Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Prevalence and Factors Associated with Anemia among Women with Uterine Fibroids at Mbarara Regional Referral Hospital, Uganda

Patrick Etwop

patricketwop35@gmail.com

Department of Obstetrics and Gynaecology, Faculty of Medicine, Mbarara University of Science and Technology, P.O. Box 1410, Mbarara, Uganda

Richard Migisha

Department of Physiology, Faculty of Medicine, Mbarara University of Science and Technology, P.O. Box 1410, Mbarara, Uganda

Brenda Ainomugisha

Department of Obstetrics and Gynaecology, Faculty of Medicine, Mbarara University of Science and Technology, P.O. Box 1410, Mbarara, Uganda

Leevan Tibaijuka

Department of Obstetrics and Gynecology, Mbarara Regional Referral Hospital, P.O. Box 40, Mbarara, Uganda

Godfrey R. Mugyenyi

Department of Obstetrics and Gynaecology, Faculty of Medicine, Mbarara University of Science and Technology, P.O. Box 1410, Mbarara, Uganda

Joseph Ngonzi

Department of Obstetrics and Gynaecology, Faculty of Medicine, Mbarara University of Science and Technology, P.O. Box 1410, Mbarara, Uganda

Hamson Kanyesigye

Department of Obstetrics and Gynaecology, Faculty of Medicine, Mbarara University of Science and Technology, P.O. Box 1410, Mbarara, Uganda

Henry Mark Lugobe

Department of Obstetrics and Gynaecology, Faculty of Medicine, Mbarara University of Science and Technology, P.O. Box 1410, Mbarara, Uganda

Rogers Kajabwangu

Department of Obstetrics and Gynecology, Mbarara Regional Referral Hospital, P.O. Box 40, Mbarara, Uganda

Paul Kalyebara

Department of Obstetrics and Gynaecology, Faculty of Medicine, Mbarara University of Science and Technology, P.O. Box 1410, Mbarara, Uganda

Raymond Timothy Mugerwa
Department of Obstetrics and Gynaecology, Faculty of Medicine, Mbarara University of Science and Technology, P.O. Box 1410, Mbarara, Uganda

Patrick Ochuga
Department of Obstetrics and Gynaecology, Faculty of Medicine, Mbarara University of Science and Technology, P.O. Box 1410, Mbarara, Uganda

Emmanuel Adupa
Department of Obstetrics and Gynaecology, Faculty of Medicine, Mbarara University of Science and Technology, P.O. Box 1410, Mbarara, Uganda

Daniel Begumana
Department of Obstetrics and Gynaecology, Faculty of Medicine, Mbarara University of Science and Technology, P.O. Box 1410, Mbarara, Uganda

Musa Kayondo
Department of Obstetrics and Gynaecology, Faculty of Medicine, Mbarara University of Science and Technology, P.O. Box 1410, Mbarara, Uganda

---

Research Article

Keywords: Leiomyoma, Anemia, Prevalence, Women, Uganda

Posted Date: March 25th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-8839698/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Background

Uterine fibroids are common during reproductive years and are frequently symptomatic, with anemia being a major complication following heavy menstrual bleeding. However, the burden of anemia and the characteristics of affected women with uterine fibroids remain poorly documented in low-resource settings, including Uganda, limiting evidence-based care. We determined the prevalence and factors associated with anemia among women with uterine fibroids at a tertiary referral hospital in southwestern Uganda.

Methods

We conducted a cross-sectional study among women with a sonographic diagnosis of uterine fibroids attending the gynecology clinic and ward at Mbarara Regional Referral Hospital (MRRH), Uganda, between July and December 2024. Sociodemographic, gynecological, and medical characteristics were collected using interviewer-administered structured questionnaires. Menstrual blood loss was assessed using the pictorial blood loss assessment chart, with scores ≥ 100 indicating heavy menstrual bleeding (> 80 mL per cycle). Anemia was defined as a hemoglobin concentration < 12.0 g/dL, in accordance with World Health Organization criteria for non-pregnant women, and severity was classified as moderate (8.0–10.9 (g/dL) or severe (< 8.0 g/dL). Modified Poisson regression with robust variance was used to identify factors independently associated with anemia, reported as adjusted prevalence ratios (aPRs) with 95% confidence intervals (CIs).

Results

In total, 273 women were enrolled. The mean age was 40 ± 9 years; most participants were married (67.4%), urban residents (52.7%), and unemployed (72.9%). Overall, 179 women had anemia, giving a prevalence of 65.6% (95% CI: 59.6%–71.2%), predominantly moderate (46.4%) and severe (29.0%). Presence of fibroids in multiple uterine sites (aPR = 1.89; 95% CI: 1.02–3.52) and a history of heavy menstrual bleeding (≥ 80 mL) (aPR = 2.17; 95% CI: 1.68–2.81) were independently associated with anemia.

Conclusion

The prevalence of anemia was high, affecting two-thirds of women with uterine fibroids. There is need for strengthening routine anemia screening among women presenting with multiple uterine fibroids and heavy menstrual bleeding so as to prevent them for developing anemia associated complications.

Introduction

Uterine fibroids, also known as leiomyomas, are the most common benign gynaecological tumors affecting women during their reproductive years. Globally, up to 70–80% of women develop fibroids by

the age of 50, although many remain asymptomatic [1]. When symptoms occur, they commonly include heavy menstrual bleeding, pelvic pain, pressure symptoms, infertility, and clinical signs such as anemia [2, 3]. Fibroid-related anemia primarily results from chronic menstrual blood loss caused by increased endometrial surface area, abnormal uterine vascularity, reduced myometrial contractility, and endometrial ulceration [4]. Anemia affects women's quality of life, leading to fatigue, reduced productivity, frequent hospital visits, and increased perioperative risk, particularly among women undergoing surgical management for fibroids [5–7].

In sub-Saharan Africa, the burden of uterine fibroids and anemia is disproportionately high. Women of African ancestry tend to develop fibroids at a younger age, experience more severe symptoms, and present late for care compared with women in other regions[8, 9]. At the same time, anemia remains a major public health problem in the region, driven by nutritional deficiencies, infectious diseases such as malaria, and limited access to timely healthcare services[10, 11]. Studies from Africa consistently report a high prevalence of anemia among women seeking care for uterine fibroids, often exceeding estimates from high-income settings[12–14]. Heavy menstrual bleeding, fibroid number, and fibroid location—particularly submucosal involvement—have been repeatedly identified as important contributors to anemia severity[13, 15, 16]. Nonetheless, evidence from low-income settings is sparse and heterogeneous, with limited characterization of the prevalence, severity, and determinants of anemia among women with uterine fibroids, constraining effective risk stratification and routine screening protocols in clinical practice.

In Uganda, uterine fibroids are commonly encountered in gynaecological practice, particularly at tertiary referral hospitals. Previous work at Mbarara Regional Referral Hospital (MRRH), southwestern Uganda, reported a fibroid prevalence of 28.2% among women attending gynaecology clinics, with heavy menstrual bleeding as a frequent presenting symptom[17]. However, the study did not document the proportion of women with anemia and uterine fibroids. Therefore, this study was conducted to determine the prevalence and to identify factors associated with anemia among women with uterine fibroids at MRRH, so as to inform the need for routine screening of anemia and targeted management in similar low-resource settings.

Methods

Study design, study setting and study population

We conducted a hospital-based cross-sectional study at the gynecology outpatient clinic and gynecology ward of Mbarara Regional Referral Hospital (MRRH), a public, government-owned tertiary hospital located in southwestern Uganda. The study was conducted between July and December 2024. MRRH serves as a teaching hospital for Mbarara University of Science and Technology and has a bed capacity of approximately 350. The hospital serves an estimated catchment population of over three million people from Mbarara City and surrounding districts, and also receives referrals from neighboring countries, including Rwanda, Tanzania, and the Democratic Republic of Congo. MRRH has a fully

functional radiology unit providing pelvic ultrasonography and a level III laboratory capable of performing complete blood counts.

The study population comprised all women with a sonographic diagnosis of uterine fibroids attending the gynecology outpatient clinic or admitted to the gynecology ward at MRRH during the study period. We included women with a documented sonographic diagnosis of uterine fibroids who provided written informed consent. We excluded women with confirmed pregnancy because pregnancy-related hemodilution could affect hemoglobin measurements.

Sample size and Sampling

The sample size was calculated using the Kish–Leslie formula for cross-sectional studies[18]. An estimated anemia prevalence of 80% among women with uterine fibroids, based on a prior study conducted in Ghana[12], was used. With a 95% confidence level and a precision of 5%, the minimum required sample size was 246 participants. After adjusting for a 10% non-response rate, the final sample size was 273 participants. All eligible women attending the gynecology outpatient clinic or admitted to the gynecology ward during the study period were recruited consecutively until the required sample size was attained.

Data collection and laboratory procedure

Data were collected using an interviewer-administered structured questionnaire by trained research assistants who were midwives with prior experience in clinical research and training in responsible conduct of research. Prior to commencement of the study, the questionnaire was pretested at the gynecology outpatient clinic of MRRH among 15 women with uterine fibroids who were not included in the final analysis. The pretest aimed to assess clarity, appropriateness of wording, flow of questions, estimated duration of interviews, and respondent comprehension. Feedback from the pretest was used to refine question phrasing, improve logical sequencing, and minimize ambiguity, thereby enhancing the validity and reliability of the data collection tool **(Appendix 1).**

Eligible participants were identified through daily review of clinic and ward records after routine clinical assessment by the gynecology team. Women with a documented sonographic diagnosis of uterine fibroids were approached by the research assistants, provided with information about the study objectives and procedures, and invited to participate. Written informed consent was obtained prior to enrollment. Interviews were conducted in a private setting within the clinic or ward to ensure confidentiality and lasted approximately 20 minutes.

The questionnaire captured information on sociodemographic characteristics, medical history, gynecological history, and fibroid-related factors. Additional clinical information, including the number and anatomical location of fibroids, was abstracted from pelvic ultrasound reports performed within five days of enrollment to ensure validity. Participants whose ultrasound reports lacked sufficient detail had

repeat imaging done at no cost. Menstrual blood loss during the most recent cycle was assessed using the pictorial blood loss assessment chart (PBLAC)[19]. Weight and height were measured using calibrated equipment and used to calculate body mass index (weight in kilograms divided by height in meters squared). Following the interview, venous blood samples were collected for complete blood count analysis, including hemoglobin concentration.

Approximately 2 mL of venous blood was collected into EDTA vacutainers under aseptic conditions and transported to the MRRH laboratory within one hour. Hemoglobin concentration was analyzed using an automated hematology analyzer (Sysmex XN-1000i; Sysmex Corporation, Kobe, Japan). The laboratory performs routine internal quality control procedures.

Study variables

The primary outcome variable was anemia, defined as a hemoglobin concentration of < 12.0 g/dL in accordance with World Health Organization criteria for non-pregnant women[20]. For descriptive analyses, anemia severity was further classified using WHO threshold: mild and moderate anemia were defined as hemoglobin concentration of 11-11.9g/dL and 8.0–10.9 g/dL, while severe anemia was defined as a hemoglobin concentration of < 8.0 g/dL. Participants with hemoglobin concentrations ≥ 12.0 g/dL were classified as non-anemic.

Independent variables included sociodemographic, medical, gynecological, and fibroid-related factors. Continuous variables comprised age in completed years, parity, body mass index, age at menarche, duration since diagnosis of uterine fibroids in months, number of fibroids, and estimated menstrual blood loss per cycle. Categorical variables included place of residence, marital status, level of education, employment status, HIV serostatus, history of chronic kidney disease, diabetes mellitus, hypertension, sickle cell disease, anatomical location of fibroids, and history of prior surgical treatment.

HIV status was defined based on documented test results obtained within the three months preceding enrollment; participants without documented results underwent HIV testing in accordance with hospital protocols. Estimated menstrual blood loss was assessed using the pictorial blood loss assessment chart (PBLAC), with scores ≥ 100 corresponding to heavy menstrual bleeding, equivalent to an estimated blood loss of more than 80 mL per menstrual cycle[19].

Data management and analysis

Data were entered into Research Electronic Data Capture based MRRH (REDCap®; Vanderbilt University, Nashville, TN, USA) by the principal investigator and subsequently exported to STATA statistical software version 17 (StataCorp LLC, College Station, TX, USA) for data cleaning and analysis. Descriptive analyses were performed to summarize participant characteristics. Continuous variables were assessed for normality and summarized using means and standard deviations, while categorical variables were summarized using frequencies and proportions expressed as percentages. Comparisons between

women with anemia and those without anemia were conducted to explore differences in participant characteristics. Categorical variables were compared using the chi-square test, or Fisher's exact test if the expected cell counts were small (fewer than five). The prevalence of anemia was calculated as a proportion by dividing the number of participants with hemoglobin concentrations < 12.0 g/dL by the total number of participants enrolled in the study, and expressed as a percentage with corresponding 95% confidence intervals.

Associations between independent variables and anemia were evaluated using a two-stage analytical approach. At the bivariate level, associations were quantified using crude prevalence ratios. Variables with a p-value < 0.20 at bivariate analysis, as well as variables considered biologically plausible based on existing literature, were included in the multivariable analysis. Modified Poisson regression with robust variance estimation was used to estimate adjusted prevalence ratios and their corresponding 95% confidence intervals. Variables with a p-value < 0.05 in the multivariable model were considered statistically significant and interpreted as factors independently associated with anemia among women with uterine fibroids.

Results

During the study period, 276 women with a sonographic diagnosis of uterine fibroids were assessed for eligibility. Three women were excluded because they were pregnant. A total of 273 participants met the inclusion criteria and were enrolled in the study and included in the final analysis as shown in Fig. 1.

Among the 273 women with a sonographic diagnosis of uterine fibroids included in the analysis, 179 were classified as anemic, corresponding to an anemia prevalence of 65.6% (95% CI: 59.8%–71.4%). Of the 179 women with anemia, 83 (46.4%) had moderate anemia, 52 (29.1%) had severe anemia, and 44 (24.6%) had mild anemia.

Base line characteristics of the study participants

The mean age of the participants was 40.2 (± 8.9) years). Of the 273 women participants, most participants were married (67.4%), resided in urban areas (52.7%), had attained primary education (41.4%), and were unemployed (72.9%) as shown in Table 1.

Table 1
Baseline sociodemographic and medical characteristics of the participants

Characteristics	Total	Anemia	No Anemia	
	N = 273	n = 179	n = 94	P-value
	n (%)	n (%)	n (%)	
Age in years, mean (SD)	40.2 (8.9)	40.1 (9.06)	40.5 (8.9)	0.77
Age categories (years)				0.82
20–35	83 (30.4)	57 (31.8)	26 (27.7)	
35-<45	93 (34.1)	60 (33.5)	33 (35.1)	
≥ 45	97 (35.5)	62 (34.6)	35 (37.2)	
Residence				0.15
Rural	129 (47.3)	79 (44.1)	50 (53.2)	
Urban	144 (52.7)	100 (55.9)	44 (46.8)	
Marital status				0.47
Married	184 (67.4)	118 (65.9)	66 (70.2)	
Unmarried	89 (32.6)	61 (34.1)	28 (29.8)	
Level of education				0.74
None	11 (4.0)	7 (3.9)	4 (4.3)	
Primary	113 (41.4)	70 (39.1)	43 (45.7)	
Secondary	81 (29.7)	55 (30.7)	26 (27.7)	
Tertiary	68 (24.9)	47 (26.3)	21 (22.3)	
Employment status				0.67
Yes	74 (27.1)	50 (27.9)	24 (25.5)	
No	199 (72.9)	129 (72.1)	70 (74.5)	
Body Mass Index (kg/m^2)				0.4
Normal (18.5–24.9)	96 (35.2)	66 (36.9)	30 (31.9)	
Overweight (25–29)	130 (47.6)	86 (48.0)	44 (46.8)	
Obese(≥ 30)	47 (17.2)	27 (15.1)	20 (21.3)	

*p < 0.05, SD: standard deviation, HIV: Human immune virus, CKD: Chronic kidney disease

Characteristics	Total	Anemia	No Anemia	
	N = 273	n = 179	n = 94	P-value
	n (%)	n (%)	n (%)	
HIV sero-status				0.78
Negative	230 (84.2)	150 (83.8)	80 (85.1)	
Positive	43 (15.8)	29 (16.2)	14 (14.9)	
Known CKD				0.016*
No	270 (98.9)	179 (100.0)	91 (96.8)	
Yes	3 (1.1)	0 (0.0)	3 (3.2)	
Known chronic hypertension				0.13
No	248 (90.8)	166 (92.7)	82 (87.2)	
Yes	25 (9.2)	13 (7.3)	12 (12.8)	
Known diabetes mellitus				0.36
No	260 (95.2)	172 (96.1)	88 (93.6)	
Yes	13 (4.8)	7 (3.9)	6 (6.4)	
*p < 0.05, SD: standard deviation, HIV: Human immune virus, CKD: Chronic kidney disease				

Most participants were multiparous (62.3%), reported heavy menstrual bleeding (62.3%), and had fibroids located in more than one anatomical site (54.6%) as shown in Table 2.

Table 2
Baseline gynecological and fibroid-related characteristics

Characteristics	Total	Anemia	No Anemia	
	N = 273	n = 179	n = 94	P-value
	n (%)	n (%)	n (%)	
Parity				0.003*
Nulliparous (0)	62 (22.7)	52 (29.1)	10 (10.6)	
(1–4)	170 (62.3)	102 (57.0)	68 (72.3)	
(≥ 5)	41 (15.0)	25 (14.0)	16 (17.0)	
Ever used contraceptive				0.63
No	131 (48.0)	84 (46.9)	47 (50.0)	
Yes	142 (52.0)	95 (53.1)	47 (50.0)	
Menarche				0.13
< 12	28 (10.3)	22 (12.3)	6 (6.4)	
≥ 12	245 (89.7)	157 (87.7)	88 (93.6)	
Heavy menstrual bleeding (HMB)				< 0.001*
No (PBLAC < 100)	103 (37.7)	39 (21.8)	64 (68.1)	
Yes (PBLAC ≥ 100)	170 (62.3)	140 (78.2)	30 (31.9)	
Numbers of fibroids				0.004*
1	51 (18.7)	26 (14.5)	25 (26.6)	
2–5	196 (71.8)	130 (72.6)	66 (70.2)	
> 5	26 (9.5)	23 (12.8)	3 (3.2)	
Fibroid location (Figo stage)				0.002*
Subserosal (5–7)	19 (7.0)	6 (3.4)	13 (13.8)	
Submucosal (0–2)	77 (28.2)	48 (26.8%)	29 (30.9)	
Intramural (3–4)	28 (10.3)	16 (8.9)	12 (12.8)	
More than one site	149 (54.6)	109 (60.9)	40 (42.6)	
Duration with fibroids (months)				0.013*

*p < 0.05, SD: standard deviation, PBLAC: Pictorial blood loss assessment chart

Characteristics	Total	Anemia	No Anemia	
	N = 273	n = 179	n = 94	P-value
	n (%)	n (%)	n (%)	
< 6	79 (28.9)	43 (24.0)	36 (38.3)	
≥ 6	194 (71.1)	136 (76.0)	58 (61.7)	
History of myomectomy				0.95
No	267 (97.8)	175 (97.8)	92 (97.9)	
Yes	6 (2.2)	4 (2.2)	2 (2.1)	
*p < 0.05, SD: standard deviation, PBLAC: Pictorial blood loss assessment chart				

Factors associated with anemia among women with uterine fibroids

Women who reported heavy menstrual bleeding, defined as a pictorial blood loss assessment chart score ≥ 100, had approximately twofold higher prevalence of anemia compared with those without heavy menstrual bleeding (adjusted prevalence ratio [aPR] = 2.10, 95% CI 1.62–2.72; p < 0.001). Similarly, anemia was common among women with uterine fibroids located in more than one anatomical site compared to those with subserosal fibroids only (aPR = 1.89, 95% CI 1.02–3.52; p = 0.043) as shown in Table 3.

Table 3
Bivariate and multivariable analysis of factors associated with anemia among women with uterine fibroids at Mbarara Regional Referral Hospital, Uganda

Variables	Bivariate analysis	P-value	Multivariable analysis	P-value
	cPR (95% CI)		aPR (95% CI)	
Age categories (years)				
20–35	1		1	
35-<45	0.94[0.76,1.16]	0.559	0.98[0.82,1.19]	0.865
≥ 45	0.93[0.76,1.15]	0.501	1.09[0.88,1.34]	0.426
Residence				
Rural	1		1	
Urban	1.13[0.95,1.35]	0.160	1.14[0.95,1.37]	0.146
Parity				
Nulliparous (0)	1		1	
(1–4)	0.72[0.61,0.84]	0.009*	0.77[0.64,1.39]	0.209
(≥ 5)	0.73[0.56,0.95]	0.020*	0.83[0.62,1.11]	0.833
Menarche				
< 12	1		1	
≥ 12	0.82[0.66,1.01]	0.064	0.87[0.71,1.07]	0.180
Heavy menstrual bleeding				
No (PBLAC < 100)	1		1	
Yes (PBLAC ≥ 100)	2.17[1.68,2.81]	< 0.001*	2.10[1.62,2.72]	< 0.001*
Number of fibroids				
1	1		1	
2–5	1.30[0.98,1.73]	0.073	1.12[0.81,1.55]	0.485
> 5	1.74 [1.28,2.35]	< 0.001*	1.23[0.85,1.77]	0.265
Fibroid location (Figo stage)				
Subserosal (5–7)	1		1	

PBLAC: *Pictorial Blood Loss Assessment Chart*, **cPR**: *Crude Prevalence Ratio*, **aPR**: *Adjusted Prevalence Ratio*, **CI**: *Confidence Interval, *p-value < 0.05*, **1**: *Reference category*

Variables	Bivariate analysis	P-value	Multivariable analysis	P-value
	cPR (95% CI)		aPR (95% CI)	
Age categories (years)				
Submucosal (0–2)	1.97[0.99,3.92]	0.052	1.94[0.88,3.61]	0.057
Intramural (3–4)	1.81[0.87,3.78]	0.115	1.81[0.94,3.50]	0.076
More than one site	2.32[1.19,4.53]	0.014*	1.89[1.02,3.52]	0.043*
Duration with fibroids (months)				
< 6	1		1	
≥ 6	1.29[1.03,1.61]	0.026*	1.05[0.85,1.29]	0.675
History of myomectomy				
No	1		1	
Yes	1.02[0.57,1.80]	0.954	1.00[0.58,1.75]	0.991

PBLAC: *Pictorial Blood Loss Assessment Chart*, **cPR**: *Crude Prevalence Ratio*, **aPR**: *Adjusted Prevalence Ratio*, **CI**: *Confidence Interval, *p-value < 0.05*, **1**: *Reference category*

Discussion

In this hospital-based cross-sectional study conducted at a tertiary referral facility in southwestern Uganda, we found that nearly two-thirds of women with a sonographic diagnosis of uterine fibroids had anemia, with most cases classified as moderate or severe. Heavy menstrual bleeding, and the presence of fibroids in multiple uterine sites were independently associated with a higher prevalence of anemia. These findings extend the limited evidence from low-resource settings and underscore the substantial burden of anemia among women with uterine fibroids receiving care at a tertiary facility in Uganda.

The prevalence of anemia among women with uterine fibroids in this was 65.6%. This prevalence is similar to findings from a tertiary hospital–based study in South India, which reported anemia in 66% of women with uterine fibroids and menorrhagia [14]. Comparable estimates across these settings may reflect late presentation to referral hospitals, where women often seek care after complications have developed[21]. The prevalence observed in our study was higher than that reported in studies from the Caribbean and Ireland, where anemia prevalence among women with uterine fibroids ranged from approximately 52% to 54%[22, 23]. Differences in study design, sample size, and health system context—including retrospective data collection and smaller study populations—may partly explain these lower estimates. In contrast, a higher prevalence (80%) was reported in Ghana among women actively seeking care for known uterine fibroids[12], suggesting that differences in case mix and care-seeking patterns may influence observed prevalence.

Notably, the prevalence of anemia in our study was approximately double the global estimate for non-pregnant women and substantially higher than national estimates for women of reproductive age in Uganda [24] [25]. This suggests that uterine fibroids are an important contributor to the anemia burden [26]

Nearly one-third of anemic participants had severe anemia, a finding consistent with reports from other low-resource settings where women with uterine fibroids frequently present with advanced disease requiring blood transfusion [14] [26]. Delayed recognition of symptoms and barriers to timely care may contribute to this pattern. This highlights the importance of screening for anemia among women with uterine fibroids, particularly in settings where delays in care are common.

Women with fibroids involving more than one anatomical site had a higher prevalence of anemia compared with those with fibroids confined to a single site. Similar findings have been reported in a multicenter retrospective cohort study in Ireland, where women with four or more fibroids were more frequently anemic[13]. Fibroids located in different uterine layers may be associated with cumulative disruption of uterine structure and function, including altered myometrial contractility and increased endometrial surface area, which have been linked to prolonged or heavier menstrual bleeding[27]. When fibroids occur in multiple uterine layers, such as the submucosal, intramural, and subserosal regions, their overlapping effects on uterine structure and bleeding patterns may be associated with prolonged blood loss and lower hemoglobin levels.

Heavy menstrual bleeding, measured using the pictorial blood loss assessment chart, was also independently associated with anemia. This finding is consistent with findings from Ghana and other sub-Saharan African settings, where abnormal uterine bleeding has been frequently reported among women with uterine fibroids and anemia[12]. Prior studies have shown that fibroids are associated with dysregulated endometrial angiogenesis and hemostasis, including altered expression of vascular endothelial growth factor, fibroblast growth factors, platelet-derived growth factors, and plasminogen modulators, which may contribute to increased menstrual blood loss [28],[29]. Chronic heavy menstrual bleeding can result in progressive iron depletion, limiting hemoglobin synthesis and red blood cell production, and ultimately manifesting as iron-deficiency anemia [30], [31]. Overall, the identified associations underscore the importance of systematically assessing menstrual blood loss and fibroid distribution when evaluating women with uterine fibroids in similar low-resource settings.

Findings from this study have important public health and policy implications. First, the high prevalence of anemia among women with uterine fibroids indicates a substantial burden of gynecological morbidity in low-resource settings and an increased demand for blood transfusion services. Second, the observed associations with heavy menstrual bleeding and fibroids involving multiple uterine sites underscore the need to strengthen routine anemia screening and targeted clinical assessment within gynecology services. Incorporating standardized evaluation of menstrual blood loss and routine hemoglobin testing into care pathways may facilitate earlier identification of anemia, improve preoperative optimization, and reduce progression to severe disease among women at higher risk. Finally, integrating anemia

assessment into existing reproductive health platforms, alongside community sensitization to promote timely care-seeking for gynecological symptoms, may help reduce late presentation with advanced fibroid-related complications and improve equity and quality of women's health care in similar low-resource settings, consistent with global recommendations on integrated women's health services [32, 33].

Study limitations

This study has some limitations that should be considered when interpreting the findings. First, the study was conducted at a single tertiary referral hospital, which may limit the generalizability of the findings. Women presenting to referral facilities are more likely to have advanced disease or complications, and the prevalence and severity of anemia observed in this study may therefore be higher than would be expected among women with uterine fibroids in community or primary care settings. Second, menstrual blood loss was assessed using the pictorial blood loss assessment chart, which relies on participant recall of the most recent menstrual cycle. Although the tool is validated and widely used, recall bias and subjective interpretation of pad saturation may have affected the accuracy of blood loss estimation. Finally, several potential contributors to anemia were not assessed. Nutritional status, dietary iron intake, micronutrient deficiencies, parasitic infections, malaria and markers of chronic inflammation were beyond the scope of this study but may have influenced hemoglobin levels. Residual confounding from these unmeasured factors cannot be excluded. Despite these limitations, the study provides important evidence on the burden, severity, and associated factors of anemia among women with uterine fibroids in a low-resource tertiary care setting.

Conclusions

Anemia was common among women with uterine fibroids in this tertiary care setting, affecting nearly two-thirds of participants, and was frequently moderate or severe at the time of presentation. These findings suggest a substantial burden of fibroid-related anemia in low-resource settings. Strengthening routine anemia screening and early fibroid evaluation within gynecology services, with closer monitoring of women reporting heavy menstrual bleeding or multiple fibroids, could help reduce progression to severe complications. Future studies should further examine nutritional and infectious contributors to anemia, the type of anemia and evaluate the effectiveness of integrated screening and early management strategies in improving health outcomes among women with uterine fibroids in comparable to low-income settings.

Abbreviations

AUB:
Abnormal Uterine Bleeding
FIGO:
International Federation of Gynecology and Obstetrics

Hb:
Hemoglobin
HIV:
Human Immunodeficiency Virus
HMB:
Heavy Menstrual Bleeding
MRRH:
Mbarara Regional Referral Hospital
GOPD:
Gynaecology Outpatient Department
PBLAC:
Pictorial Blood Loss Assessment Chart
WHO:
World Health Organization

Declarations

Ethical considerations

Ethical clearance was obtained from the Research Ethics committee (No: **MUST-2024-1353)** of Mbarara University of Science and Technology (MUST) and the Uganda National Council for Science and Technology (**UNCST-HS5815ES**). Administrative permission was obtained from the Director of Mbarara Regional Referral Hospital. The study was explained to all participants and informed consent was duly obtained to allow the study be carried out. We respected the guidelines of Helsinki and Council for International Organization of Medical Sciences, (CIOMS-2002) regarding research with humans, avoiding any type of physical or moral harm. All participants had the right to withdraw from the study at any time they wished to and this did not affect their rights to receive health care services and participant's information were kept confidential throughout the study.

Availability of data and materials

The datasets generated and analysed for this study are available from the corresponding author upon reasonable request.

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

Funding

There was no funding for this work.

Authors' contributions

All authors have read, edited and approved the final copy of the manuscript and accept responsibility for the integrity and accuracy of the work in its entirety.

Concept and design: Etwop Patrick., Musa Kayondo, Brenda Ainomugisha, Paul Kalyebara Godfrey R. Mugyenyi.

Acquisition, analysis, or interpretation of data: Patrick Etwop [1]*, Musa Kayondo[1], Brenda Ainomugisha[1], Richard Migisha[2], Leevan Tibaijuka[3], Godfrey R. Mugyenyi[1], Joseph Ngonzi[1], Hamson Kanyesigye[1,4], Henry Mark Lugobe[1], Rogers Kajabwangu[1,2], Paul Kalyebara[1], Raymond Timothy Mugerwa[1,] Patrick Ochuga[1], Emmanuel Adupa[1], Daniel Begumana[1]

Drafting of the manuscript: Patrick Etwop, Musa Kayondo, Brenda Ainomugisha and Richard Migisha.

Critical review of the manuscript for important intellectual content: Patrick Etwop, Musa Kayondo, Brenda Ainomugisha, Richard Migisha, Joseph Ngonzi and Leevan Tibaijuka.

Supervision: Patrick Etwop, Musa Kayondo and Brenda Ainomugisha.

Acknowledgement

We immensely appreciate the support from all the Obstetrics and Gynecology Department members of Mbarara University of Science and Technology not forgetting the administration of Mbarara Regional Referral Hospital during the study period. We also thank Sr. Dorothy, Sr. Dorothy and Ms. Nampijja Aisha who honestly collected the data, and all the women who willingly accepted to participate in this study.

References

1. Marsh EE, Wegienka G, Williams DR. Uterine Fibroids. JAMA, 2024.
2. Wegienka G. Are uterine leiomyoma a consequence of a chronically inflammatory immune system? Med Hypotheses. 2012;79(2):226–31.
3. Ahmad A, et al. Diagnosis and management of uterine fibroids: current trends and future strategies. J Basic Clin Physiol Pharmacol. 2023;34(3):291–310.
4. Fuldeore MJ, Soliman AM. Patient-reported prevalence and symptomatic burden of uterine fibroids among women in the United States: findings from a cross-sectional survey analysis. Int J women's health, 2017: pp. 403–11.

5. MacDonald C, Namarika R, Yiannakis M. Anemia—can its widespread prevalence among women in developing countries be impacted. Table; 2006.
6. Kawano M, et al. Life-threatening anemia due to uterine fibroids: a case series. Experimental Therapeutic Med. 2022;24(5):669.
7. Wang A, et al. Health care costs and treatment patterns associated with uterine fibroids and heavy menstrual bleeding: a claims analysis. J Women's Health. 2022;31(6):856–63.
8. Stewart EA, Laughlin-Tommaso SK. Uterine fibroids. N Engl J Med. 2024;391(18):1721–33.
9. Giuliani E, As-Sanie S, Marsh EE. Epidemiology and management of uterine fibroids. Int J Gynecol Obstet. 2020;149(1):3–9.
10. Karami M, et al. Global prevalence of anemia in pregnant women: a comprehensive systematic review and meta-analysis. Matern Child Health J. 2022;26(7):1473–87.
11. Baldi A, Pasricha S-R. *Anaemia: worldwide prevalence and progress in reduction*, in *Nutritional anemia*. Springer; 2022. pp. 3–17.
12. Buadi LO. Anemia among Women Seeking Treatment for Uterine Fibroids in three Selected Hospitals in Accra Metropolis. University of Ghana; 2016.
13. Keshta MS et al. A Multicenter Retrospective Cohort Study Assessing the Incidence of Anemia in Patients Associated With Uterine Fibroids. Cureus, 2024. 16(9).
14. Munusamy MM, Sheelaa WG, Lakshmi VP. Clinical presentation and prevalence of uterine fibroids: a 3-year study in 3-decade rural South Indian women. Int J Reprod Contracept Obstet Gynecol. 2017;6(12):5596–602.
15. Puri K, et al. Submucosal fibroids and the relation to heavy menstrual bleeding and anemia. Am J Obstet Gynecol. 2014;210(1):38. e1-38. e7.
16. Donnez J, et al. Uterine disorders and iron deficiency anemia. Fertil Steril. 2022;118(4):615–24.
17. Adawe M, et al. Prevalence, clinical presentation and factors associated with Uterine fibroids among women attending the Gynecology Outpatient Department at a large Referral Hospital in Southwestern Uganda. East Afr Sci. 2022;4(1):48–53.
18. Kish L. Survey sampling. new york: John wesley & sons. Am Polit Sci Rev. 1965;59(4):1025.
19. Magnay JL, et al. A systematic review of methods to measure menstrual blood loss. BMC Womens Health. 2018;18(1):142.
20. Organization WH. Guideline on haemoglobin cutoffs to define anaemia in individuals and populations. World Health Organization; 2024.
21. Kiwanuka S et al. *Access to and utilisation of health services for the poor in Uganda: a systematic review of available evidence.* 2008. 102(11): pp. 1067–1074.
22. Millien C, et al. Assessing burden, risk factors, and perceived impact of uterine fibroids on women's lives in rural Haiti: implications for advancing a health equity agenda, a mixed methods study. Int J Equity Health. 2021;20:1–17.

23. Keshta MS, et al. A Multicenter Retrospective Cohort Study Assessing the Incidence of Anemia in Patients Associated With Uterine Fibroids. Cureus. 2024;16(9):e69899.
24. Stevens GA, et al. National, regional, and global estimates of anaemia by severity in women and children for 2000–19: a pooled analysis of population-representative data. Lancet Global Health. 2022;10(5):e627–39.
25. Kato Jumba K. *Prevalence and Risk Factors of Anemia among Women in Uganda: A Comprehensive Review.*
26. Igboeli P et al. *Burden of uterine fibroids: an African perspective, a call for action and opportunity for intervention.* 2019. 2(1): p. 287.
27. Sefah N et al. *Uterine fibroids—Causes, impact, treatment, and lens to the African perspective.* 2023. 13: p. 1045783.
28. Stewart EA, Nowak RA. Leiomyoma-related bleeding: a classic hypothesis updated for the molecular era. Hum Reprod Update. 1996;2(4):295–306.
29. Doherty L, et al. Uterine fibroids: clinical manifestations and contemporary management. Reproductive Sci. 2014;21(9):1067–92.
30. Donnez J, et al. Uterine disorders iron Defic anemia. 2022;118(4):615–24.
31. Critchley HO, et al. Menstruation should not be overlooked in control of anaemia. Lancet. 2021;397(10268):26.
32. Organization WH. *Continuity and coordination of care: a practice brief to support implementation of the WHO Framework on integrated people-centred health services.* 2018.
33. Azenha GS, et al. Recommendations towards an integrated, life-course approach to women's health in the post-2015 agenda. Bull World Health Organ. 2013;91:704–6.

Figures

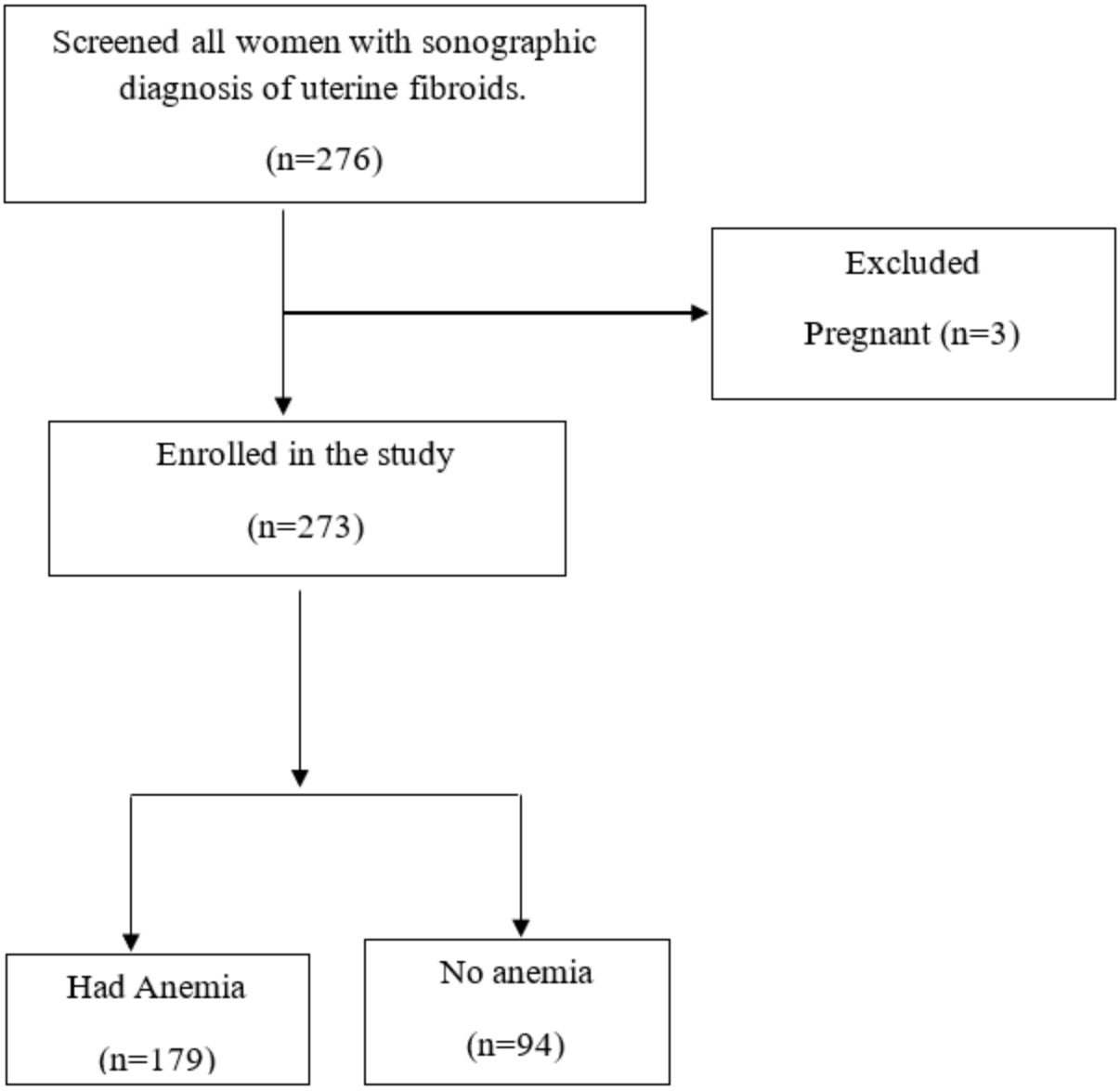


Figure 1

Participant flow diagram

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- APPENDIX1.pdf