(51.1)	8(16.67)			
4-6 children	14(14.9)	3(21.42)			
Body mass index					
Underweight:>18.5	13(13.8)	5(38.46)	7.221	1	0.0117
Normal :18.5-24.99	69(73.4)	15(21.73)			
Overweight:24.99-<30	12(12.8)	1(8.3)			
Currently breastfeeding					
Yes	19(20.2)	3(15.8)	0.219	1	0.64
No	75(79.8)	18(24)			
Vegetarians					
Yes	13(13.8)	3(23.07)	3.130	1	0.077
No	81(86.2)	18(22.2)			
WRA slept under mosquito bed net					
Yes	49(52.1)	12(24.5)	0.002	1	0.969
No	45((47.9)	9(20)			
delays in menstruation period					
4days	14(14.9)	1(7.14)	5.130	1	0.029
5days	42(44.7)	7(16.7)			
6days	16(17)	5(31.25)			
7days	19(20.2)	6(31.6)			
more than 7days	3(3.2)	2(66.7)			
Had ever treated for anemia					
Yes	31(33)	6(19.35)	0.021	1	0.886
No	46(48.9)	12(26.08)			
Don't know	17(18.1)	3(17.64)			
Family history for bleeding disorder					
Yes	7(7.4)	2(28.6)	0.125	1	0.723
No	17(18.1)	3(17.64)			
Don't know	70(74.5)	16(22.85)			
WRA had vaginal bleeding					
Yes	64(68.1)	16(25)	0.111	1	0.739
No	30(31.9)	5(16.7)			
Use of contraceptive methods					
None or Natural	18(19.1)	4(2.2)	7.533	1	0.045
Injection contraceptive	27(28.7)	10(37.03)			
Contraceptive implant	12(12.8)	1(8.3)			
Oral contraceptive	11(11.7)	2(18.2)			
IUD	5(5.3)	3(60)			
Emergency pills	21(22.3)	3(14.3)			
Given or bought iron during last pregnancy					

Not given or bought	31(33)	7(22.6)	1.121	1	0.123
Given or bought iron	27(28.7)	10(37.03)			
No birth/birth in >5 years	36(38.3)	11(28.9)			
Use of malaria drug during last pregnancy					
No malaria drug	53(56.4)	12(22.64)	0.122	1	0.372

In addition to the social demographic characteristics which were statistically significantly for some variables,Body mass index was also significantly associatedto iron deficiency anemia (p value 0.0177 for underweight >18.5) but other variables under health status factors of women of reproductive ages were not significantly (p value >0.05 for all variables). In this table 4 only women whom their days of period last for 7 days per period were significantly with iron deficiency anemia with p value of 0.029, moreover sleeping under mosquito bed net, history of treated with anemia and having disorders of vaginal bleeding was not associated with iron deficiency anemia with p value > 0.05 in bivariateanalysis. As shown in table 4 above, the use of Intra uterine device as contraceptive method for family planning methods was only one found to be associated with iron deficiency anemia with p value of 0.045 compared to those who were usingany, had vaginal bleeding, current pregnant and breastfeeding which were not associated with iron deficiency anemia with p value >0.05. Moreover, having taken malaria drug or iron during the last pregnancy or who did not, was not found to be associated with iron deficiency anemia in WRA with p value >0.05.

IV. Discussion

This cross-sectional study was able to identify prevalence andthe risk factors of iron deficiency anemia among WRA attending Ruhengeri referral hospital**.** The study included all WRA who participated in the study and who had the hemoglobin and serum ferritinresults with anemia levels results and the risks factors that have been identified to be influencing iron deficiency anemia in WRA in other settings were compared to those found in this study. The study findings showed that IDA in WRA is increasing over time in Ruhengeri referral hospital. This pattern is different to other hospitals where there hasbeen a reduction of IDA in WRA over the past years. Moreover, IDA was more prevalentamong young women (25-29), as well as in pregnant women compared to those who were not pregnant. Thisis in line with other studies which found a high prevalence of IDA on those groups (Stephen *et al*., 2018).

Besides that, the IDA prevalence was higher and also almost the same among WRA with noeducation and those who complete primary as well as among those with secondary.However, that difference has not been statistically significant and thus education level has not beenfound to be a risk factor of anemia among WRA in this study. Such findings aredifferent to the other studies which found that education level was associated to the iron deficiency anemia. Studiesconducted in Tanzania and in Ethiopia by Stephen *et al*. (2018). concluded that women with poor education had a higherrisk of being anemic compared to those with improved education .An explanation of suchdifferences is being the fact that there's a relation between education and wealth status and thus,those with primary education may have an improved economic status and thus reduce the risk of iron deficiency anemia (Gebremedhin &Enquselassie, 2011).In addition to that, although the use of health related services was considered to be among the factorsinfluencing anemia in WRA as well as having given or bought iron in other studies, our study did not find them as risk factors of anemia in Ruhengeri hospital; this may be explained by the fact thatalthough 80% of women take iron tablets or syrup during pregnancy, only 3% take it forthe recommended period of 90 days which reduce the iron effect. Gebre*et al*. (2015)demonstratedthat daily iron intervention provides more protection against a decline in the storage iron pool inpregnant women than does an intermittent schedule. Additionally, such questions in DHS are asked to women who had birth during their last 5 yearsand thus, taking iron over the past years may not still has effect to the actual IDA status becausethe iron supplementation requires continuous effect and the DHS don't specify when the ironwere taken. On the other hand, as it is well known that pregnant women have a high risk of anemiaand iron is provided to pregnant women who attend antenatal care. Thus, having taken ironmay offer a protective effect to anemia and thus reduce that increased risk with effect of not beingfound as risk factor(Hakizimana*et al.*, 2019).

4.1. Risk factors of iron deficiency anemia among women of reproductive age

The study found that factors of being poor (economic status), use of hormonal or IUD as contraceptive method, nutritionstatus of the women, as well as delaying in menstruation periods were associatedwith iron deficiency anemia among WRA attending Ruhengeri referral hospital. Wealth index in WRA was found to be a significant factor associated to iron deficiency anemia among WRA attending RRH where the risks are reduced

the more the economic status is increased. Such findings arenot different from those found in other settings (Hakizimana*et al*., 2019). IDA is a multifactor problem, andwealth index status also is associated with different factors that may impact anemia directly orindirectly. Evidences shows that improved economic status is associated with improved hygieneand low infection morbidity rate, improved access to information, education and to health servicesas well as to the fact of having the facilities likes good toilet.All those factors have been found to be associated with anemia in other studies unless they werenot associated with IDA in WRA in our study. Thus, WRA with improved economic status havelower risks of IDA as they are able to use available preventive measures compared to those whoare poor. For example, people with lowest economic status have also low access in termsofpossession of mosquito net where only 53% of people with low economic status have access to anITN in the household in Rwanda. As malaria is known to be among the risk factors of anemia,this also increase their risks of having IDA (Mantadakis*et al*, 2020). Besides that, the use of hormonal contraceptives has been found to be reducing the risk of iron deficiency anemia among WRA compared to those who are not using any method or those using natural methods. Such findings are similar with those found in similar studies conducted in Rwanda and in other settings by Hakizimana*et al.* (2019). Amenorrhea is one the common side effect of hormonal contraceptives where a woman may even pass a long time without having her period. Thus, this reduces the risk of anemia as there will be no blood loss over that period and thus the hemoglobin level will be stable. However, more investigations are still needed to understandthe real physiological mechanisms (Clark, 2018).

A part from that, present study found that women using IUD have a greater risk of iron deficiency anemia compared to those who are not using any method or those using natural, or permanent methods. Those findings are similar to those of the study conducted by Hakizimanaet *al*. (2019) but those studies about significant difference of anemia risk among those using IUD compared to others non-users recommended also further investigations. Although such non-conclusive findings, some reasons may be the fact that women using IUD have extended time of their periods as well as the quantity of blood during their periods especially during the first months of stating using it which impact their hemoglobin level (Monjok*et al*., 2010). Thus, with such increased needs in hemoglobin replacement, when associated with other factors, the risk may increase. Additionally, there has been also an increase in IUD use among women in Rwanda over the past years from 0.2% in 2010 to 0.7% in 2015 (Hakizimana*et al*., 2019).Furthermore, present study shows that nutritional status of women of reproductive age was found to be a risk factor of iron deficiency anemia and those findingsare similar to the study conducted by Rakic*et al*. (2013) amongSerbian non-pregnant women, BMI was found to be associated with iron deficiency anemia .This may be due to the fact that anemiaitself is one form of malnutrition and the most common cause is the iron deficiency which in mostof the case associated with other types of malnutrition. Thus, women who are underweightedhave a greater risk of iron deficiency, infections which have been found to be increasing iron deficiency anemiarisks. Thus, those with normal nutrition status have lower risks of having anemia as it's forthe obese WRA as their nutrition status is improved and thus have lower risks of having nutritiondeficiencies including iron deficiency unless obesity is associated with health conditions like noncommunicable diseases where studies have found that IDA risk is increased. However, present study found that there was no difference of IDA risks between those overweighed WRA andnormal weighted.

V. Conclusion and Recommendations

Referring to our hypothesis, they are variations of iron deficiency anemia factors like delaying in menstruation period (seven days and more) have a higher risk of iron deficiency anemia, our study confirmed that the hypothesis that the iron deficiency anemia among women of reproductive age attending Ruhengeri referral hospital is associated with economic status, the nutrition status of the WRA, the wealth index and as the more the economic status improves, the more the risk of anemia reduces. Additionally, type of contraceptive used by WRA is associated with anemia; the used IUD as contraceptive method increases the risk of IDA while the use of hormonal contraceptives reduces the risk. Besides that, nutrition status of WRA is an important risk factor, WRA with normal BMI and obese have a reduced risk of IDA compared to the underweighted by increasing diet rich in iron may reduce the risk.Sustained effort for supplementation of iron for women with menorrhagia and IUD users. Different opportunities should be used to improve iron supplementation for WRA.For example, as 99% of Rwandan mothers received antenatal care, Rwandan mothers attending antenatal care should be counselled to iron supplementation and nutrition subjects in general during their IEC sessions.Iron supplementation services could also be decentralized to the community and be provided by the community health workers (CHWs).Government policy are recommended tocontinue to empower women economically through income generating activities to be able to meet challenges of anemia whose solution requires purchases of food supplements. Apart from that this study doesn't make an exception of having limitations same study have to be conducted on many samples size and in different hospitals across a country and I recommend them to use more test like serum iron, TIBC which were not used due to financial problems.

Data availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflict of interest

The authors declare that they have no conflicts of interest.

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