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# Effect of direct monitoring by family members and counseling by health professionals on iron-folic acid supplementation: A cross-sectional study among pregnant women in Puducherry, India

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## Abstract:

**BACKGROUND:** The prevalence of iron-deficiency anemia in pregnant Indian women is reportedly quite high. Despite the sustained efforts of the current national control program and undisputed efficacy of iron-folic acid supplementation (IFAS), the onslaught of anemia has not been curtailed, probably as a result of noncompliance to IFAS. The objective of this study was to assess the effect of direct monitoring of pregnant women by family members, counseling by health professionals, and other variables on adherence to IFAS in Puducherry, India.

**MATERIALS AND METHODS:** A cross-sectional study was conducted among 250 pregnant women visiting Outpatient Clinic, Obstetrics and Gynecology, Jawaharlal Institute of Postgraduate Medical Education and Research, Puducherry. Missing  $\geq 2$  doses of IFAS in the preceding 7 days was considered as nonadherence. The Pearson Chi-square test was applied to identify the association between the different variables. Bivariate and multivariate logistic regressions revealed variables affecting adherence.

**RESULTS:** Around 34.4% of respondents reported nonadherence to IFAS. Direct monitoring by family members (Adjusted Odds Ratio [aOR] = 7.04;  $P < 0.001$ ), counseling by health professionals (aOR = 2.97;  $P = 0.002$ ), and improvement in hemoglobin (Hb) levels (aOR = 2.4;  $P = 0.01$ ) were associated with better adherence. Vomiting, abdominal pain, and diarrhea were common ADRs. The distance to hospital, improvement in Hb levels, counseling by health professionals, and direct monitoring by family members significantly reduced the odds of ADRs.

**CONCLUSION:** Direct monitoring of intake by family members and counseling by health professionals improved adherence to IFAS. Further in-depth formative research studies are recommended for strategies to improve adherence to IFAS in the vulnerable pregnant population of Puducherry and streamline the implementation of anemia national control program in a specific context.

## Keywords:

Anemia, iron-folic acid supplementation, medication adherence, pregnant women

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## Introduction

The global toll of women dying from preventable causes related to pregnancy and childbirth was approximately 810 per

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day in 2017.<sup>[1]</sup> In India, the maternal mortality rate from 2014 to 2016 was 130 (per 100,000 live births).<sup>[2]</sup> Moreover, adverse maternal and birth outcomes such as premature birth, low birth weight, and increased mortality were often associated with anemia during pregnancy.<sup>[3]</sup>

The global prevalence of anemia in pregnant women ranged from 38.9% to 48.7% in the WHO South-East Asia, Eastern Mediterranean, and African Regions.<sup>[4]</sup> However, the prevalence of anemia in pregnant Indian women is quite high, over 50% being diagnosed with anemia.<sup>[5]</sup> A slightly better situation was observed in the Union Territory of Puducherry where 27.8% of the pregnant women were found to be anemic.<sup>[6]</sup>

In accordance with the WHO guidelines,<sup>[7]</sup> the National Iron Plus Initiative (NIPI) promoted free daily Iron-folic acid supplementation (IFAS) to all pregnant Indian women for at least 100 days.<sup>[8]</sup> However, in spite of the sustained efforts of the current national control program and the undisputed efficacy of IFAS, not much progress had been observed in the control of prevailing anemia in India. The NFHS-4 reported that only 30.3% pregnant Indian women took IFAS for  $\geq 100$  days.<sup>[5]</sup> This lack of adherence to IFAS is one of the chief reasons for the failure of interventions.

Adherence is defined by the WHO as “the degree to which the person’s behavior corresponds with the agreed recommendations from a healthcare provider.”<sup>[9]</sup> Although studies have been conducted to assess adherence to IFAS in different regions of India,<sup>[10-13]</sup> only one study has evaluated the implementation of NIPI in urban Puducherry,<sup>[14]</sup> our region of interest. Moreover, although direct monitoring of IFAS<sup>[11,15,16]</sup> and appropriate counseling<sup>[16-18]</sup> have been reported to be crucial for achieving positive outcomes, no study investigating these variables specifically has been conducted in Puducherry. Hence, our aim was to assess the effect of direct monitoring by family members, counseling by health professionals, and other variables on adherence to IFAS by pregnant women in Puducherry, India, and determine the prevalence of nonadherence and investigate adverse effects (ADRs) with IFAS. Assessing the nonadherence to IFAS, in spite of the offer of free IFAS, will enable the formulation of effective strategies to tackle the key influences.

## Materials and Methods

Our research was a tertiary hospital-based, prospective, cross-sectional survey conducted in the Outpatient Clinic of Department of Obstetrics and Gynecology (OPD), Jawaharlal Institute of Postgraduate Medical Education and Research, Puducherry, India, in July and August 2019.

The sample size was calculated using the anticipated 64.7% adherence to IFAS,<sup>[10]</sup> with 7% absolute precision, 95% confidence interval with the formula:  $(z^2p[1-p])/d^2$  where,  $z = 1.96$ ,  $P = 0.647$  and  $d = 0.07$ . Considering a nonresponse rate of 20%, the sample size obtained was 214, which was rounded up to 250.

All pregnant women who had been started on IFAS and visited the OPD during the study period were invited to participate in the study. Medical and paramedical health professionals were excluded from the study to avoid the selection bias. Moreover, pregnant women with disabilities that would hamper their comprehension of the questionnaire and women unwilling to participate were also excluded from the study.

Ethical approval was obtained from the Institutional Ethics Committee vide Letter no. 2019-03950 dated 03/05/2019, and informed written consent was taken from all participants in Tamil (their vernacular). All pregnant women (within the inclusion criteria) attending the OPD during the study period were included in the study till the sample size was achieved. The objectives of the study were explained to the participants in Tamil.

Data were collected through a structured and pretested questionnaire developed through a series of focus group discussions with subject experts (two pharmacologists, two clinical pharmacists, and one obstetrics/gynecology specialist) and a review of the literature.<sup>[10-19]</sup> The questionnaire was prepared in English, translated into Tamil and then translated back into English for the accuracy of translation. There was pilot testing before the administration to the participants. An interviewer assisted with the completion of the questionnaire when the participant was illiterate. Operational definition of “Anemia” was given in the questionnaire as “Low red blood cells or low quantity of Hemoglobin (Hb) in the blood.”

The questionnaire covered the following aspects:

- Sociodemographic details
- Family and residential particulars: Family structure; distance of house from hospital
- Dietary preferences
- Brief Obstetric history: Antenatal visits, gestational age, parity, complications, and past history of abortions
- Hb Levels: Pre-IFAS and current values (from OPD records)
- Practices related to IFAS: Number of doses, their adherence, reasons for non-adherence, monitoring of adherence by family member, information supplied, and counseling by health professionals (physicians, nurses, and health social workers).

The collected data were coded and entered into the IBM® SPSS® for Windows version 25 (SPSS, Inc. Chicago, IL, USA). Continuous data were summarized as means and standard deviations and categorical data as numbers and percentages. The significance was set at 0.05 for all statistical analyses. The Pearson Chi-square test of significance was used to identify the association among the variables. Variables found significantly associated with adherence ( $P < 0.1$ ) in the bivariate analysis were included in the multiple logistic regression model and the odds ratio (OR) and corresponding 95% confidence intervals were generated.

Missing two or more doses of IFAS in the last 7 days was considered as non-adherence.<sup>[13,19]</sup> The presence of a family member (husband/parents/in-laws) who checked upon the subject, and reminded them to take the medications when they forgot was considered direct observation by family members. Counseling by a healthcare personnel involved the provision of detailed information on the adverse effects of anemia and the importance of IFAS. Anemia in pregnancy was diagnosed at hemoglobin level  $<11$  g/dl and classified into three grades of severity: Mild (10–10.9 g/dl), moderate (7–9.9 g/dl), and severe ( $<7$  g/dl) anemia.<sup>[8]</sup> Hemoglobin values of the first visit before the supplementation were started and the most recent visit after the supplementation had been initiated was recorded. The socioeconomic status was calculated using the Modified BG Prasad Scale, a scale for calculating socioeconomic class based on the monthly per capita income of the family.<sup>[20]</sup> A list of options with the possibility of multiple responses was included to determine the perceived reasons for nonadherence and adverse effects encountered with IFAS. Hence, the percentages for both these data did not always add up to a total of 100%. The STROBE guidelines were utilized to report the findings of this cross-sectional study.<sup>[21]</sup>

## Results

A total of 250 pregnant women were included in this study, with a mean age of 24.8 years  $\pm$  4.04. The majority were Hindus, unemployed, educated, had a mixed diet, belonged to socioeconomic Class I and lived very far ( $>5$  kilometers) from the hospital [Table 1].

Regarding nonadherence of IFAS, 34.4% claimed that they had missed at least one dose in the last 7 days. Of those who did not adhere, 26.8% ( $n = 67$ ) missed more than two consecutive doses. Adherence was significantly associated with the type of family [Table 1].

Almost all respondents had registered their pregnancies in the Antenatal Clinic (ANC; 98%;  $n = 245$ ) and were getting their regular check-ups. Most of the respondents were nulliparous, in their last trimester and had no

current complications or past history of abortions. Gestational diabetes (1.6%;  $n = 4$ ), hypertension (1.2%;  $n = 3$ ), and hyperemesis gravidarum (2.4%;  $n = 6$ ) were reported as complications in pregnancy. Adherence was significantly associated with the gestational age [Table 2].

The mean Hb level of the participants during their first visit before starting IFAS and after IFAS was  $9.72 \pm 1.32$  and  $9.75 \pm 1.15$ , respectively. More than half of the women (55.2%) showed improvement in Hb levels after starting the supplementation. The improvement in Hb levels after IFAS was significantly associated with adherence [Table 3].

The majority of the respondents (83.6%) were anemic with 24% ( $n = 60$ ) and 59.6% ( $n = 149$ ) being mildly and moderately anemic, respectively. Of the 28% ( $n = 70$ ) nonadherent anemic respondents, the majority ( $n = 55$ ; 78.6%) had missed more than two consecutive doses. There was no association of prevalence of anemia with adherence [Table 3].

Almost all respondents were advised by their doctor to take IFAS (98.8%) and were clearly instructed on the dose, frequency, and duration of the supplementation (96.8%). However, only 68.4% had been counseled by health professionals regarding the significance of taking IFAS. The majority of the women obtained their IFAS free of cost (88.4%) and had someone to directly monitor or remind them to take the tablets daily (64%). Counseling by health professionals and direct monitoring by family members were significantly associated with adherence [Table 3].

Multivariate analysis revealed that direct monitoring by family members, counseling by health professionals, and improvement in Hb levels showed increased adherence to IFAS. However, the association between adherence and occupation, type of family, gestational age, detailed instructions about IFAS given by doctor, and source of IFAS was not maintained [Table 4].

Of the 86 women who reported nonadherence to IFAS, forgetfulness (44.2%;  $n = 38$ ), perceived or experienced side-effects (43%;  $n = 37$ ), inability to visit the hospital to get IFAS (12.8%;  $n = 11$ ), existing complications of pregnancy (5.8%;  $n = 5$ ), belief that it was unnecessary (4.7%;  $n = 4$ ), travelling (3.5%;  $n = 3$ ), negligence (3.5%;  $n = 3$ ), and family influence (2.4%;  $n = 1$ ) were the reasons for not taking the IFAS.

Of the 37 women who reported adverse effects of IFAS, vomiting (86.5%;  $n = 32$ ), abdominal pain (24.3%;  $n = 9$ ), and diarrhea (13.5%;  $n = 5$ ) were the main ADRs. All the women who reported ADRs were nonadherent to IFAS. The distance to hospital, improvement in Hb

**Table 1: Sociodemographic characteristics of pregnant women by adherence to iron-folic acid supplements (n=250)**

Sociodemographic characteristics	Adherence			P-value	COR (95% CI) <sup>§</sup>
	Yes N (%)	No N (%)	Total N (%)		
Age (years)					
<20	23 (9.2)	9 (3.6)	32 (12.8)	0.497	1.47 (0.61-3.53)
20-30	128 (51.2)	67 (26.8)	195 (78.0)		1.97 (0.64-6.08)
>31	13 (5.2)	10 (4.0)	23 (9.2)		1.00
Religion					
Hinduism	126 (50.4)	66 (26.4)	192 (76.8)	0.841	1.36 (0.42-4.46)
Islam	31 (12.4)	15 (6.0)	46 (18.4)		1.46 (0.4-5.43)
Christianity	7 (2.8)	5 (2.0)	12 (4.8)		1.00
Occupation					
Employed	5 (2.0)	7 (2.8)	12 (4.8)	0.074	1.00 <sup>†</sup>
Unemployed	159 (63.6)	79 (31.6)	238 (95.2)		2.82 (0.87-9.16)
Education					
Illiterate	21 (8.4)	14 (5.6)	35 (14.0)		1.00
High school	65 (26.0)	33 (13.2)	98 (39.2)	0.753	1.31 (0.59-2.91)
College	78 (31.2)	39 (15.6)	117 (46.8)		1.33 (0.61-2.9)
Socioeconomic class					
I	65 (26.0)	31 (12.4)	96 (38.4)		1.00
II	40 (16.0)	31 (12.4)	71 (28.4)	0.340	0.62 (0.33-1.16)
III	29 (11.6)	14 (5.6)	43 (17.2)		0.99 (0.46-2.13)
IV	27 (10.8)	9 (3.6)	36 (14.4)		1.43 (0.6-3.41)
V	3 (1.2)	1 (0.4)	4 (1.6)		1.43 (0.14-14.3)
Type of family					
Nuclear	60 (24.0)	20 (8.0)	80 (32.0)		1.00 <sup>#</sup>
Joint	104 (41.6)	66 (26.4)	170 (68.0)	0.032	1.9 (1.05-3.44)
Diet <sup>‡</sup>					
Vegetarian	20 (8.0)	10 (4.0)	30 (12.0)	0.896	1.06 (0.47-2.37)
Mixed	144 (57.6)	76 (30.4)	220 (88.0)		1.00
Distance of home from hospital (km)					
Nearby (<2)	21 (8.4)	12 (4.8)	33 (13.2)		1.00
Far (2-5)	40 (16.0)	20 (8.0)	60 (24.0)	0.958	1.14 (0.47-2.78)
Very far (>5)	103 (41.2)	54 (21.6)	157 (62.8)		1.09 (0.5-2.38)
Total	164 (65.6)	86 (34.4)	250 (100)		

<sup>‡</sup>Mixed diet=Combination of vegetarian and nonvegetarian diet; <sup>\*</sup>Chi-square test, <sup>§</sup>COR, <sup>†</sup>P=0.085 and <sup>#</sup>P=0.033 in bivariate logistic regression. <sup>§</sup>COR=Crude odds ratio, CI=Confidence interval

levels after IFAS, counseling by health professionals, and direct monitoring by family members were observed to reduce the odds of ADRs through the multivariate analysis [Table 5].

## Discussion

Nonadherence is a major barrier to the effectiveness of any medical intervention. In our study, the prevalence of nonadherence to IFAS of pregnant women of Puducherry was found to be 34.4%. In view of the undisputable evidence-based benefits of IFAS, issues related to nonadherence to IFAS are of the utmost importance in the vulnerable pregnant population. Although other studies have used different criteria to assess adherence to IFAS, thus limiting comparison, our results are not unlike the prevalence of nonadherence in the different regions of India: 38%,<sup>[12]</sup> 35.3%,<sup>[10]</sup> 32.1%,<sup>[22]</sup> 31%,<sup>[23]</sup> and 29%.<sup>[24]</sup> Compared to other countries, higher (countries

of sub-Saharan Africa: 71.3%,<sup>[25]</sup> Kenya: 67.3%,<sup>[19]</sup> Egypt: 58.9%,<sup>[26]</sup> and Ethiopia: 58.6%<sup>[18]</sup>) and lower (USA: 26%<sup>[27]</sup>) nonadherence rates have been reported.

Our study reported that direct monitoring or the presence of a family member to remind the expectant mother about the IFAS, counseling by health professionals, and improvement in Hb levels were associated with better adherence to IFAS. It is presumed that direct monitoring resulted in better compliance as forgetfulness was a major cause for nonadherence in our study. Similar to our study, the deployment of a direct observer in India,<sup>[11]</sup> familial encouragement in India<sup>[16]</sup> and Egypt<sup>[26]</sup> or directly supervised IFAS in Asian and African countries<sup>[15]</sup> increased adherence to IFAS remarkably. Henceforth, direct observation strategies to counter the problem of forgetfulness should be developed. Techniques like a daily reminder messages/SMS would also improve adherence.

**Table 2: Obstetric history of the pregnant women by adherence to iron-folic acid supplements (n=250)**

Variables	Adherence			P-value*	COR (95% CI) <sup>§</sup>
	Yes N (%)	No N (%)	Total N (%)		
Antenatal visits					
Regular	159 (63.6)	82 (32.8)	241 (96.4)	0.518	1.55 (0.41-5.93)
Not regular	5 (2.0)	4 (1.6)	9 (3.6)		1.00
Gestational age (weeks)					
<28	28 (11.2)	20 (8.0)	48 (19.2)		1.00
28-36	74 (29.6)	24 (9.6)	98 (39.2)	0.030	2.2 (1.06-4.6) <sup>#</sup>
>36	62 (24.8)	42 (16.8)	104 (41.6)		1.05 (0.53-2.11)
Parity					
Nulliparous	83 (33.2)	45 (18.0)	128 (51.2)		1.00
Multiparous	81 (32.4)	41 (16.4)	122 (48.8)	0.797	1.07 (0.64-1.81)
Complications in pregnancy <sup>†</sup>					
Present	7 (2.8)	6 (2.4)	13 (5.2)		1.00
Absent	157 (62.8)	80 (32.0)	237 (94.8)	0.360	1.68 (0.55-5.17)
Past history of abortions					
Yes	22 (8.8)	8 (3.2)	30 (12.0)	0.342	1.51 (0.64-3.55)
No	142 (56.8)	78 (31.2)	220 (88.0)		1.00
Total	164 (65.6)	86 (34.4)	250 (100)		

<sup>†</sup>Complications in pregnancy=Gestational diabetes; hypertension and hyperemesis gravidarum, \*Chi-square test; <sup>#</sup>P=0.035 in bivariate logistic regression.

<sup>§</sup>COR=Crude odds ratio, CI=Confidence interval

**Table 3: Factors affecting adherence to iron-folic acid supplements (n=250)**

Variables	Adherence			P-value*	COR (95% CI) <sup>§</sup>
	Yes N (%)	No N (%)	Total N (%)		
Anemia					
Present	139 (55.6)	70 (28.0)	209 (83.6)	0.495	1.27 (0.64-2.53)
Absent	25 (10.0)	16 (6.4)	41 (16.4)		1.00
Improvement in hemoglobin levels after IFAS					
Yes	108 (43.2)	30 (12.0)	138 (55.2)	<0.001	3.6 (2.08-6.23) <sup>#</sup>
No	56 (22.4)	56 (22.4)	112 (44.8)		1.00
Advised to take IFAS by doctor					
Yes	163 (65.2)	84 (33.6)	247 (98.8)	0.237	3.88 (0.35-43.4)
No	1 (0.4)	2 (0.8)	3 (1.2)		1.00
Detailed instructions about IFAS given by doctor					
Yes	161 (64.4)	81 (32.4)	242 (96.8)	0.089	3.31 (0.77-14.21) <sup>§</sup>
No	3 (1.2)	5 (2.0)	8 (3.2)		1.00
Counseling by health professional					
Yes	130 (52.0)	41 (16.4)	171 (68.4)	<0.001	4.2 (2.38-7.4) <sup>#</sup>
No	34 (13.6)	45 (18.0)	79 (31.6)		1.00
Source of IFAS					
Free	149 (59.6)	72 (28.8)	221 (88.4)	0.094	1.93 (0.89-4.22) <sup>†</sup>
Purchased	15 (6.0)	14 (0.6)	29 (11.6)		1.00
IFAS tablets per days					
1	111 (44.4)	57 (22.8)	168 (67.2)	0.822	1.07 (0.61-1.85)
≥2	53 (21.2)	29 (11.6)	82 (32.8)		1.00
Direct monitoring by family members					
Yes	133 (53.2)	27 (10.8)	160 (64.0)	<0.001	9.38 (5.14-17.09) <sup>#</sup>
No	31 (12.4)	59 (23.6)	90 (36.0)		1.00
Total	164 (65.6)	86 (34.4)	250 (100)	-	

\*Chi-square test, <sup>#</sup>P<0.001, <sup>§</sup>P=0.090 and <sup>†</sup>P=0.098 in bivariate logistic regression. IFAS=Iron-folic acid supplements, <sup>§</sup>COR=Crude odds ratio, CI=Confidence interval

Counseling by health professionals regarding the importance of IFAS was also instrumental in enhancing compliance to IFAS. In conformity with our results, other

studies from India<sup>[12,16,23,24]</sup> had identified higher adherence rates in women who had the importance of IFAS explained to them. Globally, Kenyan,<sup>[19]</sup> Egyptian,<sup>[26]</sup> and

**Table 4: Multivariable analysis: Factors related with adherence to iron-folic acid supplements**

Variables	$\beta$	SE	aOR	95% CI	P-value
Occupation					
Employed	-	-	1.00	-	0.291
Unemployed	0.811	0.768	2.25	0.50-10.14	
Type of family					
Nuclear	0.629	0.375	1.88	0.90-3.91	0.093
Joint	-	-	1.00	-	
Gestational age (weeks)					
<28	0.42	0.46	1.42	0.42-2.57	0.928
28-36	0.665	0.369	1.94	0.94-4.0	0.072
>36	-	-	1.00	-	-
Improvement in hemoglobin levels after IFAS					
No	-	-	1.00	-	0.01
Yes	0.863	0.336	2.37	1.23-4.58	
Detailed instructions about IFAS given by doctor					
No	-	-	1.00	-	0.872
Yes	0.164	1.02	1.18	0.16-8.64	
Counseling by health professional					
No	-	-	1.00	-	0.002
Yes	1.089	0.355	2.97	1.48-5.96	
Source of IFAS					
Purchased	-	-	1.00	-	0.595
Free	0.274	0.515	1.32	0.48-3.6	
Direct monitoring by family members					
No	-	-	1.00	-	<0.001
Yes	1.952	0.333	7.04	3.66-13.53	

$\beta$ =Regression coefficient, SE=Standard error, IFAS=Iron-folic acid supplements, aOR=Adjusted odds ratio; CI=Confidence interval

**Table 5: Multivariable analysis: Factors related to adverse effects with iron-folic acid supplements (n=250)**

Variable	Women with ADRs N (%)	$\beta$	SE	aOR (95% CI)	P-value
Distance from home to hospital (km)					
Nearby (<2)	8 (3.2)	1.212	0.578	3.36 (1.08-10.44)	0.036
Far (2-5)	10 (4.0)	0.696	0.483	2.01 (0.78-5.17)	0.150
Very far (>5)	19 (7.6)	-	-	1.00	-
Gestational age (weeks)					
<28	12 (4.8)	0.452	0.493	1.57 (0.60-4.13)	0.360
28-36	8 (3.2)	-0.624	0.500	0.54 (0.20-1.43)	0.212
>36	17 (6.8)	-	-	1.00	-
Improvement in hemoglobin levels after IFAS					
Yes	8 (3.2)	-	-	1.00	
No	29 (11.6)	1.228	0.466	3.42 (1.37-8.51)	0.008
Counseling by health professional					
Yes	14 (5.6)	-	-	1.00	
No	23 (9.2)	1.153	0.428	3.17 (1.37-7.33)	0.007
Direct monitoring by family members					
Yes	11 (4.4)	-	-	1.00	
No	26 (10.4)	1.202	0.434	3.33 (1.42-7.79)	0.006
Total	37 (14.8)	-	-	-	-

ADRs=Adverse effects, CI=Confidence intervals,  $\beta$ =Regression coefficient, SE=Standard error, IFAS=Iron-folic acid supplements, aOR=Adjusted odds ratio

Ethiopian<sup>[18]</sup> women have also reported that counseling was a major reason for better compliance. This underlines the pivotal role that healthcare professionals play in enhancing compliance to IFAS. Similar to the results from Egypt,<sup>[26]</sup> no association between the prevalence of anemia and adherence was discerned in our study. However, a

significant association between improvement in Hb levels and adherence was detected. It is plausible that consistent adherence to IFAS led to the improvement in Hb levels, which may have resulted in the positive association. A cause for concern was the extremely high prevalence of anemia (83.6%) in our respondents compared to national

average (50.4%)<sup>[5]</sup> and Puducherry data (27.8%).<sup>[6]</sup> As our study site was a tertiary healthcare center, women with more complications may have been referred for follow-up, resulting in the higher prevalence of anemia. Moreover, the majority of the respondents registered in their last trimester (80.8%) with almost half reporting to the hospital after 36 weeks (41.6%).

In spite of being anemic, 28% of our respondents were nonadherent and the majority (78.6%) skipped more than two doses of IFAS. This reaffirms the need for intense counselling regarding the importance of IFAS in pregnancy. Similar noncompliance to IFAS by pregnant anemic women had also been reported in previous other studies from India<sup>[10,22-24]</sup> and Egypt.<sup>[26]</sup>

Although no association of adherence with sociodemographic characteristics was observed in our study, other studies from India, Kenya, sub-Saharan Africa, Egypt, Ethiopia, and USA have reported that adherence to IFA therapy was related to age,<sup>[10,19,22,25,26]</sup> education,<sup>[18,22,25,27,28]</sup> socioeconomic status,<sup>[10,19,25,26,28]</sup> and joint family status<sup>[24]</sup> Furthermore, gestational age, parity, and ANC visits did not influence adherence in our respondents unlike other studies in which multiparous women,<sup>[10,22]</sup> who had registered early in ANC<sup>[18,22,24,28,29]</sup> and had made regular ANC visits<sup>[18,22,24-26]</sup> were found to be more compliant with IFAS. Ethnic variations between non-Hispanic white and non-Hispanic black women had also been reported from the USA.<sup>[27]</sup>

Adherence did not depend on the daily number of tablets consumed or the source of IFAS (free or purchased tablets) in our study, probably because most women purchased medicines only when they disliked the free IFAS brands. Moreover, most women were non-compliant because they forgot to take the tablets, whether it was a free tablet or purchased. In contrast to our results, less pill burden,<sup>[10,26]</sup> and free supply of IFAS<sup>[10,24]</sup> had influenced adherence in Egypt and India. Further, improvisation of public health services may have justified the absence of association between accessibility to the healthcare center and adherence in our study, unlike reports from rural India,<sup>[29]</sup> Asian, and African countries.<sup>[17,30]</sup>

Our respondents reported forgetfulness (44.2%), perceived or experienced side-effects (44.2%), and inability to visit the hospital (12.8%), as the main excuses for missing the IFAS. Forgetfulness<sup>[10,11,17,23,29]</sup> and side-effects<sup>[10,11,17,24,26,29]</sup> have been acknowledged in other studies from India, Egypt, and many developing countries and imply general perceptions/problems of pregnant women globally. Besides these, inadequate counseling by healthcare professionals also reported in India,<sup>[23,24]</sup> Afghanistan, Bangladesh, and Indonesia,<sup>[30]</sup> is one of the factors associated with nonadherence in our analysis.

Similar to other studies,<sup>[10,26]</sup> vomiting (86.5%), abdominal pain (24.3%), and diarrhea (13.5%) were common ADRs reported by 15% of our respondents, all of whom did not adhere to IFAS. Although the prevalence of ADRs leading to total nonadherence in our study was almost similar to what had been reported by many other countries (10%),<sup>[17]</sup> almost half of our nonadherent respondents (44.2%) reported ADRs as the main excuse for nonadherence. ADRs resulting from IFAS have also significantly contributed to nonadherence in India,<sup>[11]</sup> Kenya,<sup>[19]</sup> and Egypt.<sup>[26]</sup> The close proximity of hospital, improvement in Hb levels after IFAS, counseling by health professionals, and direct monitoring by family members were significantly associated with ADRs. Easier access to health-care facilities may have resulted in the better utilization of antenatal services and higher reporting of ADRs. Moreover, as the reduction in ADRs would lead to better adherence and subsequent alleviation of anemia, the influence of improved Hb levels on reducing the odds of ADRs was justifiable. Besides, possible motivation by health professionals and family members to overcome minor and transient ADRs may have reduced the odds of the reported ADRs in our study. Similarly, Kenyan women who were advised on the management of ADRs were also reported to be more compliant.<sup>[19]</sup> This reaffirms the necessity for intense counseling by health professionals regarding the management of minor side effects and the recruitment of family members in the health care of the expectant mothers.

Although pregnant women in many countries recognize the prescribed IFAS as supplements and take them as instructed, very few realize the clinical justification of the prescription and the effectiveness of IFAS to alleviate the symptoms of anemia.<sup>[17,30]</sup> Hence, healthcare providers must be trained to efficiently counsel women on anemia, the importance of IFAS during pregnancy and evidence-based supplementation guidelines. As our study revealed that the fear of perceived or experienced side-effects was responsible for nonadherence, and counselling reduced the odds of ADRs, health workers must also be sensitized to the anticipated side effects and how to manage them. IFAS trials have also validated the fact that women who had been counselled on the health benefits of IFAS and had personally experienced improved health after IFAS were willing to disregard or try to overcome mild side effects and continue with the IFAS.<sup>[17]</sup> Counseling skills to solicit support from the family members for total adherence could also be a component of the training. Media, pamphlets, and posters can also be utilized to highlight the relevant information. Community-based delivery of IFAS, ascertaining private providers of IFAS such as community pharmacies that are up-to-date with IFAS guidelines, interventions that streamline IFAS

procurement and quality control may be strategies worth considering by the Government.

The strength of our study was the in-depth exploration of the influence of family support, counseling by health professionals, and other variables affecting compliance to IFAS by pregnant women of Puducherry, which previous studies had not attempted. Data were collected by the first author alone and thus avoided inter-observer variation. Limitations included the small sample size which precludes generalizability of our results, failure to follow up the anemic and nonadherent respondents, and the likelihood of recall bias of respondents regarding IFAS. The self-report data and the unconfirmed adherence rates through pill counts may be other limitations.

## Conclusion

Our study endeavored to explore the variables affecting the adherence to IFAS of pregnant women in Puducherry, India. More than one-fourth of the respondents reported nonadherence to IFAS, the most common excuse being forgetfulness. Direct observation of intake by family members, counseling by health professionals, and improvement in Hb levels were associated with better adherence to IFAS. Vomiting, abdominal pain, and diarrhea were the common ADRs reported by 15% of our respondents, all of whom were nonadherent to IFAS. The distance to hospital, improvement in Hb levels, counseling by health professionals, and direct monitoring by family members were observed to reduce the odds of ADRs. Further in-depth formative research studies are recommended to ratify our results, develop strategies to improve adherence to IFAS in the vulnerable pregnant population of Puducherry, and streamline the implementation of anemia national control program in this particular context.

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## Conflicts of interest

There are no conflicts of interest.

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