REVIEW PAPER

Iron–Folic Acid Supplementation Knowledge, Adherence, and Anaemia among Pregnant Women Attending a Tertiary Care Institution: A Cross-Sectional Analytical Study

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ABSTRACT

Background: Anaemia in pregnancy remains a major public-health problem in India, where NFHS-5 (2019–21) reported a prevalence of 52.2% despite the national iron and folic acid (IFA) supplementation policy. Hospital-based evidence linking IFA knowledge, adherence, and anaemia in one cohort is limited.

Aims: To assess knowledge and practices regarding IFA supplementation among pregnant women attending antenatal care (ANC), and to identify the determinants of adequate knowledge and of current anaemia.

Methods and Material: A hospital-based cross-sectional analytical study was conducted in the tertiary care institution. The study was conducted on 450 pregnant women. Knowledge, adherence, counselling exposure, and haemoglobin were recorded. Bivariate associations were tested with chi-square test, and multivariable binary logistic regression was done for adequate knowledge and current anaemia. $P < 0.05$ was considered significant.

Results: Adequate IFA knowledge was present in 89 women (19.8%), strict adherence in 201 (44.7%), counselling in 328 (72.9%), and anaemia in 194 (43.1%). After adjustment, higher-secondary or graduate education (aOR 16.43, 95% CI 7.15–37.76) and counselling (aOR 3.59, 95% CI 1.76–7.33) were the dominant predictors of adequate knowledge. Strict adherence remained protective against anaemia (aOR 0.54; $P = 0.002$), and third trimester carried higher anaemia odds (aOR 1.58; $P = 0.021$).

Conclusions: Education and counselling were the dominant determinants of knowledge, and strict adherence was independently protective against anaemia. A counselling-integrated IFA support package and education-stratified outreach for women with secondary schooling or less are needed.

Key-words: Iron; Folic Acid; Pregnant Women; Anaemia; Cross-Sectional Studies; India

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Introduction

Anaemia in pregnancy remains one of the most persistent nutritional problems in low- and middle-income countries, and India carries a disproportionate share of the global load. The WHO estimates that around 37% of pregnant women worldwide are anaemic, with South Asia accounting for the highest regional burden.[1] NFHS-5 (2019–21) reported that 52.2% of pregnant women in India were anaemic, an increase from 50.4% in NFHS-4.[2] Anaemia in pregnancy is linked to preterm birth, low birthweight, and higher perinatal mortality, and the rise in anaemia prevalence from the first to the third trimester (reaching 70.7%) observed in Eastern Maharashtra shows that risk does not fall uniformly across gestation.[3]

India's response has been one of the largest public-sector IFA programmes in the world. The Anemia Mukt Bharat strategy prescribes at least 180 IFA tablets across the antenatal period together with counselling and point-of-care testing at every ANC visit.[2] World Health Organization (WHO) ANC guidance recommends daily oral iron (30–60 mg elemental) and 400 µg folic acid from early pregnancy.[1] Uptake on the ground is uneven. At a

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Puducherry tertiary centre, only 63.8% of ANC mothers met the prescribed regimen, with side effects and forgetfulness as the leading reasons for falling short.[4] A Ballabgarh sub-district analysis placed compliance at 77.1%, with lower compliance among multiparous women and those from joint families.[5] Work from rural Bihar identified education and counselling exposure as the strongest individual-level levers.[6] with a comparable pattern in Northwest Ethiopia.[7] A north-Indian KAP survey found that only one in two antenatal mothers were familiar with the correct timing, duration, and food-interaction rules around IFA.[8]

Integrated hospital-based evidence on knowledge, practices, and determinants among antenatal women in a single Indian cohort remains limited, and most prior work has looked at knowledge or adherence in isolation rather than as a linked pathway terminating in current anaemia. The present study was therefore undertaken to address this gap among pregnant women attending the ANC services at a tertiary care institution.

Materials and Methods

The present study was carried out after clearance from the Scientific Research Committee and the Institutional Ethics Committee.

Type of Study

Hospital-based, observational, cross-sectional study.

Study Area

Tertiary care institution serving peri-urban and rural catchment in Perambalur District, Tamilnadu.

Study Period

Twelve months from January 2025 to December 2025.

Study Population

Pregnant women attending the ANC OPD during the study period.

Inclusion Criteria

Pregnant women aged 18 years or above, booked or under follow-up at the study institution's ANC OPD, and willing to give written informed consent.

Exclusion Criteria

Severe maternal illness, known haemoglobinopathy or any condition contraindicating oral iron, or refusal to give consent.

Sample Size Calculation

Sample size was estimated using Cochran's formula, $n = Z^2pq/d^2$, with $Z = 1.96$, $p = 50\%$,[8] $q = 50\%$, and $d = 5\%$. The calculated sample size was 385. A 10% non-response buffer gave 428, rounded up to 450.

Sampling Technique

Consecutive sampling until 450 eligible women were enrolled.

Study Tools

A semi-structured questionnaire with four sections was used.

Section 1: Sociodemographic and obstetric proforma covering age, education, occupation, family type, residence, religion, monthly household income, gravidity, trimester, previous abortion, gestational age, comorbidity, and pre-pregnancy BMI.

Section 2: Seven-item IFA knowledge questionnaire (K1–K7), each scored 1 for correct and 0 for incorrect, with the answer key drawn from the Anemia Mukt Bharat programme and WHO ANC 2016 guidance. Items covered ever heard of IFA (K1), purpose (K2), timing of iron (K3), timing of folic acid (K4), duration ≥180 tablets (K5), best time of day (K6), and food-interaction rules (K7). Knowledge was classified using Bloom's three-band cut-offs: Adequate (≥6/7), Moderate (4–5/7), and Poor (≤3/7).

Section 3: IFA practice questionnaire covering receipt, current intake, frequency of intake, pills consumed in the last 30 days, side effects, reasons for irregular intake, counselling, sources of information, and perceived measures to improve adherence. Strict adherence was defined as daily intake and ≥28 of the last 30 pills consumed. Inclusive adherence was ≥24/30 pills (≥80% of days).

Section 4: Laboratory measurement of haemoglobin on a venous sample. Anaemia was defined using WHO trimester-specific haemoglobin cut-offs (Hb <11.0 g/dL in T1, <10.5 g/dL in T2, and <11.0 g/dL in T3).

Data Collection Procedure

Every eligible and willing woman was approached on the day of her OPD visit. The purpose, voluntary nature, and confidentiality safeguards were explained in the local language. Written informed consent was obtained, and the questionnaire was administered in a single sitting.

Data Analysis

Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics version 26. Descriptive statistics were reported as frequencies, percentages, and mean ± standard deviation, with Wilson 95% CIs for proportions. Bivariate associations were tested using Pearson's chi-square test with Yates' correction, and Fisher's exact test for sparse cells. Multivariable binary logistic regression was done for two binary outcomes (Adequate knowledge; current Anaemia), with adjusted odds ratios (aOR) and 95% Wald confidence intervals reported. All tests were two-sided; $P < 0.05$ was taken as significant.

Ethical Considerations

Ethical approval was obtained from the Institutional Ethics Committee before recruitment (IEC No: IECHS/IRCHS/NO.727). Written informed consent was obtained from every participant. Data were de-identified and the study followed the Declaration of Helsinki and the ICMR National Ethical Guidelines (2017).

Results

A total of 450 pregnant women were enrolled and analysed.

The mean age was 25.7 ± 3.9 years; 330 (73.3%) were of rural residence, 302 (67.1%) were homemakers, 298 (66.2%) were in nuclear family and 184 (40.9%) were in the third trimester [Table 1].

Table 1: Baseline maternal sociodemographic, obstetric, and clinical characteristics (n=450)

Characteristic		Number (%)
Age, mean±SD (years)		25.7±3.9
Monthly household income (₹), median (IQR)		18,582 (12,561–26,399)
Pre-pregnancy BMI, mean±SD (kg/m²)		22.3±3.5
Education	Graduate or higher	118 (26.2)
	Higher secondary	106 (23.6)
	Secondary	115 (25.6)
	Primary	66 (14.7)
	Illiterate	45 (10.0)
Occupation	Homemaker	302 (67.1)
	Skilled worker	59 (13.1)
	Unskilled worker	58 (12.9)
	Professional	31 (6.9)
Trimester	First	98 (21.8)
	Second	168 (37.3)
	Third	184 (40.9)
Gravidity	G1	195 (43.3)
	≥G2	255 (56.7)
Any antenatal comorbidity		58 (12.9)

SD: Standard deviation; IQR: Interquartile range; BMI: Body mass index

Mean knowledge score was 3.9 ± 1.7 out of 7. All 450 (100%) had heard of IFA, but only 35.5% knew folic acid timing and 41.1% knew the 180-tablet duration rule [Table 2]. By Bloom's three-band classification, 89 women (19.8%) had adequate, 177 (39.3%) moderate, and 184 (40.9%) poor knowledge [Figure 1].

Table 2: Item-level correctness knowledge-band distribution

Knowledge item	Correct response, n (%)
Heard of IFA tablets	450 (100)
Purpose of IFA	340 (75.6)
Correct timing to start iron	207 (46.0)
Correct timing to start folic acid	161 (35.5)
Duration ≥180 tablets	185 (41.1)
Best time of day	245 (54.4)
Food-interaction rules	229 (50.9)

IFA: Iron and folic acid

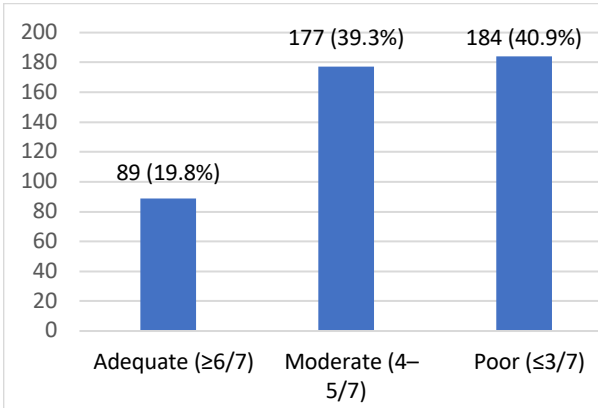


Figure 1: Composite knowledge-band distribution

Of the 450 women, 418 (92.9%) had received IFA tablets and 354 (78.7%) were currently taking them. Strict adherence was achieved by 201 (44.7%) and inclusive adherence by 242 (53.8%). Counselling was reported by 328 (72.9%), side effects by 134 (29.8%), and anaemia by 194 (43.1%) [Table 3].

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Table 3: IFA practice profile and anaemia status (n=450)

Practice/outcome	n (%)
Received IFA in current pregnancy	418 (92.9)
Currently taking IFA	354 (78.7)
Strict adherence (daily and ≥28/30 pills)	201 (44.7)
Inclusive adherence (≥80% of days)	242 (53.8)
Any side effect attributed to IFA	134 (29.8)
Counselling received	328 (72.9)
Anaemia, current pregnancy	194 (43.1)
Mild	140 (31.1)
Moderate	47 (10.4)
Severe	7 (1.6)

IFA: Iron and folic acid

Of 201 strictly adherent women, 69 (34.3%) were anaemic versus 125 of 249 (50.2%) non-adherent ($\chi^2 = 10.53$, P = 0.001; OR 0.52, 95% CI 0.36–0.77) [Table 4].

Table 4: Association between strict IFA adherence and current anaemia (n=450)

Adherence	Anaemic n (%)	Non-anaemic n (%)	χ^2 (Yates)	P	Crude OR (95% CI)
Strict adherence (exposed)	69 (34.3)	132 (65.7)	10.53	0.001	0.52 (0.36–0.77)
Non-adherent (not exposed)	125 (50.2)	124 (49.8)			1.00 (Reference)

IFA: Iron and folic acid; OR: Odds ratio; CI: Confidence interval

Adequate IFA knowledge was associated with higher-secondary or graduate education (36.6% vs 3.1% among women with ≤secondary schooling; P < 0.001), counselling exposure (23.8% vs 9.0%; P < 0.001), urban residence (28.3% vs 16.7%; P = 0.009), strict adherence (25.4% vs 15.3%; P = 0.010), and absence of current anaemia (23.8% vs 14.4% among anaemic women; P = 0.019). Age ≥30 years and multigravidity were not associated with knowledge [Table 5].

Table 5: Bivariate and multivariable logistic regression for predictors of adequate IFA knowledge (n=450)

Variable	Adequate n (%)	Inadequate n (%)	p-value†	Crude OR (95% CI)	aOR (95% CI)	p-value
Education						
≥Higher secondary	82 (36.6)	142 (63.4)	<0.001	18.07 (8.10–40.30)	16.43 (7.15–37.76)	<0.001
≤Secondary (reference)	7 (3.1)	219 (96.9)		1.00	1.00	–
Counselling received						
Yes	78 (23.8)	250 (76.2)	<0.001	3.15 (1.63–6.10)	3.59 (1.76–7.33)	<0.001
No (reference)	11 (9.0)	111 (91.0)		1.00	1.00	–
Residence						
Rural	55 (16.7)	275 (83.3)	0.009	0.51 (0.31–0.83)	0.63 (0.37–1.10)	0.107
Urban (reference)	34 (28.3)	86 (71.7)		1.00	1.00	–
Age (years)						
≥30	11 (15.7)	59 (84.3)	0.421	0.72 (0.36–1.45)	0.67 (0.31–1.46)	0.314

<30 (reference)	78 (20.5)	302 (79.5)		1.00	1.00	–
Gravid status						
Multigravida (≥G2)	51 (20.0)	204 (80.0)	0.892	1.03 (0.65–1.65)	1.11 (0.65–1.92)	0.699
G1 (reference)	38 (19.5)	157 (80.5)		1.00	1.00	–
Strict adherence						
Yes	51 (25.4)	150 (74.6)	0.010	1.89 (1.19–3.03)	1.62 (0.96–2.74)	0.073
No (reference)	38 (15.3)	211 (84.7)		1.00	1.00	–
Current anaemia						
Yes	28 (14.4)	166 (85.6)	0.019	0.54 (0.33–0.89)	0.71 (0.42–1.20)	0.205
No (reference)	61 (23.8)	195 (76.2)		1.00	1.00	–

†Pearson's Chi-square test with Yates' correction. IFA: Iron and folic acid; OR: Odds ratio; aOR: Adjusted odds ratio; CI: Confidence interval

Strict adherence was independently protective against anaemia (aOR 0.54; P = 0.002), and third trimester carried higher odds (aOR 1.58; P = 0.021). Adequate knowledge was also independently associated with lower odds of anaemia (aOR 0.70; P = 0.019) [Table 6].

Table 6: Multivariable logistic regression for predictors of current anaemia among pregnant women (n=450)

Predictor	Category	Anaemic n (%)	Non-anaemic n (%)	Crude OR (95% CI)	aOR (95% CI)	P
Strict adherence	Yes	69 (34.3)	132 (65.7)	0.52 (0.36–0.77)	0.54 (0.36–0.80)	0.002
	No (reference)	125 (50.2)	124 (49.8)	1.00	1.00	–
Adequate knowledge	Yes	28 (31.5)	61 (68.5)	0.54 (0.33–0.89)	0.70 (0.33–0.89)	0.019
	No (reference)	166 (46.0)	195 (54.0)	1.00	1.00	–
Trimester	Third trimester	91 (49.5)	93 (50.5)	1.55 (1.06–2.28)	1.58 (1.07–2.33)	0.021
	1st/2nd trimester (reference)	103 (38.7)	163 (61.3)	1.00	1.00	–
Gravidity	Multigravida(≥G2)	113 (44.3)	142 (55.7)	1.12 (0.77–1.63)	0.93 (0.63–1.38)	0.731
	Primigravida (G1) (reference)	81 (41.5)	114 (58.5)	1.00	1.00	–
Comorbidity	Yes	30 (51.7)	28 (48.3)	1.49 (0.86–2.59)	1.31 (0.74–2.31)	0.357
	No (reference)	164 (41.8)	228 (58.2)	1.00	1.00	–
Education	Higher secondary and above	89 (39.7)	135 (60.3)	0.76 (0.52–1.10)	0.80 (0.51–1.24)	0.317
	Secondary and below (reference)	105 (46.5)	121 (53.5)	1.00	1.00	–
Residence	Rural	144 (43.6)	186 (56.4)	1.08 (0.71–1.66)	1.19 (0.74–1.94)	0.470
	Urban (reference)	50 (41.7)	70 (58.3)	1.00	1.00	–

OR: Odds ratio; aOR: Adjusted odds ratio; CI: Confidence interval

Discussion

The present study assessed knowledge of IFA, IFA practices, and current anaemia among 450 pregnant women attending the ANC OPD of a tertiary care institution. The study found that adequate IFA knowledge was uncommon (19.8%), strict daily adherence reached 44.7%, and current anaemia was present in 43.1% of the participants. Education and counselling were the dominant determinants

of adequate knowledge, and strict adherence was independently protective against anaemia.

In the present study, the mean age was 25.7 ± 3.9 years, most participants were of rural residence (73.3%) and homemakers (67.1%), and most were in the second or third trimester. Similar sociodemographic profiles were reported by Deori et al., Lavanya et al., and Wendt et al., with mean age between 23 and 27 years and a predominance of rural residence among antenatal women.[4,5,6] These findings indicate that the profile of the present cohort reflects the broader profile of Indian antenatal women attending public-sector ANC services.

In the present study, only 19.8% of the participants had adequate IFA knowledge, with the deepest gaps on folic acid timing (35.5%) and the 180-tablet duration rule (41.1%). Similar findings of low IFA knowledge among Indian antenatal women were reported by Wendt et al. in rural Bihar and by Sharma et al. in northern India, where about one in two mothers knew the correct timing, duration, and food-interaction rules.[6,8] In contrast, Deori et al. at Ballabgarh and Lavanya et al. in Puducherry placed adequate-knowledge proportions at close to half their samples.[4,5] These differences may be due to the stricter Bloom's ≥80% cut-off on a seven-item composite used here, and the more rural, lower-education profile of the present catchment. These findings highlight that even women attending an ANC service often lack procedural knowledge of IFA, and counselling content needs deliberate emphasis on folic acid timing and the 180-tablet duration rule.

In the present study, higher-secondary or graduate education (aOR 16.43) and counselling (aOR 3.59) were the dominant independent predictors of adequate knowledge. Similar education-knowledge gradients were reported by Wendt et al. in Bihar and Sharma et al. in northern India.[6,8] Similar positive effects of counselling were reported by Deori et al. at Ballabgarh.[5] In contrast, Lavanya et al. in Puducherry reported a weaker independent counselling effect once household-level covariates entered the model.[4] These differences may be explained by the use of a single binary counselling indicator here versus a counselling-intensity score in Puducherry. These findings highlight that education and counselling are the two most modifiable individual-level levers behind IFA awareness.

In the present study, strict adherence reached 44.7%, with side effects (29.8%) and forgetfulness as the leading reasons for irregular intake. Similar findings were reported by Lavanya et al. in Puducherry and Yismaw et al. in northwest Ethiopia, where counselling acted as a positive correlate of adherence.[4,7] In contrast, Wendt et al. in rural Bihar reported much lower adequate consumption, anchored in supply-side stock-out.[6] These differences may be explained by the supply-chain gradient; in the present catchment supply was reliable and the rate-limiting step shifted from access to tolerance. These findings highlight that an adherence-support intervention needs to combine a tolerance arm and a behavioural-anchor arm to address side effects and forgetfulness together.

In the present study, strict adherence was independently protective against anaemia (aOR 0.54; P = 0.002), and third trimester carried higher odds (aOR 1.58; P = 0.021). Adequate knowledge was also independently associated with lower odds of anaemia (aOR 0.70; P = 0.019). Similar findings of an inverse adherence-anaemia relationship were reported by Deori et al. at Ballabgarh.[5] and the third-trimester rebound matched the pattern described by Locks et al. in eastern Maharashtra.[3] In contrast, Wendt et al. in rural Bihar did not surface a comparable adherence-anaemia signal, most plausibly because of range compression at low baseline consumption.[6] These differences may be explained by the cumulative biological effect of daily IFA on iron stores, set against the plasma-volume expansion peaking between 28 and 34 weeks of gestation. These findings highlight that adherence-focused intervention is the highest-yield single lever for reducing third-trimester anaemia in this catchment.

Strengths and Limitations

The study used a pre-specified knowledge cutoff and trimester-adjusted WHO anaemia definition, and multivariable analysis controlled for the main confounders. The cross-sectional design limits causal inference. The single-centre setting limits generalisability. Self-report instruments for adherence carry social desirability and recall bias, and the anaemia trajectory across pregnancy was not captured longitudinally.

Conclusions

Adequate IFA knowledge was present in only one in five pregnant women in this antenatal cohort, and strict adherence was achieved by less than half. Education and counselling were the dominant determinants of adequate knowledge, and strict adherence was independently protective against anaemia after multivariable adjustment, while third trimester carried higher anaemia odds. These findings highlight the need for a counselling-integrated IFA support package within ANC and an education-stratified outreach approach for women with secondary schooling or less, alongside stage-stratified anaemia screening. Larger multi-centre and longitudinal studies are needed to confirm these findings.

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Conflicts of Interest

There are no conflicts of interest.

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