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RESEARCH

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Adherence to iron deficiency interventions among pregnant women attending antenatal clinics in Ubungo municipality, Dar es Salaam, Tanzania

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Abstract

Background Iron deficiency anemia in pregnant women remains a public health concern despite iron deficiency interventions that have been implemented. This study investigated adherence to iron deficiency interventions and the associated factors among pregnant women attending antenatal clinics in Ubungo Municipality.

Methods This cross-sectional study used a systematic random sampling technique to obtain 503 participants from the surveyed clinics. Interviews were conducted by using interviewer-administered questionnaires. Data were analyzed using Stata version 17. The study employed binary and multivariable logistic regression analysis to determine factors associated with adherence to iron deficiency interventions.

Results In this study, 72% of participants were non-adherent and 28% were adherent to the interventions. In multivariable regression analysis, participants who forgot to take their iron tables on most days (AOR 2.35; 95% CI 1.23–4.48) and those who reported that not enough time was spent on education and counseling during antenatal clinic visits (AOR 3.87; 95% CI 1.08–13.84) were more likely to be non-adherent to iron deficiency interventions.

Conclusions Majority of pregnant women in Ubungo Municipality were non-adherent to iron deficiency interventions. Non-adherence was associated with a tendency to forget taking iron tablets, and lack of enough time in providing health education and counseling. Improving the quality of health education and counseling could increase adherence to iron deficiency interventions and reduce maternal–child morbidity and mortality rates.

Keywords Iron, Adherence, Anemia, Tablets, Foods

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Introduction

Iron is one of the essential micronutrients that contributes to growth and development (Di Renzo et al. 2015). The majority of anemia in women of childbearing age is due to low or absent iron stores, which remains a public health concern (WHO 2012). Anemia in pregnancy is associated with an increased risk of morbidity and mortality for both the mother and the child (Fisher and Nemeth 2017; Stephen et al. 2018). Iron requirements in pregnancy are increased due to the increasing blood volume of the mother as well as the additional iron requirements for fetal red blood cell production and fetoplacental growth (Fareeq and Zangana 2019). Other factors that may contribute to the depletion and deficiency of iron include reduced bioavailability and inadequate dietary intake of iron-rich foods (Kangalgil et al. 2021). It is therefore important to increase iron intake through dietary and supplementary sources in order to prevent moderate and severe forms of iron deficiency anemia in pregnancy (Di Renzo et al. 2015). There are consequences of anemia for women who enter pregnancy with depleted iron stores, including an increased risk of neurodevelopmental abnormalities in the child, premature birth, low birth weight, and increased maternal mortality (Sharma et al. 2021; Garzon et al. 2020; Georgieff et al. 2019).

The prevalence of anemia among pregnant women of all trimesters is 36.8% on a global scale compared to Africa, which is 41.7%, the highest of all continents. Tanzania has a prevalence of 57.1% (Karami et al. 2022; Sunguya et al. 2021). Several factors have been reported to contribute to the high prevalence of anemia in Tanzania. These include a large household size, young maternal age, a low level of education, insurance coverage, a low number of antenatal care (ANC) visits, and the low use of antimalarial prophylaxis for mothers (Stephen et al. 2018; Sunguya et al. 2021). To combat the problem of iron deficiency anemia, the World Health Organization (WHO) has recommended a daily elemental iron supplementation of 30 mg–60 mg per day to all pregnant women from the first trimester throughout the pregnancy in all settings (WHO 2012). These recommendations are practiced in all health facilities throughout the country by providing iron and folic acid supplements to pregnant women in every visit (Kearns et al. 2014; Sambili et al. 2016).

The level of adherence to iron deficiency interventions in most low- and medium-income countries (LMIC) is concerning. The overall level of adherence in sub-Saharan countries is 39.2%, with most countries having more than half of pregnant women being non-adherent to iron supplementation (Fite et al. 2021). Adherence to iron deficiency interventions is supported by a comprehensive national reproductive and maternal system that addresses local concerns on non-adherence, thereby contributing to increased adherence, as seen in Sri Lanka, where the level of adherence was as high as 80.1% (Pathiranthna 2020). The surrounding factors for a pregnant woman, such as partner involvement or family support, have been found to increase adherence, while other studies also support the feasibility of direct observation in order for a pregnant woman to follow through with the interventions (Triharini et al. 2018; Bilimale et al. 2010).

Furthermore, advice on the intake of iron supplements provided during ANC visits has been shown to facilitate a positive attitude, which in turn increases adherence (Fite et al. 2021). Providing early health education on the purpose, dosage, and duration, as well as possible side effects of the supplement, has been associated with increased adherence to the intake of iron supplements (Solomon et al. 2021). Incorporating and refining dietary education and guidance on modification and intake to boost iron uptake has shown to not only reduce anemia but also increase adherence (Assefa et al. 2019).

The adherence to the intervention is negatively attributed to pathophysiological factors such as gastrointestinal side effects and intolerance, as well as behavioral and sociodemographic factors (Sambili et al. 2016). The latter include forgetfulness, considering oneself to be healthy, misconceptions about intervention, and lack of enough knowledge on the importance of the intervention. The frustrations that come along with service being provided and accessibility to medication have been shown to reduce adherence to pregnant women (Rai et al. 2020). Comparatively, good adherence to the intervention is influenced by the short distance of healthcare facilities from residential areas, availability of medications, and quality of care provided at the healthcare facilities that include comfortability and satisfaction of ANC services, which in turn influence adherence to the intervention to pregnant women (Konje et al. 2022).

Despite the presence of prophylactic efforts such as supplementation, anemia in pregnant women remains a public health concern in Tanzania (Sunguya et al. 2021). Poor adherence to iron interventions could be a hindering factor toward reducing and lifting the burden of anemia among pregnant women, as evidenced in regions of the Northwestern Tanzanian zone, where adherence was 12% (Konje et al. 2022). Therefore, this study aimed to determine adherence and assess factors affecting adherence to iron deficiency interventions in pregnant women.

Methods

Study design and population

This was a cross-sectional study conducted in the antenatal clinics of Sinza Hospital and Kimara Health Centre in Ubungo Municipality, Dar es Salaam, Tanzania, during

the period of March to April 2023. Inclusion criteria included a woman of any gravida status who had started iron supplementation or therapy for at least a month or more and is in the second antenatal visit and above. Exclusion criteria included pregnant women with morbidity such as sickle cell disease, thalassemia, or other blood disorders; pregnant women who have used iron supplementation or therapy secondary to a prior medical condition; and those who were allergic to sulfur-containing medications. The ferrous supplementation provided was combined with sulfur.

Sample size and sampling procedure

The sample size was retrieved from Espa Rodriguez for infinite proportion (Espa et al. 2016) considering: n = the number of sample sizes obtained, t = standard normal deviation of a 95% confidence interval with 4.5% tolerable error, p = proportion, from the presumed prevalence of adherence 50% used with a 5% non-response rate. A minimum of 503 respondents were acquired. A systematic random sampling technique was used to obtain the study participants. The study used a list of attendees of the day; one attendee from the list of one to ten was selected at random, and thereafter every fifth attendee was selected to participate in the study.

Description of variables

Adherence to iron deficiency interventions was the dependent variable, which was measured using a composite score from four self-reported questions on daily intake and frequency of iron tablets and iron-rich foods from the time of receiving the first health education and counseling at the antenatal clinic. The four questions included: (i) when did they start taking iron tablets (*score 1* = the day it was provided; *score 0* = the following days); (ii) how often did they take the iron tablets in a span of a week over the past 1 month (*score 1* = every day; *score 0* = 6 days or less per week); (iii) if they had started consuming iron-rich foods (*score 1* = yes; *score 0* = no); and how often they consumed iron-rich foods (*score 1* = every day; *score 0* = 6 days or less per week). Participants who responded with a composite score of 4 out of 4 from the questionnaire were considered adherent to iron deficiency interventions.

Independent variables included sociodemographic characteristics, behavioral factors, and health service factors affecting adherence to iron deficiency interventions. Behavioral factors, which are daily practices related to adherence to iron deficiency interventions, were measured using eleven questions, each with a Likert scale of "1–5." Health service factors, which are enabling factors provided through health services to adherence, were measured using eight questions to respondents, who were needed to choose the most correct answer.

Data collection process

The tool was validated using a sample of 5% of questionnaires which were administered to respondents at a Mukuamula Health Centre in Ubungo Municipality. Statistical and field experts were consulted to ensure that the tool was well understood and answered the research questions. Thereafter, primary data about the main sample population were collected from respondents, using an interviewer-administered questionnaire, attending antenatal care clinic; identifiers were eliminated to preserve confidentiality. Data collected comprised sociodemographic data and questions on adherence and factors that may affect one's adherence to iron deficiency interventions. Data quality was assessed through an independent verification process, wherein a secondary party reentered the primary data into Microsoft Excel to identify and correct any errors.

Alongside the authors, the recruitment of four research assistants was done considering their educational background which involved three third-year medical school students, and one enrolled nurse. They underwent training for two days to ensure they were familiar with the research process and how to assist in data collection procedures including creating rapport, ethical considerations, and data collection techniques.

Data management and analysis

From Microsoft Excel 2019, the collected data were imported into Stata software version 17.0 for further analysis, whereby both descriptive and inferential analysis was deployed. On descriptive analysis, proportions and frequency tables were used to summarize all categorical variables, which included behavioral factors and health service factors. Likewise, adherence was measured by using self-reported questions provided to the respondents. Inferential analysis using bivariate and multivariable logistic regression was deployed to determine the factors associated with adherence to iron deficiency intervention (i.e., 1 = non-adherence and 0 = adherence). Potential confounders added to the models included age, education, and occupation. All statistical tests were done at a 5% significant level.

Results

Sociodemographic characteristics of the participants

Out of 503 respondents, 279 of the respondents' ages (55.5%) ranged from 25 to 35 years old, with a median age of 26 (IQR, 23 to 31) (Table 1). Respondents with married or living-together partners comprised 83.7% (421/503), and those that had 1–3 children were 51.5%

Table 1 Characteristics of the study participants

Variable	Adherence			*p* value (Chi-squared test)
	N (%)	Yes *N* (%)	No N (%)	
	n = 503	141 (28)	362 (72)	
Age(years)				
18–25	178 (35.4)	48 (27.0)	130 (73.0)	0.690
26–35	279 (55.5)	82 (29.4)	197 (70.6)	
Above 35	46 (9.1)	11 (23.9)	35 (76.1)	
Marital status				
With no partner	82 (16.3)	24 (29.3)	58 (70.7)	0.785
With partner	421 (83.7)	117 (27.8)	304 (72.2)	
Education				
No formal education	10 (2.0)	4 (40.0)	6 (60.0)	0.015
Basic education	402 (79.9)	101 (25.1)	301 (74.9)	
Tertiary	91 (18.1)	36 (39.6)	55 (60.4)	
Occupation				
Unemployed	304 (60.4)	97 (31.9)	207 (68.1)	0.017
Employed	199 (39.6)	44 (22.1)	155 (77.9)	
Number of biological children				
None	236 (46.9)	63 (26.7)	173 (73.3)	0.792
1–3	259 (51.5)	76 (29.3)	183 (70.7)	
4 and above	8 (1.6)	2 (25.0)	6 (75.0)	
Attendance of ANC clinic with partner				
Always	18 (3.6)	4 (22.2)	14 (77.8)	0.827
Sometimes	328 (65.4)	94 (28.7)	234 (71.3)	
Never	156 (31.1)	43 (27.6)	113 (72.4)	
Initiation of ANC clinic				
First trimester	260 (51.8)	63 (24.3)	197 (75.8)	0.095
Second trimester	236 (47.0)	77 (32.6)	159 (67.4)	
Third trimester	6 (1.2)	1 (16.7)	5 (83.3)	
Anemia (Current Hb)				
Yes	264 (55.4)	71 (26.8)	193 (73.1)	0.517
No	213 (44.6)	63 (29.6)	150 (70.4)	

(259/503), respectively. This study noted that 65.4% (328/503) sometimes attend antenatal visits with their partners, mostly during the first visit. However, 31.1% (156/503) have never attended the antenatal clinics with their partners. It is important to note that slightly above half of women, 51.8% (260/503), started attending an antenatal clinic in the first trimester. Around three-quarters of pregnant women of all ages were found to be non-adherent to iron deficiency interventions. A Chi-square test showed an association between adherence status and having formal education as well as adherence unemployment status (Table 1).

Table 2 Adherence to iron deficiency interventions related to the prevalence of anemia

Variable	*N* (%)	Anemia prevalence (%)
Start of medication intake		
The day it was provided	429 (85.3)	53.7
The following days	74 (14.7)	65.2
Uptake of medication		
Everyday	412 (81.9)	53.3
Every other day	45 (8.9)	55.8
Less than 4 days in a week	46 (9.1)	71.7
Dietary modification on iron-rich foods		
Yes	441 (87.7)	54.9
No	62 (12.3)	58.1
Frequency of uptake of iron-rich foods		
Everyday	201 (40)	55.2
Seldom (2–6 times)	261 (51.9)	54.9
Once a week	41 (8.1)	58.5
Adherence status		
Adherence	141 (28)	53.0
Non-adherence	362 (72)	56.3

Adherence characteristics with anemia

This study found that 72% (362/503) of pregnant women were non-adherent to iron deficiency interventions, with anemia among the non-adherent being 56.3% and 53.0% among those who were adherent (Table 2). Participants who were taking iron tablets less than 4 days a week were found to have anemia of 71.7%, which is higher compared to those who take their tablets every day. This study found that 87.7% (441/503) of the participants did some sort of dietary modification on iron-rich foods. Most participants reported that slightly over half, 51.9% (261/503) increased their iron-rich food intake to 2–6 times a week and that 40% (201/503) take an iron-rich food every day (Table 2).

Behavioral factors associated with adherence to iron deficiency interventions

In all questions that were asked, almost three-quarters of the participants were non-adherent to iron deficiency interventions. Lesser odds of non-adherence to iron deficiency interventions (OR 0.71: CI 0.33–1.54, *p* value 0.391) were seen among respondents who reported that their partners reminded them to take iron tablets (Table 3). Some behaviors, such as finding no problem in skipping uptake of iron tablets, were found to be 1.4 had higher odds (OR 1.4: CI 0.32–6.04, *p* value 0.646) of being non-adherent. It is noteworthy that this study found that

Table 3 Behavioral factors associated with adherence to iron deficiency interventions among pregnant women

Variable	Adherence			COR		AOR	
	N (%)	Yes *N* (%)	No *N* (%)	OR, 95% CI	*p* value	OR, 95% CI	*p* value
	n = 503	141 (28)	362 (72)				
Behavioral factors							
Partner's knowledge on the importance of iron tablets							
Disagree	47 (9.5)	14 (29.8)	33 (70.2)	1		1	
Agree	446 (90.5)	124 (27.8)	322 (72.2)	1.10, (0.57–2.12)	0.773	2.53, (0.84–7.64)	0.098
Partner's contribution in reminding the uptake of iron tablets							
Disagree	105 (21.3)	25 (23.8)	80 (76.2)	1		1	
Agree	388 (78.7)	112 (28.9)	276 (71.1)	0.77, (0.46–1.26)	0.306	0.71, (0.33–1.54)	0.391
I don't need iron tablets if I look healthy							
Disagree	423 (90.8)	119 (28.1)	304 (71.9)	1		1	
Agree	42 (9.3)	12 (28.6)	30 (71.4)	0.97, (0.48–1.97)	0.952	0.96, (0.35–2.60)	0.940
There's no problem in skipping the uptake of iron tablets							
Disagree	414 (90.9)	120 (29)	294 (71)	1		1	
Agree	42 (9.1)	5 (23.8)	16 (76.2)	1.30, (0.46–3.64)	0.610	1.40, (0.32–6.04)	0.646
Iron tablets may harm the baby							
Disagree	414 (95.2)	123 (28.8)	303 (71.1)	1		1	
Agree	21 (4.8)	1 (20)	4 (80)	1.62, (0.17–14.67)	0.666	1.14, (0.10–12.67)	0.910
I take iron tablets when I feel sick							
Disagree	426 (98.8)	103 (28)	265 (72)	1		1	
Agree	5 (1.2)	35 (29.9)	82 (70.1)	0.91, (0.57–1.43)	0.688	1.19, (0.64–2.19)	0.576
I forget to take iron tablets in most days							
Disagree	368(75.8)	119 (32.7)	245 (67.3)	1		1	
Agree	117 (24.1)	22 (16.1)	115 (83.9)	2.53, (1.53–4.21)	0.000	2.35, (1.23–4.48)	0.009
I take extra tablets the next time after an episode of forgetting							
Disagree	491 (98)	139 (28.3)	352 (71.7)	1		1	
Agree	10 (2.0)	1 (10.0)	9 (90.0)	3.55, (0.44–28.31)	0.231	NC[a]	NC[a]
I get bored taking tablets every day							
Disagree	308 (62.4)	89 (28.9)	219 (71.1)	1		1	
Agree	186 (37.6)	49 (26.3)	137 (73.7)	1.13, (0.75–1.71)	0.540	1.18, (0.68–2.04)	0.549
I eat healthy as advised by the healthcare professional							
Disagree	24 (4.8)	1 (4.2)	23 (95.8)	1		1	
Agree	473 (95.2)	138 (29.2)	335 (70.8)	0.10, (0.01–0.78)	0.028	0.21, (0.02–1.88)	0.166
I do not like foods advised by the healthcare professional							
Disagree	436 (88.1)	130 (29.8)	306 (70.2)	1		1	
Agree	59 (11.9)	10 (17.0)	49 (83.0)	2.08, (1.02–4.23)	0.043	1.74, (0.77–3.93)	0.179

[a] Non Calculable

participants who had a tendency to forget taking iron tablets were 2.35 times more likely (OR 2.35: 1.23–4.48 *p* value 0.009) to be non-adherent to iron deficiency interventions (Table 3).

Health service factors associated with adherence to iron deficiency interventions

This study found that 94.8% (477/503) received health education and counseling, and among those who received health education and counseling, 91.6% (437/503) reported being provided a complete maternal education, including maternal nutrition. And that those who were provided with health education 2–4 times during their pregnancy had lesser odds (OR 0.79: CI 0.33–1.90) of being non-adherent and even lesser odds (OR 0.66: CI 0.26–1.66) were seen among those who received maternal education above 4 times during their pregnancy (Table 4). On account for the time that was used for education and counseling, the study found that those who reported that the time used for health education was not

Table 4 Health service factors associated with adherence to iron deficiency interventions among pregnant women

Variable	Adherence			COR		AOR	
	N (%)	Yes *N* (%)	No *N* (%)	OR, 95% CI	*p* value	OR, 95% CI	*p* value
	n = 503	141(28)	372(72)				
Health Services							
Education and counseling received during the ANC visit							
Yes	477 (94.8)	136 (28.5)	341 (71.5)	0.59, (0.22–1.61)	0.310	NC	NC
No	26 (5.2)	5 (19.2)	21 (80.7)	1		1	
Frequency of education and counseling sessions received							
Once	41 (8.6)	9 (21.9)	32 (78.5)	1		1	
2–4	301 (63.1)	83 (27.6)	218 (72.4)	0.73, (0.33–1.61)	0.448	0.79, (0.33–1.90)	0.605
4 and above	135 (28.3)	44 (32.6)	91 (67.4)	0.58, (0.25–1.32)	0.197	0.66, (0.26–1.66)	0.383
Type of counseling received							
Nutrition	14 (2.9)	4 (28.6)	10 (71.4)	1		1	
Health (Danger signs, etc.)	26 (5.5)	7 (26.9)	19 (73.1)	1.08, (0.25–4.61)	0.911	1.02, (0.20–5.07)	0.976
All	437 (91.6)	125 (28.6)	312 (71.4)	0.99, (0.30–3.24)	0.998	1.06, (0.28–4.00)	0.922
Was enough time spent in education and counseling							
Yes	451 (94.6)	133 (29.5)	318 (70.5)	1		1	
No	26 (5.4)	3 (11.5)	23 (88.5)	3.20, (0.94–10.86)	0.061	3.87, (1.08–13.8)	0.037
Iron tablets were provided during ANC visits							
Yes	499 (99.2)	141 (28.3)	358 (71.3)				
No	4 (0.8)	0 (0.0)	4 (100.00)	NC[a]	NC	NC	NC
Access to iron tablets							
Healthy facility	489 (97.2)	139 (28.4)	350 (71.6)	1		1	
Community Pharmacies	14 (2.8)	2 (14.3)	12 (85.7)	2.3, (0.52–10.78)	0.260	1.81, (0.34–9.51)	0.482
Iron tablets enough to sustain to the next visit							
Often	414 (82.3)	124 (30)	290 (70)	1		1	
Seldom	63 (12.5)	13 (20.6)	50 (79.4)	1.64, (0.86–3.13)	0.131	1.75, (0.86–3.59)	0.121
Never	26 (5.2)	4 (15.4)	22 (84.6)	2.35, (0.79–6.96)	0.123	1.78, (0.58–5.45)	0.312

[a] Non Calculable

enough were more likely (OR 3.87: CI 1.08–13.8, *p* value 0.037) to be non-adherent to iron deficiency interventions. This study found that 97.2% (489/503) of the iron tablets were distributed from the antenatal clinics. However, higher odds (OR 1.75: CI 0.86–3.59) of being non-adherent were seen among participants who reported that iron tablets were not enough to sustain them up to the next visit; this was however not significant (Table 4).

Discussion

Iron deficiency and iron deficiency anemia among pregnant women remain a public health concern in Tanzania (Fisher and Nemeth 2017; Sunguya et al. 2021). In the current study, adherence to iron deficiency interventions was found to be low at 28%. A tendency to forget taking iron tablets and lack of enough time for education and counseling were positively associated with low adherence to iron deficiency interventions.

This study found that adherence to iron deficiency interventions is significantly low and that among the non-adherent, the prevalence of anemia was found to be slightly more than half, which is almost that of the national prevalence of anemia among pregnant women. This implies that, with iron deficiency interventions not adhered to, secondary negative effects associated with anemia that occur to the mother and child will most likely persist (Sunguya et al. 2021; Winardi and Grahardika Andani 2018). The percentage of adherence varies widely with other low- and middle-income countries (LMIC) across Africa, ranging from 55.3% in Ethiopia, 56% in Cameroon, and 79.7% in Kasulu, Tanzania (Lyoba et al. 2020; Birhanu et al. 2018; Fouelifack et al. 2019).

On account of the uptake of iron-rich foods, this study found that the lesser the frequency of uptake of iron-rich foods, the higher the prevalence of anemia, regardless of the presence of iron tablets. This finding is similar to a study in Sri Lanka where only a quarter of respondents adhered to iron-rich foods while taking iron tablets, with the prevalence of anemia being over half, similar to that of this study. And though iron deficiency anemia (IDA)

can be solely managed with iron therapy, the inclusion of dietary modifications provides improved results in terms of hemoglobin levels and iron levels as a whole (Pathiranthna 2020). Incorporating a dietitian has also been shown to improve the intake of iron-rich foods. In conditions with fewer human resources, training healthcare providers on dietary guidance to pregnant women may also show similar results (Fite et al. 2021).

A tendency to forget to take iron tablets has been found significant in this study. This could be explained by the limited support from male partners, as evidenced in this study, whereby only 3% of women were accompanied to the clinic for all the visits. Similar studies in Zambia, Ethiopia, and Nigeria report male involvement or the presence of a family member in reminding and supporting the antenatal interventions as a whole has been found to reduce forgetfulness in taking iron tablets among pregnant women (Simuyemba et al. 2020; Desta et al. 2019; Ugwu et al. 2014). Furthermore, this study found that women who accepted the modification of iron-rich foods resulting from the education provided, increased adherence to iron tablets and iron-rich foods, hence, reducing the occurrence of anemia. Contrary to this study, the study conducted in Nigeria reported that participants thought there was no need for iron tablets as long as the intake of iron-rich food was good and adequate (Ugwu et al. 2014). However, living in a tropical environment where there is exposure to malaria infections and helminths, which can lower the level of iron, supplementation is highly supported (Di Renzo et al. 2015; Ugwu et al. 2014).

The majority of the respondents agreed that health education is provided in the ANC clinics during visits in this study. However, lack of enough time in delivering health education and counseling that is patient-centered has been associated with non-adherence, as evidenced by this study's findings. The findings imply that participants who do not get enough time for education and counseling may not know why they have to be adherent, hence making it difficult for them to practice. Similar findings have been found in Kigoma, where shorter and non-interactive health education sessions lead to a lower rate of adherence to iron deficiency interventions. Another quasi-experimental study conducted in Indonesia found participants who received health counseling and education that included teaching aids such as pictures of iron interventions had a higher adherence to intake of iron-rich foods and iron tablets compared to those who did not receive education and counseling (Lyoba et al. 2020; Nahrisah et al. 2020).

The current study also revealed that almost all participants accessed iron tablets from the health facility during ANC visits. However, for almost a quarter of the participants, the iron tablets were not enough to sustain them up to the next visit. This may encourage non-adherence and increase reluctancy to take iron tablets among respondents by either skipping days in taking tablets or taking tablets until they run out and wait until the next visit. This is also supported by a study in Indonesia where enabling factors such as the availability and number of iron tablets taken facilitated the consistent uptake of iron tablets (Winardi and Grahardika Andani 2018).

Conclusions

The study concludes that adherence to iron deficiency interventions in Ubungo municipality, Dar es Salaam, is still low. Factors associated with low adherence to iron deficiency interventions include a tendency to forget intake of iron tablets and insufficient time allocated for health education and counseling. To increase adherence to iron deficiency interventions, health centers are to improve on the provision of quality education and patient-centered counseling sessions. Further exploration of dietary modification strategies can be done in order to improve intake of iron-rich foods.

Abbreviations

ANC	Antenatal clinics
IDA	Iron deficiency anemia
LMIC	Low–middle income countries
WHO	World Health Organization

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Author contributions

GB and HM designed research; GB, NN, and HM conducted research; GB, AW, and EM analyzed data; and GB, HM, NN, and AW wrote the paper. GB, HM, and AW had primary responsibility for the final manuscript content. HM was the overall overseer of the study. All authors read and approved the final manuscript.

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Data availability

The data that support the findings of this study are available from the authors and will be granted upon request to the corresponding authors.

Declarations

Ethics approval and consent to participate

Ethical approval to conduct the study was obtained from the Senate Research and Publications Committee of Muhimbili University of Health and Allied Sciences (MUHAS-REC-03-2023-1559). The committee serves as the Institutional Review Board. Permissions from Ubungo Municipality, the Head of Sinza Hospital and Kimara Health Centre, and the Head of Reproductive and Child Health Department were also obtained to collect the primary data. Respect was granted to the respondents in every aspect of interaction and communication.

Consent for publication
Informed written consent for those who could read and write and fingerprints for those who could not read and write were obtained from respondents for participation in the study. Participants were assured that their participation was voluntary and they could withdraw at any time during the study. Confidentiality was strictly upheld by ensuring that there are non-identifiers in the data collection tool.

Competing interests
The authors declare no competing interests.

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