

A Mixed-Method Study on Iron-Folic Acid Adherence and its Determinants among Pregnant Women in Puducherry, India

Poosarla Saimaa¹, Mathiyalagen Prakash², Jayabal Pandiamunian³, Pulavarthi Sabita⁴, Kanagasabapathy Sivagami⁵, Mausumi Basu⁶

¹MBBS student, Indira Gandhi Medical College & Research Institute, Puducherry, India

²Associate Professor, Department of Community Medicine, Indira Gandhi Medical College Research Institute, Puducherry, India

³Assistant Professor, Department of Pharmacology, Indira Gandhi Medical College & Research Institute, Puducherry, India

⁴Professor and Head, Department of Obstetrics and Gynaecology, Indira Gandhi Medical College & Research Institute, Puducherry, India

⁵WHO consultant, Coimbatore, India

⁶Professor and Head of Department, Department of Community Medicine, Institute of Post Graduate Medical Education and Research, Kolkata, India

Correspondence: Dr. Mausumi Basu, Email: basu.mausumi544@gmail.com

Abstract:

Introduction: Anaemia poses a significant risk to maternal health, contributing to preventable morbidity and mortality among pregnant women. Iron-folic acid (IFA) supplements are provided free of charge to meet the pregnancy's nutritional needs; however, consumption and adherence remains suboptimal.

Objectives: To assess the compliance and associated factors for IFA supplementation and to explore the perceptions and barriers among pregnant women attending antenatal clinic. **Method:** The authors conducted a sequential explanatory mixed-method study at a tertiary care hospital, involving 219 pregnant women in the third trimester seeking antenatal care. The participants were selected through systematic random sampling during the study period of two months. Quantitative data were collected using a pre-tested interview schedule and the Morisky Green Levine Medication Adherence Scale. Qualitative data were obtained through focus group discussions, analyzed using content analysis. **Results:** Among the participants, 64.4% (95% CI: 57.7%-70.7%) were adherent to IFA during pregnancy. Factors significantly associated with adherence included higher monthly income, increase the number of antenatal check ups and absence of anemia. Common reasons for non-adherence were forgetfulness (62.8%), unawareness (26.9%), side-effects (25.6%), inadequate counseling (23.1%) and tablet taste (3.8%). Qualitative analysis revealed two themes and eight categories. The categories identified under knowledge regarding anaemia were causes, symptoms, complications, treatment options and places for procuring IFA supplements and the categories under barriers to adherence were patient factors, medication factors and health system factors. **Conclusion:**


Approximately one-third of pregnant women did not adhere to IFA supplementation. Findings underscore the importance of consistent nutrition counseling during ante-natal visits, with a special focus on addressing side effects. These results have implications for maternal health programs and policies aimed at improving adherence to essential supplements during pregnancy.

Keywords: Adherence, Anaemia, Haemoglobin, Pregnant women.

Introduction:

Anaemia is a major public health problem worldwide. In pregnancy, anaemia is typically defined as hemoglobin level below 11g/dl at sea

level^[1] The global prevalence of anaemia among pregnant women is 36% and in India it reaches as high as 50%.^[2] In Puducherry, according to the 2019 National Family Health Survey (NFHS-5), the

Quick Response Code	Access this article online	How to cite this article :
	Website : www.healthlinejournal.org	Saimaa P, Prakash M, Pandiamunian J, Sabita P, Sivagami K, Basu M. A Mixed-Method Study on Iron-Folic Acid Adherence and its Determinants among Pregnant Women in Puducherry, India. Healthline. 2024;15(3): 190-200
	DOI : 10.51957/Healthline_646_2024	

Received : 28-07-2024

Accepted : 24-09-2024

Published : 30-09-2024

prevalence of anaemia among pregnant women stands at 42.5%, marking a concerning increase from 26% reported in the previous NFHS-4 survey.^[3] Anaemia reduces the oxygen carrying capacity of hemoglobin, which has an effect on all the organs. It poses a dual threat to both the mother and the fetus. Maternal anaemia increases the risk of pre-eclampsia, peri-natal infection and hemorrhage, whereas in the offspring, it is associated with low birth weight, prematurity and impaired growth and development.^[4]

To address the pervasive issue of anaemia among pregnant women, India has launched various national health programs since 1970s, including the National Nutrition Anaemia Control Program (NNACP), National Iron Plus Initiative (NIPI), Weekly Iron Folic acid Supplementation (WIFS) and Anemia Mukh Bharat (AMB)/ Intensified National Iron Plus Initiative (INIPI). Under AMB, antenatal mothers are provided with 60 mg of elemental iron and 500 mcg of folic acid for 180 days before and after child birth.^[5] However, despite these initiatives, the adherence to iron-folic acid (IFA) supplementation remains notably low.^[6] Iron is considered as the one-way element as it is rarely excreted through kidneys in healthy individuals.^[7] Oral iron absorption is tightly regulated according to the body's requirements, rendering excess iron inaccessible for absorption in the gastrointestinal tract. The accumulation of excess iron, as seen in repeated transfusions, can have detrimental effects on endocrine organs, the heart and the liver due to generation of free hydroxyl radicals through the Fenton reaction.^[8] Therefore, unless medically warranted, parenteral forms of iron should be avoided.

Numerous studies^[9-10] have examined the prevalence of adherence to IFA supplementation but a standard tool has not been consistently employed. In the present study four-item Morisky Green Levine scale (MGLS) was employed, which demonstrates moderate internal consistency reliability with

Cronbach's $\alpha=0.651$.^[11] This scale offers the advantage of brevity, making it suitable for assessing IFA adherence during busy outpatient department (OPD) consultations. This study adopts a mixed method approach encompassing both quantitative and qualitative components. This approach allows to gain insight into participants' perspectives, encourages scholarly interaction, offers methodological flexibility, and yields rich and comprehensive data.

Previous research by Manasa et al^[12] in 2017 assessing the compliance to IFA supplementation in pregnancy at a tertiary care center in Mysore, considered individuals who had taken 100 tablets as compliant, revealing a compliance rate of 71%. Reasons for non-compliance included inadequate counselling by health care worker, side effects, tablet cost, ignorance and fear of side effects. Similarly, Kumar et al's^[10] study in 2018, conducted in a primary health center in Tamil Nadu, found that 69% of pregnant females were compliant with IFA supplementation. Reasons for non-compliance included the tablet's color and taste, side-effects, negligence and loss of tablets. Another hospital based cross sectional study conducted in the antenatal clinic of a tertiary care hospital in Deoghar Jharkhand and revealed that the proportion of compliance to IFA among antenatal mothers was 58.8%, and the reason for noncompliance in the majority was forgetfulness (46.7%) followed by "side effects".^[13] Given the aforementioned factors, the present study aims to determine the proportion of compliance to IFA supplementation and identify the determinants of non-compliance among pregnant women attending an antenatal clinic in a tertiary care center.

Method:

Study Design

This sequential explanatory mixed-method design was carried out at the Obstetrics and Gynaecology (OG) OPD of a tertiary care teaching hospital in Puducherry, India between September

2021 and October 2021. Quantitative part using descriptive cross-sectional study design was followed by qualitative part in the form of focus group discussion. The tertiary care hospital was catering the population of Union territory of Puducherry and also the nearby districts of Tamil Nadu.

Quantitative component

Study population

Every day, 70 antenatal mothers were be registered and provided antenatal care services at the Obstetrics and Gynaecology OPD. Pregnant women aged 18-45 years, in their third trimester (after completing 27 weeks), attending the clinic for the first time during the study period and who gave informed written consent were included in the study upon giving consent. Study participants who were not comprehensive for data collection, those with known haemoglobinopathies and those in whom iron supplementation was contraindicated were excluded from the study.

Sample size

The sample size was calculated by considering the proportion of pregnant women compliant to IFA supplementation as 85.7%^[12] with absolute error of margin as 5% and alpha error as 5% and it was estimated to be 189 using the formula, $N = Z^2_{(1-\alpha/2)} PQ/d^{2[14]}$ The final adjusted sample size by adding a non-response rate of 10% was estimated to be 210 using the formula, $N_f = N/1-q$.^[15]

Sampling technique

In the study setting, every day 20 to 25 eligible pregnant women were attending out of the 60 to 70 antenatal mothers registered in the antenatal OPD. Since the registration was completed in the beginning of the day (around one hour), the sampling frame from this register was used for systematic random sampling. The study participants were determined by using the formula: $k = N/n$ ^[16] where N represents the total number of eligible pregnant women expected to attend the OPD during the study

period of two months, estimated at 1050 as recorded by the Medical Registration Department for the previous two months, and 'n' represents the sample size, ($k=1050/210=5$). Every fifth registered person was selected as a study participant daily until the sample size was achieved.

Data collection

A pre-designed, pre-tested, semi-structured interview schedule was used for face to face interview with study participants which has the following parts: Part 1 - Socio-demographic details, brief antenatal history, personal history, details on iron and folic acid supplementation (knowledge on how many tablets used per day, for how many days, the side effects etc.); Part 2- Morisky Green Levine Medication Adherence Scale (MGLS)^[17], Self-reporting adherence^[18] measure; Part 3- Examination to look for pallor, Haemoglobin status- latest report if available/blood examination by automated methods.

Data analysis

Data capturing was done using Epicollect 5 and analysis was done using SPSS Version 22 and Open Epi Version 3.01. Descriptive statistical analysis was done to represent the frequency, percentage, mean, standard deviation and median with inter-quartile range. Shapiro-Wilk test was used to assess the normality of the data. Categorical variables using chi-square test and continuous variables using either student's unpaired t test or Mann-Whitney U test were analyzed. Multi-collinearity was assessed using Tolerance (<0.1) and Variance Inflation Factor (>10) to remove the variables. Variables with p value ≤ 0.25 in the univariate analysis were subjected to binary logistic regression, after meeting assumptions, to derive adjusted odds ratio. P value <0.05 was considered as significant.

Operational definition

MGLS has four questions/ items with yes or no options. Levels of medication adherence can be categorized as high (0 point), medium (1-2 points) and low (3-4 points). A dichotomous categorization with 0 point for adherence and 1 or more points for

non-adherence is also widely used.^[19] In self-report adherence measure^[18] the patients are considered to be adherent, if they have consumed IFA tablets for more than four days in a week. Haemoglobin level less than 11gm/dl is defined as anaemia in pregnancy.^[1]

Qualitative component

Sampling technique and sample size

Purposive sampling technique was adopted to select the pregnant women attending the OPD who were vocal and willing to participate. Ten antenatal mothers were included for the focus group discussion (FGD) and the data was collected till the point of saturation (two FGDs).

Data collection

FGD was done among antenatal mothers attending the OPD in a common place near the OG OPD. The discussion was facilitated by a female medical under-graduate student under the guidance of a trained faculty in qualitative research, using a topic guide to explore the knowledge related to anaemia, anaemia in pregnancy, complications of anaemia in pregnancy, treatment options for anaemia, iron and folic acid supplementation and reasons for non-compliance to iron and folic acid. After explaining the purpose of the study and informing about the audio recording the discussion, consent was obtained from all the participants. Initially, the members were welcomed and after a brief explanation the session was started. The FGD was carried out in the local language, Tamil and the discussion took about 45 minutes. COVID appropriate behavior was followed during the entire process of FGD. Summary of the discussion was read in front of the participants from the field notes for validation. Refreshments were provided to the study participants at the end of the FGD.

Data analysis

Verbatim transcription was carried out from the audio-recordings. Translation and back translation were done by two different authors to ensure the consistency of the meaning while translating from Tamil to English. The final version of English transcript was checked with audio-recording and field notes for accuracy of the data. Descriptive content analysis was done manually.

Ethical considerations

The Institute Ethics Committee approval (No. 281/IEC-30/IGMC&RI/PP/2020 dated 28.07.2021) was obtained before starting the data collection. Written informed consent was obtained from the study participants. COVID appropriate behavior was advocated and followed during the entire study period.

Results:

Quantitative component

Socio-demographic characters associated with adherence to iron and folic acid supplementation among pregnant women are shown in Table 1. The mean age of the participants was 25.4±3.84 years. Higher adherence to IFA was observed among women having graduate and post-graduate education (OR: 1.785; 95% CI: 1.021, 3.123; p value=0.0414) compared to education up to higher secondary level. Similarly those with higher monthly income (>10,000INR) (OR: 2.17; 95% CI: 1.234, 3.814; p value=0.0067) had higher adherence compared to those with lower monthly income. There was no statistically significant association between adherence and other socio-demographic variable like age, occupation and type of family.

Obstetric care related characters associated with adherence to iron and folic acid supplementation among pregnant women is shown in Table 2. Higher adherence to IFA was observed among women having more no. of ante-natal visit

Table 1: Socio-demographic Determinants IFA Adherence (N=219)

Factors	Total (N=219) n (%)	Adherent (N=141) n (%)	Non-adherent (N=78) n (%)	p value	Odds Ratio (95% CI)
Age, mean (SD)	25.4 (3.84)	25.5 (3.73)	25.2 (4.04)	0.567*	-
Age category					
≤20 years	22 (10.0)	13 (59.1)	9 (40.9)	0.821	0.77 (0.31-1.89)
21-30 years	176 (80.4)	115 (65.3)	61 (34.7)		1
≥31 years	21 (9.6)	13 (61.9)	8 (38.1)		0.86 (0.34-2.19)
Education					
Up to High school	44 (20.1)	25 (56.8)	19 (43.2)	0.054	1
Higher secondary	51 (23.3)	29 (56.9)	22 (43.1)		1.00 (0.44-2.26)
Graduate	101 (46.1)	67 (66.3)	34 (33.7)		1.50 (0.73-3.09)
Post graduate	23 (10.5)	20 (87.0)	3 (13.0)		5.07 (1.31-19.59)
Occupation					
Employed	37 (16.9)	22 (59.5)	15 (40.5)	0.493	0.78 (0.38-1.60)
Un employed	182 (83.1)	119 (65.4)	63 (34.6)		1
Monthly income					
≤10000 INR	105 (47.9)	58 (41.1)	47 (60.3)	0.012	0.38 (0.20-0.72)
10001-20000 INR	77 (35.2)	59 (41.8)	18 (23.1)		1
>20000 INR	37 (16.9)	24 (17.0)	13 (16.7)		0.56 (0.24-1.33)
Monthly income, Median (IQR)	12000 (11500)	15000 (10000)	10000 (8000)	0.004#	-
Type of family	115 (52.5)	76 (66.1)	39 (33.9)	0.580	1.17 (0.67-2.03)
Joint Nuclear	104 (47.5)	65 (62.5)	39 (37.5)		1

Chi-square test,*Un-paired t-test, #Mann-Whitney U test

(≥4) (OR: 2.629; 95% CI: 1.192, 5.798; p value=0.0141), longer health facility distance (>3km) (OR: 1.862; 95% CI: 1.052, 3.298; p value=0.0320), no history of anemia (OR: 5.514; 95% CI: 2.645, 11.49; p value<0.001), weekly doses (≥4 doses IFA consumption) (OR: 19.69; 95% CI: 9.399, 41.26; p value<0.001), absence of pallor (OR: 13.03; 95% CI: 6.558, 25.87; p value<0.001) and non-anemic HB category (OR: 2.51; 95% CI: 1.386, 4.543; p value=0.0021). Overall the mean Hb level was 10.56 (1.44). Those who were adherent had higher mean Hb level than non-adherent participants [10.86 (1.33) versus 10.03 (1.50)].

Table 3 shows that majority of the patients said forgetfulness as the reason for non-adherence followed by ignorance, side-effects and inadequate counselling. Few patients said taste, fear and colour

were also some of the reasons for non-adherence.

Binary logistic regression analysis was done using Enter method to determine the effects of education, income, ANC visits, anemic history and health facility distance on the likelihood that the pregnant women was adherent to IFA. The results showed that pregnant women, who had higher monthly income, had 2 times higher odds of adherence to IFA (aOR: 2.039; 95% CI: 1.095, 3.777; p value=0.025) than their counterpart. Women, who visited ANC more than four times, had 3 times higher odds of adherence to IFA (aOR: 3.143; 95% CI: 1.281, 7.714; p value=0.012) and women, who had no history of anaemia, had 6 times higher odds of adherence to IFA (aOR: 6.129; 95% CI: 2.775, 13.538; p value<0.001).

Table 2: Obstetric Care Related Determinant of IFA Adherence Antenatal (N=219)

Factors	Total n (%)	Adherent n=141 (%)	Non-adherent n=78 (%)	p value*	Odds Ratio (95% CI)
Gravida					
Primigravida	101 (46.1)	66 (65.3)	35 (34.7)	0.783	1.08 (0.62-1.88)
Multigravida	118 (53.9)	75 (63.6)	43 (36.4)		1
Antenatal visit					
≥ 4	45 (20.5)	36 (80.0)	9 (20.0)	0.014	2.63 (1.19-5.80)
< 4	174 (79.5)	105 (60.3)	69 (39.7)		1
Health facility distance category					
≤ 3 km	122 (55.7)	71 (58.2)	51 (41.8)	0.059	0.39 (0.17-0.89)
3-6 km	56 (25.6)	38 (67.9)	18 (32.1)		0.59 (0.24-1.50)
>6 km	41 (18.7)	32 (78.0)	9 (22.0)		1
IFA taken for past pregnancy(n= 118)					
No	8 (6.8)	2 (25.0)	6 (75.0)	0.050	0.17 (0.03-0.88)
Yes	110 (93.2)	73 (66.4)	37 (33.6)		1
Place for procurement of IFA					
Private	41 (18.7)	26 (63.4)	15 (36.6)	0.886	0.95 (0.47-1.92)
Public	178 (81.3)	115 (64.6)	63 (35.4)		1
Current history of anemia					
No	178 (81.3)	128 (71.9)	50 (28.1)	<0.001	5.51 (2.65-11.49)
Yes	41 (18.7)	13 (31.7)	28 (68.3)		1
Health Care Worker home visit					
No	164 (74.9)	109 (66.5)	55 (33.5)	0.267	1.42 (0.76-2.66)
Yes	55 (25.1)	32 (58.2)	23 (41.8)		1
Weekly doses of IFA					
<4	65 (29.7)	13 (20.0)	52 (80.0)	<0.001	1
≥4	154 (70.3)	128 (83.1)	26 (16.9)		19.69 (9.40-41.26)
Presence of Pallor					
Absent	152 (69.4)	124 (81.6)	28 (18.4)	<0.001	13.03 (6.56-25.87)
Present	67 (30.6)	17 (25.4)	50 (74.6)		1
Hb category					
Non-anemic	92 (42.0)	70 (76.1)	22 (23.9)	<0.001	1
Mild	72 (32.9)	47 (65.3)	25 (34.7)		0.59 (0.30-1.17)
Moderate	53 (24.2)	24 (45.3)	29 (54.7)		0.26 (0.13-0.54)
Severe	2 (0.9)	0 (0.0)	2 (100.0)		NA

*Chi-square test, Women, OR-Odds Ratio, CI- Confidence Interval

Table 3: Reasons for Non-Compliance for IFA among Pregnant (N=78)

Reasons	Frequency*	Percentage	95%CI
Forgetfulness	49	62.8	51.13-73.50
Not aware (ignorance)	21	26.9	17.50-38.16
Side effects	20	25.6	16.42-36.79
Inadequate counseling	18	23.1	14.29-34.00
Taste of the tablet	3	3.8	0.01-10.83
Fear	2	2.6	0.01-8.96
Color of the tablet	1	1.3	0.01-6.94

*Multiple response

Table 4: Summary of the Qualitative Research Findings and Suggestions for IFA Adherence

Theme	Category	Descriptors
Knowledge about anemia during pregnancy	Causative factors for anemia	<ul style="list-style-type: none"> • Poor nutrition • Not taking the IFA supplements • Due to pregnancy • Hookworm infestation • Blood loss during delivery • Operative procedures • Tiredness
	Symptoms due to anemia	<ul style="list-style-type: none"> • Breathlessness • Giddiness • Iron and folic acid tablets
	Treatment options for anemia	<ul style="list-style-type: none"> • Blood transfusion • Iron sucrose injection • Iron rich food items • Low birth weight of baby • Blood loss after delivery
	Complications of anemia	<ul style="list-style-type: none"> • Decreased Hb for the child • Primary health care centers • Government hospitals
	Places for procurement of IFA supplements	<ul style="list-style-type: none"> • Tertiary health care centers • From healthcare workers • Private hospitals
Reasons for IFA non-adherence	Patient factors	<ul style="list-style-type: none"> • Unplanned pregnancy • Forgetfulness • Taking iron rich foods instead of tablet • Nausea and Vomiting
	Medication factors	<ul style="list-style-type: none"> • Loose stools • Stomach ache • Size and taste of tablet
	Health facility factors	<ul style="list-style-type: none"> • Crowded OPD
Suggested measures for better IFA adherence	Patient factors	<ul style="list-style-type: none"> • Drug reminder SMS daily • Seeking help for side effects • Family support • More ANC visits • Clarifying myths • Palatable IFA
	Medication factors	<ul style="list-style-type: none"> • Alternative Iron • Adequate stock • IFA with least side effects • Assess side effects and manage
	Health system factors	<ul style="list-style-type: none"> • Early detection of anemia • Nutrition counselors • Home visits by ANM

Hb: Hemoglobin; ANM: Auxiliary Nurse Midwife; OPD: Out-patient department; IFA: Iron and folic acid; ANC: Antenatal care.

Qualitative component

One FGD was conducted among 10 participants to know their perception regarding the importance of IFA supplementation and the barriers to IFA adherence. The minimum age group was 22 years and maximum age group was 30 years. The discussion lasted for about 45 minutes. Content analysis of the FGD was done using a deductive approach. Two predetermined themes were analyzed namely knowledge regarding anaemia and barriers to non-adherence. Through this analysis, eight categories and 30 codes were generated as shown in the Table 4. The categories identified under knowledge regarding anaemia were causes, symptoms, complications, treatment options and places for procuring IFA supplements and the categories under barriers to adherence were patient factors, medication factors and health system factors.

Causes of anaemia

Pregnant women believed that decreased intake of iron rich foods, blood loss during delivery and hookworm infestation were the causes of anaemia.

Participant 1 said *"If we do not eat foods rich in iron and if the iron and folic acid tablets are not taken correctly every day, it will lead to decrease in haemoglobin level."*

Participant 2 said *"Haemoglobin level decreases in pregnancy and also hookworm infestation will lead to anaemia."*

Participant 5 said *"Due to blood loss during delivery and operation like C- section can also lead to reduction in haemoglobin level."*

Symptoms of anaemia

The symptoms of anaemia perceived and told by pregnant women were tiredness, breathlessness, giddiness.

Participant 7 said *"I used to feel very tired and breathless. So, I got a blood test done and found out that my haemoglobin level was 8.2g/dL."*

Participant 10 said *"I used to feel giddy very often and I had to take a lot of rest compared to the usual."*

Treatment of anaemia

Pregnant women highlighted that IFA tablets, blood transfusion, iron-sucrose injection were the treatment options available for anaemia. They also believed the importance of consuming iron rich foods like drumstick leaves, beetroot et along with the above treatments.

Participant 2 said *"Iron and folic acid tablets are available and should be used daily during pregnancy and that it should be continued after delivery also."*

Participant 3 said *"I didn't want to continue my pregnancy, so I stopped taking iron and folic acid tablets, but my haemoglobin level was 7.2g/dL. So, I had to get a blood transfusion done and iron sucrose injection was also given to me."*

Participant 5 said *"Along with iron tablets we should include iron rich foods such as drumstick leaves, beetroot, fruit or vegetable juices with lemon, food preparations containing jaggery like rice cakes, peanut bars, and non-vegetarian foods."*

Complications of anaemia

The complications mentioned by those women due to anaemia in pregnancy were low birth weight, reduced levels of Hb in the new-born and increased blood loss during delivery.

Participant 2 said *"It can lead to low birth weight of born child and also leads to blood loss after delivery."*

Participant 6 said *"It will lead to decreased haemoglobin level for the child also."*

Places for procurement of IFA supplements

The pregnant women were aware that IFA supplements can be procured from government PHCs and also from private hospitals.

Participant 7 said *"I got my tablets from PHC which was near my house. Also, from healthcare workers who came to check."*

Participant 10 said *"I got my tablets from a private hospital and if they were not available there, I used to get from government hospital."*

Patient factors responsible for non-adherence

The factors that were barriers to adherence of IFA were unplanned pregnancy and forgetfulness of the mothers.

Participant 3 said *"This was an unplanned pregnancy. I didn't want to continue it, so I stopped taking iron and folic acid tablets, but it was past time for abortion, so I had to continue the pregnancy."*

Participant 9 said *"I forget to take my tablets very frequently and even if I remember later in the day, I skip that day's tablet."*

Factors related to the medication responsible for non-adherence

According to pregnant women, certain side effects of the IFA tablets like nausea, vomiting, loose stools and abdominal pain prevented them from continuing the medications. They also responded that the size of the tablet supplied in the government hospitals were big which made it inconvenient for them to swallow and the taste of the tablet also acted as a factor which increased the non-adherence to the medications.

Participant 7 said *"I had nausea and vomiting for many days. So, I stopped taking the iron and folic acid tablets."*

Participant 8 said *"I had loose stools and stomach ache while using the tablets. I substituted the tablets by taking iron rich foods."*

Participant 9 said *"The tablets provided by the government are bigger in size and the taste is also not good. So, I don't like to take the tablets."*

Discussion:

Adherence to IFA supplementation is a key strategy for the prevention of anaemia in pregnancy. The study observed that 64.4% of third trimester antenatal mothers were adherent to IFA, which is

similar to the study done by Lavanya et al^[20] (63.8%) in South India. Nevertheless, 35.6% non-adherence rate highlights the need for remedial measures.

Adherence rate is varying across studies: Debi et al^[21] (81.74%), Manasa et al^[12] (71%) and Kumar et al^[10] (69%) observed higher rates of adherence, where as Choudhuri P et al^[22] (52.5%), Kamau et al^[23] (32.7%), Felipe-Dimog et al^[24] (25.8%) and Agegnehu et al^[25] (28.7%) reported lower rates. This varying prevalence could be attributed to the difference in socio-demographic characteristics, study setting and operational definitions for adherence.

The present study revealed several associated factors for IFA adherence. Pregnant women with higher educational status had 78% higher odds of adherence, which is consistent with studies done by Debi et al^[21], Dutta et al^[26], Sendeku et al.^[27] Education is more likely to improve the awareness on the outcome of anemia and the significance of IFA consumption.

The current study observed that higher monthly income was associated with 2 times higher odds of adherence, corroborating with the findings of Agegnehu et al^[25] and Kamau et al^[23] but no association was observed by Choudhuri et al^[22] This association is linked to better education and awareness among higher income groups.

More frequent antenatal visits were associated with 3 times higher odds of adherence in multi variate analysis. Similar associations were mentioned by Sendeku et al^[12], Dutta et al^[26] and Manasa et al.^[22] Increased antenatal visits provided more opportunities for the healthcare providers to motivate the mothers to take IFA supplementation. Non anaemic pregnant women had 6 times higher odds of adherence to IFA multivariate analysis. This finding was supported by the studies done by Deori et al^[28], Yadav et al^[29] and Chikakuda et al.^[30] Adherence to IFA is more likely to have increased the haemoglobin status.

Forgetfulness, ignorance, side-effects, inadequate counseling, taste and colour of the tablet and fear were the reasons for non-adherence. This is consistent with the findings by Deori et al^[28], Debi et al^[21], Choudhuri et al^[22] and Manasa et al.^[12] To address forgetfulness, reminders from the family members and digital technologies could be utilized. Tinago et al^[31] reported that compliance could be increased by educating risks and benefits, and highlighting the negative health implications towards non utilization of IFA.

The side effects associated with IFA are chest pains, constipation, severe stomach pains, diarrhea, nausea, blue color lips and fingernails, vomiting, black stool, stomach cramps and clumsy skin.^[17, 32, 33] Health care providers should explain the possible side effects associated and management strategies to the pregnant women.^[23] Hyder et al^[33] reported better compliance with weekly supplementation compared to daily supplementation. Behavior change communication as mentioned in the AMB, should be utilized to improve knowledge about anaemia and IFA supplementation among pregnant mothers, involving community leaders, ASHAs and health care providers.^[5]

Study limitations include the cross-sectional design preventing causal inferences, potential recall bias and limited generalizability due to facility-based study setting. Strengths include the mixed method design, exploring the participant's perceptions in their own words and usage of standard MGL scale for assessing IFA adherence.

Conclusion:

This study showed that almost one third of the pregnant women were not compliant to IFA supplementation. The adherence was more among the pregnant women having higher education, higher income, more antenatal visits and non-anaemic status. The common reasons for non-adherence were

forgetfulness followed by unawareness, side-effects, inadequate counseling and taste of the tablets. Improve awareness and counseling about need of IFA supplementation is need of the hour.

Declaration:

Funding: Nil

Conflicts of interest: Nil

References:

1. World Health Organization. Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity. Geneva: World Health Organization; 2011.
2. Stevens GA, Paciorek CJ, Flores-Urrutia MC, Borghi E, Namaste S, Wirth JP, 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. *The Lancet Glob Health* 2022;10(5):e627-39.
3. Government of India Ministry of Health and Family Welfare. National Family Health Survey (NFHS-5) 2019-21. Compendium of Fact Sheets India and 14 States/UTs (Phase-II) [Internet]. 2021. Available from https://main.mohfw.gov.in/sites/default/files/NFHS-5_Phase-II_0.pdf [Last accessed on 24th July, 2024].
4. Abu-Ouf NM, Jan MM. The impact of maternal iron deficiency and iron deficiency anemia on child's health. *Saudi Med J* 2015;36(2):146-9.
5. Joe W, Rinju, Patel N, Alambusha R, Kulkarni B, Yadav K, et al. Coverage of iron and folic acid supplementation in India: progress under the Anemia Mukht Bharat strategy 2017–20. *Health Policy Plan* 2022;37(5):597-606.
6. Mengistu T, Lencha B, Mekonnen A, Degno S, Yohannis D, Beressa G. Compliance to iron folic acid supplementation and its associated factors among pregnant women attending Antenatal clinic in Wondo district: a cross-sectional study. *Sci Rep.* 2023;13(1):17468.
7. van Raaij SE, Rennings AJ, Biemond BJ, Schols SE, Wiegerinck ET, Roelofs HM, et al. Iron handling by the human kidney: Glomerular filtration and tubular reabsorption both contribute to urinary iron excretion. *Am J Physiol Renal Physiol* 2019;316(3):F606-14.
8. Ems T, St Lucia K, Huecker MR. Biochemistry, iron absorption. In: StatPearls [internet]. Treasure Island (FL): StatPearls Publishing; 2022.
9. Chandra SG, Prashantha B. Assessment of compliance with iron-folic acid therapy during pregnancy among postnatal mothers in a tertiary care centre, Mysuru. *Int J Community Med Public Health* 2019;6(4):1665-9.

10. Kumar PS, Priya BY. Compliance to the Iron Folic Acid Supplementation among Antenatal Mothers Attending a Primary Health Centre–A Community Based Cross Sectional Study. *Int J Adv Res Dev* 2018;3(2):223-32.
11. Kristina S, Putri L, Riani D, Ikwati Z, Endarti D. Validity of self-reported measure of medication adherence among diabetic patients in Indonesia. *Int Res J Pharm* 2019;10(7):144-8.
12. Manasa K, Chandrakumar S, Prashantha B. Assessment of compliance with iron-folic acid therapy during pregnancy among postnatal mothers in a tertiary care centre, Mysuru. *Int J Community Med Public Health* 2019;6:1665-9.
13. Athira B, Rai P, Kalyani CV, Verma B. Compliance to iron and folic acid supplementation and associated factors among antenatal mothers attending OPD in a tertiary care institute in India. *Int J Community Med Public Health* 2024;11:2344-8.
14. Whitley E, Ball J. Statistics review 4: sample size calculations. *Crit Care* 2002;6(4):335-41.
15. Raina SK. Conducting systematic sampling. *Indian J Occup Environ Med* 2015;19(1):68.
16. Morisky DE, Green LW, Levine DM. Concurrent and predictive validity of a self-reported measure of medication adherence. *Med Care* 1986;67-74.
17. Kassa ZY, Awraris T, Daba AK, Tenaw Z. Compliance with iron folic acid and associated factors among pregnant women through pill count in Hawassa city, South Ethiopia: a community based cross-sectional study. *Reprod Health* 2019;16(1):1-8.
18. Deam AO, Sullivan KM, Soe MM. OpenEpi: open source epidemiologic statistics for public health [Internet]. 2013. Available from: <http://www.OpenEpi.com>. [Last accessed on 24th July, 2024].
19. Beyhaghi H, Reeve BB, Rodgers JE, Stearns SC. Psychometric properties of the Four-Item Morisky green levine medication adherence scale among atherosclerosis risk in communities (ARIC) study participants. *Value Health* 2016;19(8):996-1001.
20. Lavanya P, Jayalakshmy R, Rajaa S, Mahalakshmy T. Adherence to iron and folic acid supplementation among antenatal mothers attending a tertiary care center, Puducherry: A mixed-methods study. *J Family Med Prim Care* 2020;9(10):5205-5211.
21. Debi S, Basu G, Mondal R, Chakrabarti S, Roy SK, Ghosh S. Compliance to iron-folic-acid supplementation and associated factors among pregnant women: A cross-sectional survey in a district of West Bengal, India. *J Family Med Prim Care* 2020;9(7):3613-3618.
22. Choudhuri P, Debbarma A, Debbarma S, Reang T. Compliance to iron and folic acid tablets among pregnant women attending antenatal clinic in Agartala Government Medical College. *J Family Med Prim Care* 2022;11(6):2763-7.
23. Kamau MW, Mirie W, Kimani S. Compliance with Iron and folic acid supplementation (IFAS) and associated factors among pregnant women: results from a cross-sectional study in Kiambu County, Kenya. *BMC Public Health* 2018;18(1):1-10.
24. Felipe-Dimog EB, Yu C-H, Ho C-H, Liang F-W. Factors Influencing the Compliance of Pregnant Women with Iron and Folic Acid Supplementation in the Philippines: 2017 Philippine Demographic and Health Survey Analysis. *Nutrients* 2021;13(9):3060.
25. Agegnehu G, Atenafu A, Dagne H, Dagne B. Adherence to iron and folic acid supplement and its associated factors among antenatal care attendant mothers in Lay Armachiho health centers, Northwest, Ethiopia, 2017. *Int J Reprod Med* 2019;2019:5863737.
26. Dutta AJ, Patel P, Bansal R. Compliance to iron supplementation among pregnant women: a cross sectional study in urban slum. *Nat J Community Med* 2014;5(4):457-62.
27. Sendeku FW, Azeze GG, Fenta SL. Adherence to iron-folic acid supplementation among pregnant women in Ethiopia: a systematic review and meta-analysis. *BMC Pregnancy Childbirth* 2020;20(1):138.
28. Deori TJ, Ramaswamy G, Jaiswal A, Loganathan V, Kumar R, Mahey R, et al. Compliance with iron folic acid (IFA) tablets and associated factors among pregnant women attending antenatal care clinic at Sub District Hospital, Ballabgarh. *J Family Med Prim Care* 2021;10(5):2006-2011.
29. Yadav KD, Yadav UN, Wagle RR, Thakur DN, Dhakal S. Compliance of iron and folic acid supplementation and status of anaemia during pregnancy in the Eastern Terai of Nepal: findings from hospital based cross sectional study. *BMC Res Notes* 2019;12(1):127.
30. Chikakuda AT, Shin D, Comstock SS, Song S, Song WO. Compliance to prenatal iron and folic acid supplement use in relation to low birth weight in Lilongwe, Malawi. *Nutrients* 2018;10(9):1275.
31. Tinago CB, Annang Ingram L, Blake CE, Frongillo EA. Individual and structural environmental influences on utilization of iron and folic acid supplementation among pregnant women in Harare, Zimbabwe. *Matern Child Nutr* 2017;13(3):e12350.
32. Oiyee S, Juma M, Konyole S, Adan F. The influence of antenatal oral iron and folic acid side effects on supplementation duration in low-resource rural Kenya: a cross-sectional study. *J Pregnancy* 2020;2020:9621831.
33. Hyder SZ, Persson LÅ, Chowdhury A, Ekström E-C. Do side-effects reduce compliance to iron supplementation? A study of daily-and weekly-dose regimens in pregnancy. *J Health Popul Nutr* 2002;20(2):175-9.