


# Nutrition-Sensitive Determinants of Anemia among Women of Childbearing Age in Eastern Uganda

Nathalie Finagnon Kiki<sup>1,2</sup>, John H. Muyonga<sup>1</sup>, Richard Bukenya<sup>1</sup>, Sênan Christa Lokossou<sup>2</sup>, Peterson Kato Kikomoko<sup>3</sup>, Andrew Mupere<sup>4</sup>, Jackline Bonabana<sup>5</sup>, Ronald Walusimbi<sup>5</sup>, Hedwig Acham<sup>1\*</sup> 

<sup>1</sup>Department of Food Technology and Nutrition, Makerere University, Kampala, Uganda

<sup>2</sup>Research Unit in Enzymatic and Food Engineering, University of Abomey-Calavi, Abomey-Calavi, Benin

<sup>3</sup>Department of Human Nutrition and Home Economics, Kyambogo University, Kampala, Uganda

<sup>4</sup>Uganda Bureau of Statistics (UBOS), Kampala, Uganda

<sup>5</sup>Department of Agribusiness and Natural Resource Economics, Makerere University, Kampala, Uganda

Email: \*hedwig.acham@mak.ac.ug

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## Abstract

Anemia remains a major public health concern, affecting approximately 30% of women aged 15 - 49 globally and 21% in Eastern Uganda, posing significant risks to maternal and child health. Addressing this issue requires understanding how nutrition is linked to broader health, social, and economic development initiatives. This study examines the relationship between nutrition-sensitive determinants—including household food insecurity, minimum dietary diversity for women, and water, sanitation, and hygiene (WASH) conditions—and the prevalence of anemia, defined as hemoglobin levels < 11 g/dL in pregnant women and <12 g/dL in non-pregnant women. Data from the Uganda National Panel Survey that included 558 weighted samples of women in Eastern Uganda were reanalyzed. Descriptive analysis revealed that the overall prevalence of anemia was 18.3%, with 24.3% and 17.8% among pregnant and non-pregnant women respectively. The prevalence of anemia among women of reproductive age varied from mild to moderate public health according to the World Health Organization. Logistic regression analysis employed to explore the nutrition-sensitive determinants of anemia among women revealed that anemia prevalence was significantly ( $p < 0.001$ ) associated with several factors (12) including the nutrition-sensitive variables such as MDD-W (AOR = 0.73,  $p = 0.03$ ), handwashing (AOR = 0.72,  $p = 0.031$ ), and wealth index (AOR<sub>middle</sub> = 0.128, AOR<sub>richer</sub> = 0.201, AOR<sub>richest</sub> = 0.103,  $p = 0.041$ ). Interven-

tions for anemia in Eastern Uganda need to focus on improving key nutrition-sensitive indicators like dietary diversity, WASH practices, and wealth status among women.

## Keywords

Iron-Deficiency Anemia Prevalence, Determinants, Reproductive-Aged Women (15 - 49 Years), Eastern Uganda

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## 1. Introduction

Anemia, a condition characterized by reduced red blood cell concentration or insufficient red blood cells to meet physiological needs [1], remains a prevalent public health concern, disproportionately affecting women of reproductive age (WRA) (15 - 49 years) [1]. Anemia during a woman's reproductive years is linked to adverse maternal, newborn, and child health outcomes, including spontaneous abortion, low birth weight, and long-term childhood neurodevelopmental disorders [1]-[4]. Globally, an estimated 30% of WRA were anemic in 2019 [5], with Sub-Saharan Africa bearing a significant portion of this burden [6]. In Uganda, despite slight decreases over time, anemia prevalence among WRA remains high, with rates of 23%, 32%, and 26% reported in 2011, 2016, and 2022, respectively [7] [8]. Eastern Uganda, in particular, registered an increase in anemia prevalence from 2016 to 2020, reaching 21% in 2019 [7] [8].

Addressing anemia requires a multi-faceted approach that considers both nutrition-specific and nutrition-sensitive interventions by providing an enabling environment for better outcomes. Nutrition-specific interventions address the immediate causes of malnutrition, while nutrition-sensitive interventions target the underlying causes, such as household food insecurity, limited access to healthcare, and inadequate water, sanitation, and hygiene (WASH) conditions [9]. The Ugandan government has implemented mixed interventions, including promoting consumption of iron-rich foods, food supplementation, treatment of diseases and infections (e.g. deworming, malaria treatment), and promoting WASH conditions [4] [10]. However, there is limited evidence to relate some of the nutrition-sensitive factors to anemia, which would better inform areas of focus. In addition, the above strategies have been implemented in Eastern Uganda, as well as in the rest of Uganda, without evidence of their effectiveness.

This study utilized data from the National Panel Surveys (UNPS) to investigate the contribution of several nutrition-sensitive factors towards anemia among WRA in Eastern Uganda. The relationship between anemia and nutrition-sensitive indicators, like minimum dietary diversity for women (MDD-W), household food insecurity, wealth index, and WASH conditions was explored. This research provides valuable insights for developing targeted interventions to address anemia, a persistent public health challenge.

## 2. Methods

### 2.1. Study Design

This study employed a secondary data analysis approach using data from the 2018/2019 and 2019/2020 National Panel Surveys, a cross-sectional survey conducted by the Uganda Bureau of Statistics (UBOS). The UNPS employed a two-stage stratified cluster sampling design to collect data representative of the Ugandan WRA.

### 2.2. Study Area and Participants

The study focused on Eastern Uganda, a region characterized by diverse socioeconomic and geographical conditions. The districts from Eastern region included Bududa, Bugiri, Bugweri, Bukedea, Bulambuli, Busia, Butaleja, Butebo, Buyende, Iganga, Jinja, Kaliro, Kamuli, Kapchorwa, Kapelebyong, Katakwi, Kibuku, Kumi, Kween, Luuka, Manafwa, Mayuge, Mbale, Namayingo, Namisindwa, Namutumba, Ngora, Palisa, Pallisa, Serere, Sironko, Soroti, and Tororo. Participants included WRA (15 - 49 years) who were either permanent residents or visitors who stayed in the selected households the night before the survey.

### 2.3. Study Participants, Sample, and Sampling

A two-stage sampling technique was used to obtain the WRA that participated in the study. The first stage involved cluster selection, consisting of enumeration areas (EAs). The second stage involved stratification sampling of households in Eastern Uganda across the 72 selected Enumeration Areas (EAs), 58 rural and 14 urban, leading to a total of 753 households [7]. WRA (15 - 49 years) who were either permanent residents of the selected households or visitors who stayed in the household the night before the survey were eligible for interview. A total of 952 WRA were successfully interviewed from the 753 households that were selected for the survey. However, 394 had missing values for hemoglobin levels, as they did not agree to take the anemia test. These were excluded. For non-pregnant women, Hb values below 4.0 g/dl or above 18.0 g/dl and for pregnant women, Hb values below 3.0 g/dl or above 17.0 g/dl were considered implausible and excluded from the analysis [4]. The final sample of 558 WRA was used in this reanalysis.

### 2.4. Variables

Details of specific procedures of obtaining anemia tests and other variables are published elsewhere [11]. Brief descriptions of these procedures are provided below.

#### **Anemia**

Blood specimens were collected for anemia testing from WRA 15 - 49 years who voluntarily consented to the testing. Blood samples were drawn from a drop of blood taken from a finger prick and collected in a microcuvette. Hemoglobin analysis was carried out on site using a battery-operated portable HemoCue analyzer [11]. This study utilized altitude-adjusted hemoglobin levels, which were pre-cal-

culated and included in the UNPS dataset. The outcome variable, anemia status, was determined based on hemoglobin concentration: a hemoglobin value below 11.0 g/dl for pregnant women and below 12.0 g/dl for non-pregnant women was indicative of anemia. The values were coded “1” as “yes” for anemia and “0” for no anemia.

#### **Nutrition-sensitive variables**

**Food Security status.** Food insecurity, from the Uganda National Panel Survey (UNPS), was determined by asking respondents: “Have you experienced situations in the past 12 months where you did not have enough food to feed your household?” Responses were coded as “1” for “Yes” indicating household food insecurity, and “0” for “No” indicating household food security.

**Minimum Dietary Diversity for Women.** The consumption pattern of the women used a standard 24 hour food frequency questionnaire containing common food items from 10 groups outlined by the Food and Agriculture Organization (FAO) [12]. The Minimum Dietary Diversity for Women (MDD-W) was the number of food groups consumed by the women in a day. The Minimum Dietary Diversity for Women (MDD-W) was classified as low MDD-W (less than five food groups) or high MDD-W (five or more food groups) and coded (low MDD-W = 0) and (high MDD-W = 1) respectively.

**Water, Sanitation, and Hygiene (WASH).** WASH variables included: Source of water for drinking (classified as safe = 1 or unsafe = 0), handwashing (coded as yes = 1 or no = 0), and type of toilet facility (coded as improved = 1 or unimproved = 0).

#### **Individual and household demographic variables**

**Age.** The women’s age was collected by inquiring their birth-dates and obtaining the age in years as difference between Survey dates and birth dates. The ages of the women were categorized and coded as 15 - 19 (coded as 0), 20 - 29 (coded as 1), 30 - 39 (coded as 2), and 40 - 49 (coded as 3) respectively during analysis.

**The household wealth index.** The wealth index was constructed using Principal Component Analysis (PCA) based on household asset ownership and housing characteristics which was calculated by the Uganda National Panel Survey (UNPS). The household wealth index was classified into five categories and coded as poorest (coded as 0), poorer (coded as 1), middle (coded as 2), rich (coded as 3) and richest (coded as 4) respectively during analysis [4].

**Place of residence.** The place of residence was defined as urban or rural.

**Education level.** The following levels of education were inquired from the women and coded as no education (coded 0), primary (coded 1), secondary (coded 2), and or higher (coded 3).

**Pregnancy status.** Women were inquired on the pregnancy status by asking “are you pregnant now?” and coded “1” for yes or and “0” for no.

**History of giving birth.** Respondents were grouped into two categories (yes or no), depending on whether or not they had ever given birth.

Factors that are known to influence iron absorption and alter anemia indicators, thus masking the effect of dietary intake (including infection and inflamma-

tion status, iron supplementation use, cultural dietary practices) were not controlled for.

## 2.5. Statistical Analysis

The entire dataset was obtained and the extraction of the data for eastern Uganda was done by the analyst. Data were sorted from the larger Uganda dataset. Data were cleaned and excluded variables and entries as explained earlier. The study used 743 households which contained 952 WRA and 394 that had missing values for hemoglobin levels, were excluded resulting into 558 WRA with complete data that was used for analysis.

Data were exported to Stata (version 15.0) software for the analysis. Descriptive statistical analysis was conducted to determine the prevalence of anemia among women of reproductive age, and the status of nutrition-sensitive determinants (household food insecurity, minimum dietary diversity for women, safety of drinking water, type of toilet facilities for sanitation, and presence of hand washing facilities for promotion of personal hygiene).

A logistic regression model was employed to assess the risk factors associated with anemia. This method uses maximum likelihood estimation to determine the parameters that best fit the probability of observing anemia according to Equation (1) below:

$$\log \left[ \frac{P(X)}{(1-P(X))} \right] = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_{11} X_{11} + \varepsilon \quad (1)$$

where:

$\log \left[ \frac{P(X)}{(1-P(X))} \right]$  is the logarithm of the odds ratio.  $P(X)$  represents the probability of anemia being present given the values of the independent variables  $X_1, X_2, \dots, X_{11}$ .

$\beta_0$  is the intercept term in the logistic regression equation. It represents the value of the log odds of the dependent variable when all independent variables ( $X_1$  to  $X_{11}$ ) are zero.

$\beta_1, \beta_2, \dots, \beta_{11}$  are the coefficients associated with each independent variable ( $X_1$  to  $X_{11}$ ). They indicate the change in the log odds of the dependent variable for a one-unit change in each independent variable, holding all other variables constant.

$X_1, X_2, \dots, X_6$  are the nutrition-sensitive determinants (minimum dietary diversity for women, WASH (safe water for drinking; presence of hand washing facilities, type of toilet), household wealth index, individual and household characteristics (age, place of residence, education level, pregnancy status, history of giving birth), included in the logistic regression model.

$\varepsilon$  represents the error or residual in the logistic regression model and it accounts for all variables not included in the model.

Lack of multicollinearity among the factor variable was observed using colline-

arity diagnostics (VIF < 5, tolerance close/larger than 1). Adequacy of the sample size (n = 558) was confirmed through a posthoc power analysis using G\*Power software following guidelines, which indicated that a sample size of 100 was sufficient to detect the observed effect in the logistic regression model. This sample size provided a power of 75.71%, an error rate of 0.05, and a final R<sup>2</sup> of 0.8122; demonstrating that the study's sample size of 558 was robust enough for assessing the associations of interest.

#### Ethical considerations

Permission to use the data from the Uganda National Panel Survey from Eastern Uganda was sought from the Uganda Bureau of Statistics (UBoS).

### 3. Results

#### 3.1. Prevalence of Anemia and Status of Nutrition-Sensitive Determinants in Eastern Uganda

**Prevalence of Anemia.** The results show the prevalence of anemia among women of reproductive age in Eastern Uganda to be 18.3%, with a 24.3% and 17.8% prevalence among pregnant and non-pregnant women, respectively.

**Nutrition Sensitive factors.** The majority (94.3%) of women of reproductive age had access to safe drinking water sources. Most households (77.1%) used unimproved toilet facilities, with only 22.9% using improved facilities and only 7.3% of women practicing handwashing (Table 1). Despite a larger portion of WRA (75.6%) being considered food secure, most (80.6%) of them had low minimum dietary diversity (fewer than five food groups) with only 19.4% meeting the recommended minimum dietary diversity (of at least five food groups).

**Table 1.** Prevalence of anemia and status of nutrition-sensitive determinants in Eastern Uganda among women of reproductive age (n = 558).

Variables	Not anemic	Anemic	Proportion (%)
<b>Anemia Status</b>			
Overall	456	102	18.3
Pregnant women	28	9	24.3
Non-pregnant women	428	93	17.8
<b>Household food security</b>			
Household food secure	349	73	75.6
Household food insecure	107	29	24.4
<b>Minimum Dietary Diversity for Women (MDD-W)</b>			
Low MDD-W	365	85	80.6
High MDD-W	91	17	19.4
<b>Sources of water for drinking</b>			
Safe	442	94	94.3
Unsafe	14	8	5.7

## Continued

<b>Hand washing practice</b>			
No	387	91	92.7
Yes	69	11	7.3
<b>Type of toilet facilities</b>			
Improved	58	15	22.9
Unimproved	398	87	77.1
<b>Given birth</b>			
Yes	346	69	72.9
No	110	33	27.1
<b>Residence</b>			
Rural	399	82	86.2
Urban	57	20	13.8
<b>Household wealth index</b>			
Poorest	130	29	28.5
Poorer	83	18	18.1
Middle	102	23	22.4
Richer	104	14	9.1
Richest	37	18	21.9
<b>Age range</b>			
15 - 19	108	29	24.6
20 - 29	119	27	26.2
30 - 39	132	23	27.8
40 - 49	97	23	21.5
<b>Education level</b>			
No education	121	27	26.5
Primary	255	49	54.5
Secondary	70	22	16.5
Higher	10	4	2.5

### 3.2. Nutrition-Sensitive Determinants of Anemia Status in Eastern Uganda

Minimum dietary diversity for Women (AOR = 0.737,  $p = 0.030$ ), handwashing (AOR = 0.726,  $p = 0.031$ ), and variables like giving birth (AOR = 4.349,  $p = 0.010$ ), wealth index (AOR = 0.278,  $p = 0.041$ ); and pregnancy (AOR = 56.533,  $p = 0.000$ ) were significant predictors of anemia status (**Table 2**).

Women who were pregnant at the time of the survey had approximately 57-times likelihood of being anemic. Women with high dietary diversity (MDD-W high) had a 26 percent lower likelihood of having anemia compared to those with low dietary diversity (LR = 0.737; 95% CI: 0.560 - 0.971), suggesting that higher

dietary diversity may have a protective effect against anemia, and the association is statistically significant.

**Table 2.** Logistic regression model results for the nutrition-sensitive determinants of anemia status in Eastern Uganda.

Nutrition sensitive determinants	Adjusted odds ratio	95% C.I. for Adjusted odds ratio		p-value
		Lower	Upper	
MDD-W (rc: low)				
high	0.737	0.560	0.971	0.030
Source of water (rc: unsafe)				
safe	0.738	0.160	3.409	0.698
Type of toilet (rc: unimproved)				
improved	2.052	0.780	5.396	0.145
Hand washing practice (rc: no)				
yes	0.726	0.149	0.911	0.031
Household wealth index (rc: poorer)				
poorest	0.278	0.061	1.265	0.041
middle	0.128	0.028	0.583	
richer	0.201	0.043	0.949	
richest	0.103	0.020	0.520	
Education level (rc: no education)				
primary	0.323	0.056	1.855	0.320
Secondary	0.462	0.092	2.333	
higher	0.191	0.028	1.330	
Given birth (rc: no)				
yes	4.349	1.411	13.403	0.010
Pregnancy (rc: no)				
yes	56.533	20.895	152.955	0.000
Residence (rc: rural)				
urban	0.297	0.060	1.467	0.136
Age range (rc: 15 - 19)				
20 - 29	0.278	0.066	1.162	0.249
30 - 39	0.621	0.213	1.810	
40 - 49	0.424	0.139	1.291	

C.I: Confidence Interval; rc: Reference Category.  $R^2 = 0.8122$ ,  $p < 0.001$ .

The odds for anemia were 27 times higher among women who did not practice handwashing. Furthermore, the odds of anemia were 0.3 times higher for women from poor households.

## 4. Discussion and Conclusion

### 4.1. Discussion

The prevalence of anemia among WRA was of a mild to moderate public health problem according to the World Health Organization definition [13]. This prevalence was similar to that reported in the study conducted in Southwest China (18.9%) by Wu *et al.* [2] but lower than previous estimates reported by the Uganda National Panel Survey (21%) in Eastern Uganda [8], and lower than the global level, which is estimated to be 30% [8]. The possible variation could be because of the differences in socioeconomic status, educational level, and dietary habits [3]. A diet low in essential vitamins and minerals like iron, folic acid, and calcium can increase the risk of iron deficiency anemia [14]-[16], while poor intake and limited dietary diversity during pregnancy contribute to maternal malnutrition [16]. In addition to this, variations in the prevalence of anemia might exist due to the geographic area of residence, and the study period [17].

While the prevalence of anemia among women of reproductive age in this study was lower than the national rate of 26% reported by UBOS (7), it remains a concern. Nearly one-fifth of WRA in Eastern Uganda are affected, representing a mild public health problem according to WHO standards [1] [11] that warrants attention. As expected, the apparent prevalence varied with pregnancy status, with anemia prevalence higher by 1.5 times among pregnant than non-pregnant women. It is understood that during pregnancy, the plasma volume increases progressively [18], causing a two-to three-fold and 10- to 20-fold increase in the requirement for iron and folate, respectively [19].

A closer look at the magnitude of water, sanitation and hygiene (WASH) indicates that the proportion of households who had access to a safe source of water for drinking was high (Table 1), and in fact higher than that reported in rural Ethiopia [20] and much higher than that found in Peru [21], all of which are low-middle income countries facing issues such as poverty, malnutrition and limited access to quality healthcare, but have implemented nutrition-sensitive and nutrition specific programs. Incidentally, this proportion is even higher than that reported at country level [4], requiring a lot of efforts to provide the needed infrastructure and services for safe water supply. Also, the study findings regarding household sanitation facilities (type of toilet) are much higher than study findings by Kothari *et al.* [22]. Additionally, the study findings indicate that hand washing practices in Eastern Uganda were slightly higher than the national average [8], but lower than those reported by Ibarra *et al.* [23] in California. This is notable given that California, despite having advanced infrastructure and better access to water and sanitation, still faces behavioral and public health challenges [24]. These differences could be attributed to other underlying factors such as knowledge [25], access to facilities like soap and clean water [26], and socioeconomic factors, all of which have been reported to influence hand hygiene practices [27]. Income level, employment status, and household wealth influence both access to diverse foods and the risk of anemia. In Eastern Uganda, widespread poverty, food insecurity,

and limited access to health care, education, and infrastructure exacerbate these challenges. The majority of the population depends on subsistence farming, and the region experiences high youth unemployment and school dropout rates.

Water sanitation and hygiene (WASH) play a crucial role in preventing infectious diseases [28], as low rates of hand washing practice can lead to higher incidences of illnesses. Also unimproved sanitation contributes to the spread of waterborne diseases such as cholera, diarrhea, and typhoid which lead to infections and ultimately, anemia [13].

The findings on household food insecurity (**Table 1**) align closely with those reported for Sub-Saharan Africa [29]. The reason may be attributed to the uneven distribution of food, the lack of diversification in livelihoods, and rising food prices [30]. In addition, other factors such as low income, dependence on rain-fed agriculture, and the seasonal fluctuations in food availability and accessibility also play significant roles [30].

Results for MDD-W revealed that the average women's minimum dietary diversity (MDD-W) for Eastern Uganda was higher compared to the national level (8) average, but much lower than values reported in other parts of Africa: Mali [31]; Oromia, Central Ethiopia [32] and Northwest Ethiopia [33]. The possible reason for this discrepancy may stem from variations in socio-demographics [34], economic vulnerability [35].

A logistic regression between anemia and nutrition-sensitive determinants including women's dietary diversity, WASH (hand washing) and household wealth index were statistically significant (**Table 2**). Other studies [29] [30] have reported association between women's dietary diversity and anemia. The positive relationship between women's dietary diversity and anemia could be attributed to the fact that women with lower dietary diversity were at greater risk of nutrient deficiencies and subsequent health complications, including anemia [35]-[38]. This therefore emphasizes the need for the promotion of a diverse diet to ensure adequate intake of essential nutrients, including iron, folate, vitamin B12, and other micro-nutrients crucial for red blood cell production and overall health [39].

This study revealed a relationship between hand washing and anemia. This finding is in agreement with the positive findings of earlier studies [15] [33] that reported that mothers who did not practice hand washing after cleaning their children's bottom were three times more likely to be undernourished. This can be explained by the fact that poor personal hygiene practices may lead to contamination by pathogenic microorganisms, which can result in communicable diseases such as infections and subsequent maternal undernutrition due to appetite loss or decreased food intake, metabolic alteration, and loss of nutrients [20].

Results of this study also revealed a relationship between household wealth index and anemia. This finding is in agreement with results from studies done in Mali [40], in East Africa [3] and in the SSA [41]. This relationship could be explained the fact that women in poorer households are less able to afford adequate diets, pay for health care, and practice good sanitation compared with women in

wealthier households [4]. Women from poor households tend to consume foods that have low nutrient-content and are likely to be food insecure. Poverty potentially limits access to diverse, nutrient-rich foods essential for maintaining iron levels, and women from lower-income households often face barriers to both iron-rich food access and timely anemia screenings [42] and treatment [43], leading to delayed diagnoses, increased anemia risk, and potential anemia as a secondary complication from untreated underlying health conditions [44] [45].

#### **Limitations**

One significant methodological limitation of the study was the exclusion of 394 participants (41.4% of the initial sample of 952) due to missing or incomplete data. The high proportion of excluded cases raises concerns about potential selection bias, particularly if the data were not missing completely at random. Such exclusion may compromise the internal validity of the study by introducing systematic differences between included and excluded participants. Furthermore, the reduction in sample size decreases the statistical power which is useful in detecting meaningful associations and limits the external validity and generalizability of the findings to the broader population.

Additionally, the study did not account for factors that are recognized to affect iron absorption and influence indicators of anemia, potentially obscuring the impact of dietary intake. These factors include infection and inflammation status, use of iron supplementation, geographical location, and cultural dietary practices.

The absence of control for these factors could lead to misinterpretation of the study findings related to dietary intake and anemia. Factors such as infection, inflammation, iron supplementation, and cultural dietary habits are known to significantly affect iron absorption and anemia status. Therefore, their uncontrolled influence might confound the observed associations, emphasizing the need for further research that considers these variables to provide more accurate conclusions on dietary impacts on anemia.

## **4.2. Conclusion**

Anemia continues to pose a major public health challenge among women of reproductive age in Eastern Uganda, particularly among pregnant women. This study highlights the critical influence of nutrition-sensitive factors—specifically minimum dietary diversity for women, handwashing practices, and household wealth index—on anemia prevalence. To effectively combat anemia, there is an urgent need for targeted, context-specific nutrition education programs that promote diversified diets and strengthen household food security. Additionally, enhancing water, sanitation, and hygiene (WASH) conditions should be prioritized, as these improvements are key to reducing the risk of anemia and fostering better health outcomes for women in this vulnerable population.

## **Authors' Contribution**

N.F.K. conceptualized the idea, contributed to data curation, formal analysis, in-

vestigation, methodology, project administration, resources, software, supervision, validation, writing the original draft, and editing the final manuscript.

H.A. A.M and R.B. contributed to the data acquisition processes, the investigation, conceptualized the idea, contributed to data curation, methodology, standardization, project administration, resources, supervision, validation, and editing of the final manuscript.

J.M. and P.K.K. contributed to methodology, standardization, validation, and editing of the final manuscript

S.C.L and RW. contributed to the methodology, formal data analysis and interpretation of results.

J.B. contributed to fine tuning the interpretations of the results and editing the final write-up.

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## **Data Availability**

The datasets generated and/or analysed during the current study are available from the corresponding author, Uganda Bureau of Statistics (UBOS) and the National Information Platform for Nutrition unit (NIPN), on reasonable request. At present, the data are not publicly available due to privacy restrictions but may be shared upon request for publication purposes.

## **Consent for Publication**

The data presented was secondary data, unidentifiable with no details on individuals reported. All listed authors have approved the manuscript for submission.

## **Conflicts of Interest**

The authors declare no conflict of interest.

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## Abbreviations and Acronyms

AOR: Adjusted Odds Ratio

CI: Confidence Interval

EAs: Enumeration Areas

FAO: Food and Agriculture Organization

Hb: Hemoglobin

RC: Reference Category

SD: Standard Deviation

UBOS: Uganda Bureau of Statistics

UDHS: Uganda Demographic and Health Surveys

UNPS: Uganda National Panel Survey

WASH: Water, Sanitation, and Hygiene

MDD-W: Minimum Dietary Diversity for Women

VIF: Variance Inflation Factor

WRA: Women of Reproductive Age