

Determinants of Iron Deficiency Anemia among Non-Pregnant Women of Reproductive Age in Malawi: A Cross Sectional Study

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ABSTRACT

In Malawi, the prevalence of Iron Deficiency Anemia (IDA) amongst ladies of reproductive age is 8%. There's lack of up-to-date information on factors associated with IDA among ladies of reproductive age in Malawi. This go sectional have a look at aimed at identifying up to daters which might be up-to-date IDA amongst non-pregnant ladies of reproductive age in Malawi the usage of secondary statistics from the Malawi Micronutrient Survey, a sub examine of the Malawi Demographic and fitness Survey, 2015-16. Up-to-date of 751 non-pregnant girls' elderly 15-49 years were protected in the final analysis. Univariate and multivariate logistic regression evaluation have been carried updated the information. The have a look at observed IDA incidence of 7.19% and become statistically up to date age of the female, sort of house (rural/city), contraceptive use, BMI and region. Within the multi-variate evaluation, age (40-49) years (OR=4.37, CI=1.72-11.09) turned inupupdated substantially up to date expanded odds of IDA whilst rural residence (OR=0.29, CI=0.14-0.57), and the usage of injectable contraceptives (OR=0.18, CI=0.05-0.64) showed a defensive impact up-to-date IDA. There's a need up to date scale up circle of relatives making plans services specifically use of injectable contraceptives. Girls residing in urban areas should updated be endorsed up-to-date eat food rich in iron. Fitness training on nutrients and nutritional change up to date be fostered.

Keywords: Iron deficiency anemia; Anemia; Non-pregnant women; Determinants; Reproductive

INTRODUCTION

Anemia is defined as a condition in which the concentration of hemoglobin is lower than normal resulting in reduced oxygen carrying capacity required to meet physiologic needs of the body ^[1]. A non-pregnant and pregnant woman is considered anemic if hemoglobin levels are lower than 12 g/dl and 11 g/dl respectively ^[2]. It is estimated that about half a billion of women of reproductive age are anemic worldwide ^[3]. Recent estimates from the World Health Organization (WHO) show that, globally, the burden of anemia has increased between 2011 and 2016, from 30% to 33% ^[4]. In Malawi, it is reported that 33% of non-pregnant women of reproductive age are anemic and the problem is more prevalent among women living in urban areas than those living in rural areas ^[5].

Iron Deficiency (ID), is the most frequent cause of anemia ^[6] contributing half of all anemia cases globally ^[7]. Iron Deficiency Anemia (IDA) negatively affects maternal health and wellbeing and is mostly associated with adverse reproductive health outcomes ^[8] such as decreased appetite, poor motor and sensory system functioning, delay in cognitive and physical development resulting in decreased work capacity of individuals thereby affecting development of the country ^[9,10].

According to the Malawi demographic and health survey (2015-16), there is a variation in the prevalence of anemia by maternity status. The report shows that 45% of pregnant women are anemic compared to 30% who are breastfeeding and 33% who are neither pregnant nor breastfeeding ^[5]. It is common to have reduced levels of hemoglobin among pregnant women due to the physiological changes associated with pregnancy. This is evidenced by the 45% prevalence of anemia as reported in the MDHS 2015-16 ^[5]. It is however surprising to note that women who were neither pregnant nor breastfeeding had anemia prevalence of 33%. Thus, there could be other factors influencing IDA status among non-pregnant women. This cross sectional study therefore, aimed at identifying potential risk factors of IDA among non-pregnant women of reproductive age in Malawi using secondary data from the MDHS and the Malawi Micronutrient Survey (MNS) undertaken in 2015-16.

MATERIALS AND METHODS

Study population

The study used MDHS and MNS 2015-16 data sets which have information on non-pregnant women of reproductive age between 15-49 years old. Using these data sets gave the researcher an opportunity to collect information on prevalence and predictors of IDA among non-pregnant women of reproductive age in Malawi.

Inclusion criteria

In this study, only women of reproductive age (15-49 years) who were not pregnant at a time the MDHS and MNS were conducted took part.

Exclusion criteria

Women who were pregnant at the time the MDHS and MNS were conducted were not considered for the study. In addition, girls who had not reached menarche and post menopause women were not part of the study.

Study sample size and sampling strategy

The study used a sample size that was used in the Malawi MNS of 2015-16 which was selected as a subsample of the MDHS to produce estimates for key indicators for Malawi as well as result stratified by region (north, central, south) and residence (urban, rural). The 2015-16 MDHS adopted a cross-sectional approach, employing a two-staged sampling design to derive estimates for national key indicators. In the initial stage, clusters were chosen with the probability proportional to their population size. The subsequent phase involved an updated household listing within each cluster. Thirty households per urban cluster and thirty-three households per rural cluster were consistently selected through systematic sampling from newly created household listings. The 2015-16 MDHS encompasses a total of 850 clusters, comprising 27,531 participating households. The 2015-16 MNS, a subset of the MDHS, aimed to finish key indicator estimates at both national and stratified regional levels. Randomly, 105 clusters were chosen from 850 MDHS clusters for the MNS.

For IDA, the Malawi MNS had a pattern size of 751 non-pregnant women of reproductive age drawn from 2114 households. At a self-assurance diploma of 95%, a electricity of 96% turn out to be used to encounter any unique minimal variations amongst proportions. The Malawi MNS is based on the countrywide representative pattern presenting reliable estimates for the country's population with a reaction rate of 90%.

Data collection

After obtaining informed consent from survey participants, research assistants collected data for the 2015-16 MDHS using four questionnaires namely; The household questionnaire, the woman's questionnaire, the man's questionnaire and the biomarker questionnaire. The MDHS teams collected survey data using tablet computers whereas the MNS teams used a paper questionnaire pre-translated in Chichewa, Tumbuka or English. The woman's questionnaire collected information from all eligible women aged 15-49 that captured different variables.

Study variables and measurements

In this study, IDA status for non-pregnant women of reproductive age was the main outcome variable. In the MNS, serum ferritin concentrations were measured to establish iron deficiency because it has the highest sensitivity and specificity for the detection of iron deficiency. Thus, IDA is defined as those with inflammation-corrected iron deficiency plus anemia (hemoglobin <12 g/dl).

The independent variables for the analysis were age, level of education, residence, region, wealth quintile, Body Mass Index (BMI), Cigarette smoking, contraception and parity. The specific categories of each independent variable are described in Table 1. For example, place of residence was categorized into rural and urban, socioeconomic status which was ascertained by computing the wealth quintile (from being poorest to richest) considering the number and kinds of consumable goods owned ranging from a television to a bicycle or car and housing characteristics such as source of drinking water, toilet facilities and flooring materials were assessed using the standard demographic and health survey tool. BMI calculated using height and weight of the woman was categorized as less than 18.5 kg/m² underweight, 18.5 to 24.9 Kg/m² normal weight, 25 to 29.9 Kg/m² overweight, and at least 30 Kg/m² obesity. Other explanatory variables assessed were number of children ever born to the woman, current method of contraception and whether they smoke cigarette or not in addition to ascertaining their level of education assessed by completed years of education.

Data management and analysis

The study merged the MDHS and MNS 2015-16 data files with an aim of using more detailed household and woman information available in the MDHS for each individual woman in the MNS sample. The datasets contain current information on prevalence and predictors of anemia and IDA among non-pregnant women of reproductive age in Malawi.

Merging the MDHS and MNS data files

As already stated, the study used variables from the MDHS and MNS hence the need to merge the two data files. Specifically, level of education, parity, contraceptive use and smoking were generated from the MDHS data set whereas age, residence, wealth quintile, region and BMI were generated from the MNS data set. These explanatory variables were quantitatively assessed to measure their significance in prevalence of iron-deficiency in non-pregnant women of reproductive age in Malawi.

The merging process aimed at having one data file, MNS-Woman data file (WRA.DTA) that contained all relevant variables that are in MDHS. Again, new variables were generated from the MNS woman dataset (WRA.DTA) using clonevar. It was ideal to use clonevar because it has the ability to generate new variables as an exact copy of an existing variable, varname, having the same storage type, values and display format as varname. In this way, varname's variable label, value labels, notes, and characteristics were also copied. In addition, to merge Household data file from DHS (HR.DTA) with MNS-Woman data file (WRA), new variables from cluster number (mcluster) and household number (mnumber) were generated. The final data file was used to carry out the analysis of the study as it contains all the required variables for this research study. However, there was a slight difference on IDA rates between what is in the MNS final report and what was found in our analysis. This was attributed to the difference in weights that were used in generating figures in the final MNS report.

Weighting

The household weight is described as a relative measure. As such, multiplying the design selection probability by the household weight would not result in any difference in the final weight or survey indicators; hence estimates are representative at the subgroup level using household weights.

Again, household weights were used for any further analysis in this study in order to ensure the survey results are representative at national and regional levels. It should also be mentioned that individual weights were calculated since fixed sampling fractions were used in selecting women within households. In addition, to generate indicators using household weights in MNS data, weights were divided by 1,000,000 as per DHS requirement. This was accomplished by

creating a new variable in the WRA data set, using $\text{gen weight} = \text{mweight}/1000000$.

Data were analyzed using statistical software (Stata version 14). Descriptive statistical information for each independent variable was presented in a univariate table. To test for association between IDA and the independent variables, a *Chi square* test was performed setting a significance level at $P < 0.05$. Independent variables with P-values of less than 0.05 in the bivariate analysis were considered statistically significant and entered into the final logistic regression model to further analyze their statistical significance.

Considering the minimal margin of the p-values of residence (0.089) and contraceptive use (0.059), a likelihood ratio test was employed in order to check their influence on the logistic regression model. In this likelihood ratio test, three variables namely age, residence and contraceptive use were tested. The results showed that p-values of age (< 0.00), residence (0.001), and contraceptive use (0.044) were statistically significant.

In the multivariate analysis, a generalized linear model was considered following the outcome of the bivariate analysis. With IDA as a binary outcome, a logistic regression model of five independent variables was fitted using the backward elimination method. A diagnostic test of coefficients for regressors at every stage was conducted and non-significant variables were eventually dropped in the next model.

RESULTS

A complete of 287 (38%) women had been between the a long time of 20 to 29 years, 509 (68%) had number one as their highest degree of education, 683 (91%) have been from rural regions, 346 (46%) women were from southern location and 185 (25%) had been from rich households. moreover, 571 (76%) had every day BMI, 728 (97%) girls had been non-smokers, 327(44%) women had in no way used any contraceptive method and 181 (24%) women had a parity of 2-three children. The baseline traits are summarized in Table 1.

Table 1. Characteristics of non-pregnant women of reproductive age.

	Weighted		
	Iron deficiency anemia		
Independent variable	Yes	No	Total
Age			
15-19	6 (4.16%)	146 (95.84%)	152 (20.24%)
20-29	14 (5.01%)	273 (94.99%)	287 (38.22%)
30-39	8 (4.5%)	175 (95.5%)	183 (24.37%)
40-49	14 (10.97%)	115 (89.03%)	129 (17.17%)
Education			
Pre-school	7 (8.14%)	80 (91.86%)	87 (11.58%)
Primary	24 (4.66%)	485 (95.34%)	509 (67.78%)
Secondary	10 (7.43%)	133 (92.57%)	143 (19.04%)
Higher	2 (14.37%)	10 (85.63%)	12 (1.60%)
Residence			
Urban	8 (10.41%)	61 (89.59%)	68 (9.05%)
Rural	36 (5.27%)	647 (94.73)	683 (90.95%)
Region			
North	9 (10.44%)	79 (89.56 %)	88 (11.72%)
Central	10 (3.22%)	307 (96.78%)	317 (42.21%)
South	24 (6.84%)	322 (93.16%)	346 (46.07%)
Wealth quintile			
Poorest	4 (2.56%)	166 (97.44%)	170 (22.64%)
Poorer	9 (5.99%)	139 (94.01%)	148 (19.71%)

Middle	7 (4.75%)	142 (95.25%)	149 (19.84%)
Richer	13 (7.21%)	172 (92.79%)	185 (24.63%)
Richest	10 (9.56%)	89 (90.44%)	99 (13.18%)
BMI			
Underweight	9 (12.99%)	63 (87.01%)	72 (9.59%)
Normal	28 (4.8%)	543 (95.2%)	571 (76.03%)
Overweight	6 (8.24%)	71 (91.76%)	77 (10.25%)
Obese	0	31 (100%)	31 (4.13%)
Smoke cigarette			
Yes	1 (3.57%)	22 (96.43%)	23 (3.06%)
No	42 (5.8%)	686 (94.2%)	728 (96.94%)
Contraceptive use			
Not using	28 (8.52%)	299 (91.48%)	327 (43.54%)
Injections	3 (1.55%)	170 (98.45%)	173 (23.04%)
Male condoms	2 (8.59%)	24 (91.41%)	26 (3.46%)
Female sterilization	5 (5.67%)	80 (94.33%)	85 (11.32%)
Implant/Norplant	3 (3.52%)	81 (96.48%)	84 (11.18%)
Other	3 (4.51%)	53 (95.49%)	56 (7.46%)
Parity			
0	9 (5.7%)	152 (94.3%)	161 (21.44%)
1	6 (5.92%)	100 (94.08%)	106 (14.11%)
2-3	7 (4.07%)	174 (95.93%)	181 (24.10%)
4-5	8 (4.78%)	157 (95.22%)	165 (21.97%)
6+	12 (8.97%)	126 (91.03%)	138 (18.38%)

Prevalence of IDA among non-pregnant women

In this survey, 54(7.19%) of non-pregnant women of reproductive age (15-49 years) had IDA and 697 (92.81) did not have IDA. Age of a woman, place of residence (urban/rural), region, BMI and current contraceptive methods used were statistically associated with IDA among non- pregnant women aged 15 to 49 (Table 2).

Table 2. Bivariate analysis of factors associated with iron deficiency anaemia (n=751).

Independent variable	IDA	No IDA	P-value (<i>Chi square</i>)
Age			
15-19	6.32 (4.16%)	145.56 (95.84)	0.04
20-29	14.38 (5.01%)	273.03 (94.99%)	
30-39	8.21 (4.5%)	174.43 (95.5%)	
40-49	14.15 (10.97)	114.89 (89.03%)	
Education			
Pre-school	7.08 (8.14%)	79.85 (91.86%)	0.147
Primary	23.74 (4.66%)	485.74 (95.34%)	
Secondary	10.65 (7.43%)	132.75 (92.57%)	
Higher	1.61 (14.37%)	9.59 (85.63%)	
Residence			
Urban	7.09 (10.41%)	61.09 (89.59%)	0.089

Rural	35.98 (5.27%)	646.83 (94.73)	
Region			
North	9.23 (10.44%)	79.16 (89.56 %)	0.017
Central	10.22 (3.22%)	306.83 (96.78%)	
South	23.62 (6.84%)	321.94 (93.16%)	
Wealth quintile			
Poorest	4.36 (2.56%)	165.83 (97.44%)	0.148
Poorer	8.86 (5.99%)	139.01 (94.01%)	
Middle	7.09 (4.75%)	142.26 (95.25%)	
Richer	13.34 (7.21%)	171.67 (92.79%)	
Richest	9.42 (9.56%)	89.16 (90.44%)	
BMI			
Underweight	9.36 (12.99%)	62.67 (87.01%)	0.02
Normal	27.37 (4.8%)	543.14 (95.2%)	
Overweight	6.35 (8.24%)	70.76 (91.76%)	
Obese	0	31.36 (100%)	
Smoke cigarette			
Yes	0.82 (3.57%)	22.03 (96.43%)	0.773
No	42.26 (5.8%)	685.90 (94.2%)	
Contraceptive use			
Not using	27.86 (8.52%)	298.97 (91.48%)	0.059
Injections	2.68 (1.55%)	170.35 (98.45%)	
Male condoms	2.24 (8.59%)	23.82 (91.41%)	
Female sterilization	4.83 (5.67%)	80.35 (94.33%)	
Implant/Norplant	2.95 (3.52%)	80.95 (96.48%)	
Other	2.52 (4.51%)	53.49 (95.49%)	
Parity			
0	9.21 (5.7%)	152.40 (94.3%)	0.44
1	6.26 (5.92%)	99.56 (94.08%)	
2-3	7.36 (4.07%)	173.40 (95.93%)	
4-5	7.90 (4.78%)	157.24 (95.22%)	
6+	12.35 (8.97%)	125.32 (91.03%)	

Multivariate analysis

A binary logistic regression model was equipped such as variables considerable in the bivariate analysis. The outcomes are shown in Table 3.

Table 3. Final logistic regression model.

Independent variable	Odds ratio	P>z (95% Confidence interval)	Overall P-value
Age			
15-19*			0.002
20-29	1.55	0.34 (0.62, 3.87)	
30-39	1.63	0.32 (0.61, 4.31)	
40-49	4.37	0.002 (1.72, 11.09)	

Residence			
Urban*			<0.001
Rural	0.29	0 (0.14, 0.57)	
Region			
North*			0.228
Central	0.69	0.37 (0.30, 1.56)	
South	1.47	0.26 (0.73, 2.95)	
BMI			
Underweight*			0.032
Normal	0.52	0.13 (0.22, 1.23)	
Overweight	0.48	0.18 (0.16, 1.40)	
Obese	1		
Contraceptive use			
Not using*			0.751
Injections	0.18	0.008 (0.05, 0.64)	
Male condoms	0.31	0.27 (0.03, 2.45)	
Female sterilization	1.04	0.91 (0.43, 2.49)	
Implant/Norplant	0.38	0.14 (0.11, 1.36)	
Other	0.61	0.451 (0.17,2.18)	

The odds of IDA for a mother aged 20 to 29 years were 1.6 times as high as the odds of mothers aged 15 to 19 years being iron deficiency anemic. This category is not statistically significant on the outcome variable (p-value 0.34). The odds of IDA for a woman aged 40-49 is 4.37 times as high as the odds of mothers aged 15 to 19 years being anemic. This category is statistically significant on the outcome variable (p-value 0.002). The true population effect for the two categories is 0.62 to 3.87 and 1.72 to 11.09 respectively. Furthermore, the overall effect of age of the woman on IDA is significant (p-value 0.002).

The odds of IDA of a rural woman are 0.29 times as high as the odds of IDA in an urban woman. The true population effect lies between 0.14 and 0.57. The overall effect of type of residence is also significant on the outcome variable (<0.001). BMI in general was significant on the outcome variable. The odds of IDA for a woman who was overweight were 0.48 times the odds of IDA for an underweight woman. This category is not statistically significant on IDA (0.18). Nevertheless, the overall effect of BMI is significant on the outcome variable (0.032). The odds of IDA for a woman who is using injections were 0.18 times the odds of IDA for a woman who is not using any method. The true population effect lies in between 0.05 to 0.64. On the other hand, the odds of IDA for a mother who is using Norplant were 0.38 times as high as the odds of IDA for a woman who is not using any method. The true population effect lies in between 0.1 and 1.3.

DISCUSSION

The study showed a 7.19% weighted prevalence of IDA among non-pregnant women of reproductive age in Malawi. Furthermore, the study has revealed that advancement in age increases the chances of IDA among women of reproductive age. IDA is less prevalent in women who live in rural areas and in those who use injectable contraceptives. The prevalence of IDA in our study is similar to the findings from a study conducted in Ethiopia (5.0%), but lower than that reported in studies conducted in Gambia (28.0%), Thailand (13.2%) and Saudi Arabia (41.6%).

The odds of having IDA increased with woman's age and most prominent in women aged 40-49 years. This finding is consistent with the results from studies conducted in Bangladesh and Darkar city which found women's age to be an important determinant of anemia with older women more likely to experience anemia. Similarly, in Myanmar, women aged 40 years and above had higher odds of anemia. The possible explanation to this trend could be that such women might have more of their lifetime births by this age group. Again, it could probably be explained in terms of cumulative obstetric conditions and pregnancy related exhaustion, including maternal workload. However, few studies have demonstrated higher distribution of IDA in age groups less than 30 years which is in contrast to the current finding. For example, in Quetta,

Pakistan, 15% of ID affected women were in the age group of 15-19.

Women residing in rural areas had less chances of developing IDA as compared to their counterparts from urban areas. This finding is supported by a cross sectional survey conducted in Malawi which showed that the odds of IDA was high among urban residents and a similar study in Tanzania demonstrated that residing in rural areas was associated with significantly reduced risk of anemia. IDA may be less prevalent in rural women owing to the better access to a variety of locally available nutritious food rich in iron such as green leafy vegetables, and fruits that contain vitamin C that promote iron absorption. On the contrary, results from the 2015-16 Myanmar demographic and health survey observed that neither urban nor rural residence was significantly associated with anemia in women of reproductive age.

Using injection as a method of contraception was protective against IDA. Thus injection users were less likely to suffer from IDA compared to women who used other contraceptive methods or did not use any method. Similar findings were reported in Tanzania where data from the demographic and health survey revealed a 47% reduced risk of anemia in hormonal contraception users and there was no association between use of other contraceptive methods with risk of anemia. This could be attributed to the fact that 47.7% of women who use injectable contraceptives do not experience menstruation hence prevention of IDA is known to be one of the non-contraceptive benefits of hormonal contraceptives.

STRENGTHS AND LIMITATIONS OF THE STUDY

It is difficult to establish temporality between IDA and its associated factors because of the cross sectional study design that was used. Again, data which were collected retrospectively may have introduced recall bias when answering the questionnaire. It was also difficult to analyze some of explanatory variables such as obesity under BMI due to missing values. The major strength was the use of the MNS dataset, a sub study of the MDHS 2015-16 which provides a national representation and reliable estimates covering all the 28 districts in Malawi.

CONCLUSION

This study demonstrated a prevalence of IDA among non-pregnant women of reproductive age (15-49) years of 7.19%. It has also found that age, place of residence, and contraceptive use are risk factors for IDA. The chances of developing IDA increased with age, prominent in women age 40-49 years. On the other hand, living in rural areas, and use of injectable contraceptives are associated with low risk of IDA.

The findings from this study could assist health and nutrition policy makers to prioritize resource allocation in order to achieve substantive returns in reducing incidences of IDA among women of reproductive age. Deliberate policies targeting women of reproductive age should be introduced or scaled up. These include provision of modern family planning services especially injectable contraceptives. In particular, women living in urban areas should be encouraged to consume foods rich in iron such green leafy vegetables.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study used secondary data from the Malawi Micronutrient Survey, a sub study of the Malawi Demographic and Health Survey, 2015-16. Prior to the use of the data, permission was sought from the DHS-ICF program and a waiver for approval and consent form was obtained from the College of Medicine Research and Ethics Committee (COMREC).

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

Most of the data generated and analyzed in this study are contained in the manuscript. However, MDHS and MNS datasets may be obtained on request from the DHS-ICF program.

COMPETING INTERESTS

There are no any competing interests.

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AUTHOR'S CONTRIBUTIONS

Andrew Chiwaya and William Stones wrote the manuscript. Chisomo Singano helped in data generation and statistical analysis.

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