ORIGINAL RESEARCH

Prevalence and Factors Associated with Adherence to Iron-Folic Acid Supplementation Among Pregnant Women in Eastern Sudan: A Cross-Sectional Study

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Purpose: The present study was conducted to determine the prevalence and factors associated with adherence to iron-folic acid supplementation (IFAS) among pregnant women in eastern Sudan.

Methods: A cross-sectional survey was conducted among pregnant women who obtained antenatal care (ANC) at Gadarif Maternal Hospital in eastern Sudan between May 1 and August 31, 2023. Face-to-face interview questionnaires were used to gather socio-demographic, obstetric, and clinical data (age, parity, education, residence, and previous medical diseases). Knowledge of anemia and IFAS was assessed. Multivariate analysis was performed to adjust for confounders.

Results: A total of 568 pregnant women were enrolled in the present study. Among them, 449 (79.0%) adhered to the IFAS. The multivariate analysis showed that the adjusted odds ratio (AOR) of IFAS adherence increased with ANC visits > 4 (AOR = 1.68, 95.0% CI = 1.01–2.77) and knowledge of anemia (AOR = 2.06, 95.0% CI = 1.437–3.276). In the univariate analysis, maternal occupation and knowledge of IFAS adherence were the only factors associated with IFAS adherence. Maternal age, parity, gestational age, education, residence, occupation, medical insurance, medical disease, and husband's occupation were not associated with IFAS. Forgetfulness (71.0%), frustration from taking many drugs (54.6%), and unpleasant tests of the supplement (50.7%) were the main reasons for not taking the IFAS.

Conclusion: About four out of five pregnant women adhered to the IFAS, indicating a good level of adherence, especially among women who attended more than four ANC visits and those with good knowledge of anemia. More attention is needed to encourage ANC to increase adherence to IFAS.

Keywords: iron, folic acid, pregnancy, age, adherence

Introduction

Pregnant women are more susceptible to anemia than their nonpregnant peers, and anemia can lead to several maternal and perinatal adverse outcomes such as preterm birth, intrauterine growth restriction (IUGR), and low birth weight.[1,2] "The World Health Organization (WHO) defines anemia during pregnancy as a hemoglobin level of less than 11 g/dl".[3] Anemia during pregnancy is one of the main health problems worldwide,[4] with an estimated prevalence of 36.8%.[5] Sub-Saharan Africa (SSA) has a high prevalence of anemia during pregnancy at a rate of 57.0%.[6] While anemia during pregnancy is multifactorial, it mainly occurs due to deficiencies in iron, folate, and vitamins A and B12,[7] and not taking iron-folic acid supplementation (IFAS).[8]

Iron and folic acid requirements increase during pregnancy.[9] A lack of bioavailable dietary iron and/or increased requirements during childhood, pregnancy, or postpartum are the main causes of iron deficiency.[10] Folic acid deficiency during pregnancy is associated with a high risk of congenital abnormalities, preeclampsia, fetal death, fetal growth restriction, and preterm delivery.[9] Thus, administering iron and folic acid medications to

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pregnant women is the most effective supplementation intervention to avoid deficiencies.[11] The WHO has recommended that all pregnant women should take daily supplements of 400 µg folic acid and 30–60 mg of elemental iron throughout pregnancy.[12] The efficiency of IFAS depends on an individual's adherence to the supplemental regimen,[13] as prescribed by their healthcare providers.[10] A woman is considered to have adhered to IFAS if she took at least 65%, which is equivalent to taking the supplement at least four days a week.[10]

While some previous studies have reported adequate levels of IFAS adherence among pregnant women,[14,15] others have reported poor adherence.[16,17] Various factors, such as parity,[18,19] maternal education level,[20] maternal residence,[21] birth interval,[22] antenatal care (ANC) level,[22] history of anemia,[23] and knowledge of anemia and IFAS[18–20,24] are associated with adherence to IFAS. Thus, most of these studies recommended raising ANC, education, and knowledge on anemia to have an optimum adherence to IFAS.[18–20,22,24] Forgetting to take the IFAS,[11] misunderstanding instructions, adverse effects, and frustration about the frequency and number of tablets taken are causes of poor adherence to IFAS.[25,26]

While there is much-published data on IFAS adherence during pregnancy in Sub-Saharan Africa,[17,18,24,27,28] no published data focusing on this topic in Sudan, the third-largest African country. Anemia is a major health problem in Sudan, with a prevalence of 53.0% among pregnant women,[29] and anemia during pregnancy is associated with poor maternal and perinatal outcomes.[30] Assessing the factors associated with adherence to IFAS during pregnancy is important for obtaining the data to apply evidence-based interventions. Considering this, the present study was conducted to determine the prevalence and factors associated with IFAS adherence among pregnant women in eastern Sudan.

Methods
Study Population
The study population comprised all pregnant women attending follow-ups at the antenatal care clinic (ANC) of Gadarif General Hospital, with at least a second visit, and who were prescribed IFAS tablets for at least one month.

Study Design
This study involved a hospital-based cross-sectional survey of pregnant women who visited the ANC at Gadarif General Hospital for routine follow-ups during the study period between May 1 and August 31, 2023. The Strengthening of the Reporting of Observational Studies in Epidemiology (STROBE) guidelines were strictly followed.[31]

Inclusion Criteria
Pregnant women aged 18–40 years who visited the ANC at least twice and had taken IFAS during their current pregnancy for at least a month before the study period were included in the study.

Exclusion Criteria
Pregnant women who were seriously ill, unable to respond because of physical or psychological disabilities, attending ANC for the first time, or having missed data were excluded.

Sample Size Determination and Sampling Procedure
The sample size of 568 was computed using OpenEpi Menu software.[32] Based on the prevalence of IFAS adherence in the nearby country of Ethiopia, it was assumed that 50.0% of the pregnant women in this study would adhere to the IFAS.[20] In addition, based on previous reports on the knowledge of anemia in Ethiopia[20] It was assumed that 53.0% of the study participants with knowledge about anemia would adhere to the IFAS, while 40.0% of the women without it would adhere to the IFAS. The determined sample size had a 95% confidence level, a 5% level of significance (α), and a 5% margin of error (d).

Sampling Technique
A total of 568 women were enrolled using the systematic random sampling technique. According to the hospital records, 1772 women attended the ANC unit during a three-month period before the current study. Thus, a sampling interval of ≈

3 was assumed by dividing the expected number (women-neonates / calculated sample size [1772/568 ≈ 3]) by 3. The eligible women were interviewed every three intervals until the required sample size 568 was reached.

Data Collection Tools

Data were collected through face-to-face interviews involving an interviewer-administered questionnaire. The questionnaire was adapted and modified based on a thorough literature review.[9,10,33,34] The main contents of the questionnaire pertained to sociodemographic, obstetric, and medical history (age, parity, gestational age, education, occupation, residency, education, husband's occupation, history of miscarriage, history of stillbirth, history of cesarean delivery, and medical disease) and the mother's knowledge about anemia and IFAS.

Operational Definition
Adherence to IFAS

Pregnant women were asked to report the number of IFA tablets they took per week from all the prescribed tablets in the previous month. Those who consumed ≥ 4 tablets a week or 20 tablets in a month without missing the prescribed daily dosage were considered adherent to the IFAS regimen; otherwise, they were considered nonadherent.[9,10,33]

Anemia

Anemia was defined as a hemoglobin level of less than 11 g/dl.[3]

Knowledge on Anemia

For the women's responses to anemia-related questions, a score of 1 was given for each correct answer and 0 for each incorrect answer/lack of knowledge. Accordingly, pregnant women who obtained scores greater than the mean value of correct answers were considered to have good knowledge about anemia; otherwise, they were considered to have poor knowledge.[9,33]

Knowledge of IFAS

For the women's responses to questions about the IFAS, a score of 1 was given for each correct answer and 0 for each incorrect answer/lack of knowledge. Participants who obtained scores greater than the mean value of correct answers were considered to have good knowledge of IFAS; otherwise, they were considered to have poor knowledge.[9,33]

Statistical Analysis

The Statistical Package for the Social Sciences® (SPSS®) for Windows, version 22.0 (SPSS Inc., New York, United States), was used to analyze the data. The Shapiro–Wilk test was used to evaluate the normality of continuous variables. The results showed that they were not normally distributed and were thus expressed as median values (interquartile range [IQR]) and were compared between the two groups (adhere and non-adhere to IFAS) using the non-parametric test (Mann–Whitney-*U* test). A univariate binary analysis was performed with IFAS as the dependent variable. Sociodemographic data, obstetric data, medical history (age, parity, gestational age, education, occupation, residency, human, education, husband's occupation, history of miscarriage, history of stillbirth, history of cesarean delivery, and medical disease), and knowledge about anemia and IFAS were the independent variables. Variables with a p-value < 0.20 were shifted to build up a multivariate binary regression analysis. The variance inflation factor (VIF) was used to check for multicollinearity, which was not detected. Moreover, the Hosmer–Lemeshow test was used to check the model's fit, and the results showed that the model fit the data adequately. The degree of association between the dependent and independent variables was assessed using an adjusted odds ratio (AOR) at a 95% confidence interval (CI). Variables with a p-value < 0.05 were considered statistically significant.

Ethical Consideration

This study was approved by the Ethics Committee of the Faculty of Medicine and Health Science, University of Gadarif, Sudan (# 2023, 09). The study complies with the Declaration of Helsinki. Each woman signed an informed consent.

Results

Sociodemographic Characteristics

A total of 568 pregnant women were enrolled in the present study. The median (IQR) age, parity, and gestational age of the women were 27.0 (22.0–34.0) years, 2.0 (1.0–4.0), and 30 (27.0–34.0) weeks, respectively. Among these women, 246 (43.3%) resided in urban areas, 455 (80.1%) were housewives, 170 (29.9%) had an education level ≥ secondary, 341 (60.0%) had health insurance coverage, and 79 (13.9%) had medical disorders. Furthermore, 170 (29.9) had attended more than four antenatal visits, 352 (62.0%) had good knowledge of anemia, and 277 (48.8%) had good knowledge of IFAS (Table 1).

Factors Associated with Adherence to IFAS

Of the 568 participants, 449 (79%) adhered to the IFAS. The median (IQR) of the women's age and parity were not different between women with and without good adherence to IFAS (Table 2). The univariate analysis showed that maternal occupation (OR = 2.33, 95.0% CI = 1.26−4.33), ANC > 4 visits (OR = 1.90, 95.0% = 1.16–3.11), knowledge of anemia (OR = 2.83, 95.0% CI = 1.87–4.28), and knowledge of IFAS (OR = 2.20, 95.0% CI = 1.44–3.37) were associated with adherence to IFAS. In contrast, maternal age, parity, gestational age education, residence, occupation, medical insurance, medical disease, and husband's occupation were not (Table 2).

After adjusting the variables, the multivariate analysis showed that the OR of adherence to IFAS increased with ANC visits > 4 (AOR = 1.68, 95.0% CI = 1.01–2.77) and knowledge of anemia (AOR = 2.06, 95.0% CI = 1.437–3.276). Maternal occupation and knowledge of IFAS were only associated with adherence to IFAS in the univariate analysis (Table 3).

Table 1 Characteristics of Pregnant Women Enrolled for Adherence to Iron-Folic Acid Supplementation in Eastern Sudan, 2023

Variable	Median		Interquartile range
Age, years		27.0	22.0–34.0
Parity		2.0	1.0–4.0
Birth spacing, years		2.0	1.0–2.0
		Frequency	*Proportion*
Maternal educational level	≥ Secondary	170	29.9
	< Secondary	398	70.1
Residence	Urban	246	43.3
	Rural	322	56.7
Maternal occupation	Housewife	455	80.1
	Employed	113	19.9
Health insurance	Yes	341	60.0
	No	227	40.0
Husband's occupation	Government/private	194	34.2
	Self	374	65.8

(*Continued*)

Table I (Continued).

Variable	Median		Interquartile range
Previous history of anemia	No	414	72.9
	Yes	154	27.1
Medical disease	No	489	86.1
	Yes	79	13.9
History of caesarian section	No	445	78.3
	Yes	123	21.7
History of abortion	No	392	69.0
	Yes	176	31.0
History of stillbirth	No	504	88.7
	Yes	64	11.3
Antenatal care > 4 times	Yes	170	29.9
	No	398	70.1
Knowledge of anemia	No	216	38.0
	Yes	352	62.0
Knowledge of iron-folic acid	No	391	51.2
	Yes	277	48.8

Table 2 Univariate Analysis of Factors Associated with Pregnant Women's Adherence to Iron-Folic Acid Supplementation in Eastern Sudan, 2023

Variable		Adherence (Number = 449)	Nonadherence (Number = 119)	Odds ratio (95% confidence interval)	P-value
		Median (interquartile range)			
Age, years		28.0 (22.0–34.0)	28.0 (22.0–33.50)	1.01 (0.98–1.03)	0.623
Parity		2.0 (1.0–4.0)	3.0 (1.0–4.0)	0.96 (0.88–1.06)	0.505
Gestational age		30.0 (27.0–34.0)	30.0 (25.0–34.0)	1.01 (0.98–1.05)	0.341
Birth spacing in years		2.0 (1.5–2.0)	2.0 (1.0–2.0)	0.97 (0.91–1.03)	0.365
		Frequency (proportion)			
Residence	Urban	197 (43.9)	49 (41.2)	Reference	0.597
	Rural	252 (56.1)	70 (58.8)	0.89 (0.59–1.34)	
Maternal educational level	≥ Secondary	135 (30.1)	35 (29.4)	Reference	
	< Secondary	314 (69.9)	84 (70.6)	0.96 (0.62–1.50)	0.890
Maternal occupation	Housewife	349 (77.7)	106 (89.1)	Reference	0.007
	Employed	100 (22.3)	13 (10.9)	2.33 (1.26–4.33)	

(*Continued*)

Table 2 (Continued).

Variable		Adherence (Number = 449)	Nonadherence (Number = 119)	Odds ratio (95% confidence interval)	P-value
Husband's occupation	Government/private	157 (35.0)	37 (31.1)	Reference	
	Self	292 (65.0)	82 (68.9)	0.83 (0.54–1.29)	0.428
Antenatal care > 4	Yes	146 (32.5)	24 (20.2)	1.90 (1.16–3.11)	0.010
	No	303 (67.5)	95 (79.8)	Reference	
History of caesarian delivery	No	357 (79.5)	88 (73.9)	Reference	0.192
	Yes	92 (20.5)	31 (26.1)	0.73 (0.45–1.16)	
History of miscarriage	No	305 (67.9)	87 (73.1)	Reference	0.278
	Yes	144 (32.1)	32 (26.9)	1.28 (0.81–2.01)	
Knowledge of anemia	No	147 (32.7)	69 (58.0)	Reference	< 0.001
	Yes	302 (67.3)	50 (42.0)	2.83 (1.87–4.28)	
Knowledge of iron - folic acid	No	212 (47.2)	79 (66.4)	Reference	< 0.001
	Yes	237 (52.8)	40 (33.6)	2.20 (1.44–3.37)	

Table 3 Multi**variate Analysis of Factors Associated with Pregnant Women's Adherence to Iron-Folic Acid Supplementation in Eastern Sudan, 2023**

Variables		Adjusted odds ratio (95% confidence interval)	P-value
Maternal occupation	Housewife	Reference	0.197
	Employed	1.54 (0.79–3.00)	
Antenatal care > 4	Yes	1.68 (1.01–2.77)	0.043
	No	Reference	
History of caesarian delivery	No	Reference	0.390
	Yes	0.80 (0.49–1.31)	
Knowledge of anemia	No	Reference	0.003
	Yes	2.06 (1.27–3.45)	
Knowledge of iron-folic acid supplement	No	Reference	0.187
	Yes	1.39 (0.85–2.27)	

Reasons for Nonadherence to IFAS

Forgetfulness (71.0%), frustration from taking many drugs (54.6%), unpleasant tests of the supplement (50.7%), fear of side effects (40.0%), and the need for too many pills (36.3%) were the main reasons for not taking the IFAS (Figure 1).

Discussion

The main finding of this study was that 79% of the sample showed good adherence to the IFAS. This level of adherence in this study is similar to the 76% adherence rate in Dire Dawa, Ethiopia.[27] Conversely, the level of adherence in the present study was higher than the rates reported in Lira District, Uganda (46%),[17] Kenya (31.2%),[18,28] Tanzania
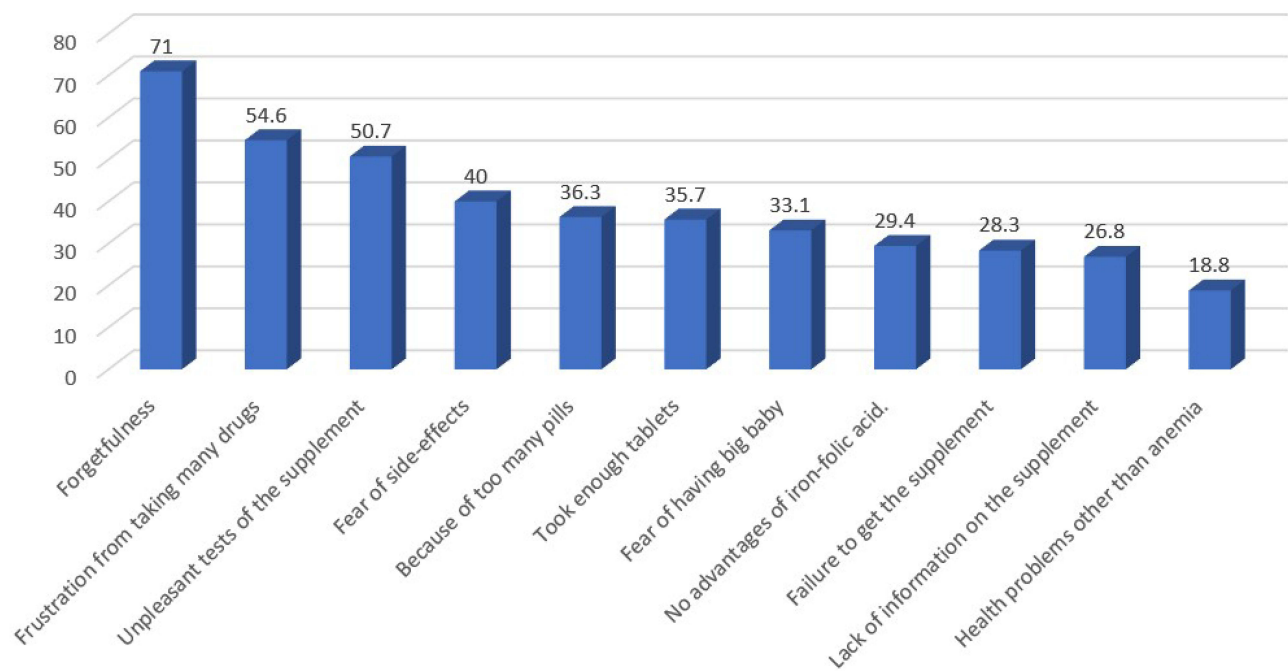
Figure 1 Pregnant women's reasons for not taking **iron-folic acid supplementation**; Eastern Sudan, 2023.

(20.3%)[18] and lower than the overall pooled prevalence (41.3%) of IFA adherence among pregnant women in Ethiopia[20] and the pooled prevalence (39.2%) across 23 studies involving 24272 pregnant women in SSA.[24] Further, the adherence rate determined in the present study is lower than the 84.5% compliance reported in the Sagnarigu municipality of Ghana.[22] The differences in adherence rates among pregnant women could be due to cultural, economic, and geographic differences, as well as differences in their knowledge about anemia and the advantages of IFAS.

The findings of this study revealed a significant association between the participants' knowledge of anemia and adherence to the IFAS regimen. This is consistent with the findings of several previous studies carried out in different regions, including the West Gondar Zone in the Amhara Regional State of Ethiopia,[11] Somaliland,[16] Wondo District in the Oromia region of Ethiopia,[35] and Kilifi County in Kenya.[28] However, studies conducted in Lira District, Uganda;[17] Sagnarigu Municipality, Ghana;[22] and Tamale, Ghana[26] found no significant association between knowledge of anemia and adherence to IFAS.

In the present study, women with more than four ANC visits were 1.68 times more likely to adhere to IFAS. This is in line with the results of several previous studies conducted in SSA.[18,20]

Our results showed that women with knowledge about anemia were 2.06 times more likely to adhere to IFAS. This finding aligns with those of several African studies:[18,20,24] In their meta analysis of 23 studies and 24272 pregnant women, Fite et al observed that women with knowledge about anemia were 5.42 times more likely to adhere to IFAS.[24] Likewise, Sendeku et al conducted a meta analysis in 2022 that included 15 studies in Ethiopia and found that women with good anemia knowledge were 2.99 more likely to adhere to IFAS.[20]

Only our univariate analysis showed an association between knowledge of IFAS and adherence to IFAS (confounder). This finding aligns with that of a study conducted in the Northern region of Ghana, wherein no significant association between IFAS knowledge and compliance was found.[26] On the contrary, several studies conducted in Wolaita, Ethiopia;[15] Mettu, Southwest Ethiopia;[36] and Kilifi County, Kenya[28] have found an association between knowledge of IFAS and adherence to IFAS.

Although no significant associations were found between IFAS adherence and women's age, parity, residence, educational level, history of anemia, and history of abortion in the present study, previous studies have found significant associations with gravidity and parity,[37] maternal education level and age,[11,28] a history of anemia,[11,36] place of residence,[26] and a history of abortion.[25,38]

According to this study's findings, various reasons may affect pregnant women's adherence to the IFAS, including fear of illness, family support, and clinician counseling. Several studies have explored factors that can enhance women's adherence to IFAS. While some of these factors align with those identified in the current study, the sequencing and nature of the reasons may vary. For instance, previous studies have highlighted that clinical counseling, fear of consequences, familial encouragement,[38] knowledge about the health benefits of IFAS, fear of getting ill,[25] guidance and counseling from healthcare providers, and knowledge about the health benefits of IFAS[37] are the primary motivators of IFAS adherence. Discrepancies in the priority and type of factors can be attributed to inherent differences in people's beliefs, perceptions, and cognitive processes.

In this study, the common reasons for nonadherence to the IFAS were forgetfulness, followed by frustration of taking many drugs, unpleasant tests of the supplement, and fear of side effects. The primary reasons for nonadherence to the IFAS in various other studies were as follows: the unpleasant taste of IFA tablets, pill burden, fear of side effects, and forgetfulness;[39] forgetting,[17] gastritis, and forgetfulness;[15] side effects, forgetfulness, and a shortage of supplements;[38] side effects, not knowing the importance of taking all the tablets, and forgetfulness;[40] forgetfulness, fear of side effects, and the failure to get adequate supplements in the health facility;[25] and forgetfulness and the unavailability of IFA supplements at the health facility.[26] The discrepancies in the causes of nonadherence among pregnant women can be attributed to cultural, economic, and regional differences.

Limitations

This is a single-center study, so its results might not be representative of other regions in Sudan and could not be generalized. As it is a cross-sectional study, the cause-effect cannot be ascertained. This study did not use the more sophisticated methods of measuring adherence, such as electronic pill counters. Moreover, a validity and reliability test was not applied to our tool (questionnaire), and the questionnaire was self-reported, which might be subject to recall bias. The dietary habits and socioeconomic status were not assessed. Further research considering these limitations is needed.

Conclusion

This study revealed a high IFAS adherence rate among pregnant women. The findings also showed that knowledge about anemia and knowledge about IFAS were significant factors associated with adherence to IFAS during pregnancy. More attention is needed to encourage ANC to increase adherence to IFAS.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis, and interpretation, or all these areas; took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

The authors report no conflicts of interest in this work.

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