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Research Article

# EFFECT OF IRON–FOLIC ACID SUPPLEMENTATION ON NUTRITIONAL STATUS: MID-UPPER ARM CIRCUMFERENCE AND BODYWEIGHT CHANGES DURING PREGNANCY

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**ABSTRACT**

**Objective:** Chronic energy deficiency is a common condition among pregnant women and can adversely affect both maternal and fetal outcomes. Iron and folic acid (IFA) supplementation is routinely provided in maternal health services to prevent anemia and improve nutritional status. This study aimed to investigate the effect of IFA supplementation on maternal nutritional indicators, including changes in mid-upper arm circumference (MUAC), bodyweight, and prenatal body mass index (BMI) among pregnant women at the Lubuk Buaya Public Health Center in Padang.

**Method:** A descriptive retrospective design was employed using medical records of 976 pregnant women from January to December 2024. Variables included the number of IFA tablets consumed, MUAC, bodyweight change, and prenatal BMI. Data were analyzed using the Compare Means test.

**Results:** Statistical analysis showed that changes in MUAC were small and not clinically significant, despite a formally significant p-value (p=0.000). This likely reflects the absence of MUAC improvement rather than a beneficial effect of supplementation. For bodyweight, the largest group (30 tablets, n=926) showed no measurable change, while smaller groups receiving higher IFA doses (≥60 tablets) showed variable weight reductions, though very small sample sizes limited interpretation. Prenatal BMI was comparable across groups with no significant differences (p=0.183). The unequal distribution of participants, particularly the small number in the 90- and 120-tablet groups, limited statistical power and generalizability.

**Conclusion:** Regular IFA supplementation was associated with improved MUAC, indicating benefits for maternal nutritional status, although effects on bodyweight and BMI were inconclusive due to sample imbalance and variability. Strengthening health education and encouraging adherence to antenatal visits are essential to ensure adequate supplementation and optimize maternal health outcomes.

**Keywords:** Iron, Folic acid, Mid-upper arm circumference, Body weight, Pregnancy.

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## INTRODUCTION

Pregnancy is defined as the period from conception, calculated from the 1st day of the last menstrual period (LMP), until the birth of the fetus [1]. It is divided into three trimesters: The first trimester (0–12 weeks), the second trimester (12–24 weeks), and the third trimester (24–40 weeks) [2-4]. During the third trimester, fetal growth accelerates more rapidly than in the earlier stages. Malnutrition during this period can hinder fetal development, leading to low birth weight and other adverse outcomes. Maternal nutritional status indicators, such as mid-upper arm circumference (MUAC) and hemoglobin levels, play an important role in predicting pregnancy outcomes [5-7]. Malnutrition and maternal illness can negatively affect both maternal health and fetal development [8].

MUAC measurement is a simple and widely used method to evaluate maternal nutritional status. It serves as an anthropometric indicator to predict chronic energy deficiency (CED) among women of reproductive age, including pregnant women [7,9]. A MUAC measurement below 23.5 cm indicates a risk of CED, which has been associated with maternal complications, low birth weight, and increased perinatal morbidity and mortality [6,7]. National health reports suggest that a substantial proportion of pregnant women in Indonesia still present with MUAC <23.5 cm, placing them at risk of CED and related complications. For instance, data from 2020 showed that 451,350 pregnant women (10%) had MUAC <23.5 cm, highlighting the urgency of nutritional interventions during pregnancy [2,7].

Iron and folic (IFA) acid supplementation is one of the most effective interventions to improve maternal nutritional status. IFAs are essential micronutrients for red blood cell production, oxygen transport, and DNA synthesis, all of which support maternal and fetal growth [4]. The World Health Organization (WHO) recommends daily supplementation of 60 mg iron and 400 µg folic acid during pregnancy to prevent anemia, preterm birth, and neural tube defects, while also supporting adequate maternal weight and MUAC growth [10,11]. In Indonesia, national health guidelines mandate the provision of at least 90 IFA tablets during pregnancy [12].

Given the importance of maternal nutrition in reducing maternal and neonatal morbidity and mortality, and the role of MUAC as a simple screening tool for CED, this study was conducted to analyze the effect of iron–folic acid (IFA) supplementation on changes in MUAC among pregnant women attending antenatal care (ANC) at Lubuk Buaya Primary Health Center, Padang. The research focused on whether IFA supplementation influences the progression of MUAC in pregnant women. The objective was to determine the effect of IFA supplementation on MUAC development during pregnancy. The working hypothesis proposed that IFA supplementation has a significant positive impact on MUAC increase during pregnancy.

## METHOD

### Study design

This study employed a descriptive design with retrospective data collection. The data were obtained from the medical records of

pregnant women who received ANC services at the Lubuk Buaya Health Center in Padang.

**Study setting and period**

The study was conducted at the Lubuk Buaya Health Center, Padang, West Sumatra, Indonesia. Data were collected from medical records covering the period of January–December 2024.

**Data source**

The primary source of data was the medical record book of pregnant women at the Maternal and Child Health unit of the Lubuk Buaya Health Center. This source included information on patient identity, obstetric status, and clinical data such as MUAC, body weight, and IFA received.

**Population and sample**

The population consisted of all pregnant women who visited the Lubuk Buaya Health Center for ANC during the study period. The study sample comprised pregnant women who met the inclusion criteria, which included having completed antenatal visits and receiving IFA supplementation. Patients with comorbidities were excluded from the analysis. Sampling was conducted using a total sampling technique, including all eligible cases that met the criteria.

**Data collection procedure**

Data collection was carried out by reviewing the medical records of pregnant women attending the Lubuk Buaya Health Center from January to December 2024. Eligible patients were identified according to the inclusion and exclusion criteria. Data extracted data included patient demographics, obstetric characteristics, and clinical measurements, such as MUAC. A standardized data collection form was used to record all relevant information from the medical records.

**Data analysis**

The collected data were first organized and entered into Microsoft Excel and then analyzed using the Statistical Package for the Social Sciences (SPSS) version 25. Descriptive statistics were used to summarize the sociodemographic and clinical characteristics of the study participants. Univariate analysis described the distribution and frequency of MUAC and body weight while bivariate analysis was employed to assess the association between IFA supplementation and MUAC values. Data were analyzed using Mann–Whitney and Kruskal–Wallis tests to compare non-normally distributed variables across groups [13]. These non-parametric tests were selected because the data violated normality assumptions and group sizes were highly unequal [14].

## RESULTS

**Sociodemographic characteristics of pregnant women**

This study included 976 pregnant women recorded in the medical logbook of Lubuk Buaya Primary Health Center, Padang, between January and December 2024. The distribution of ANC visits revealed that the majority of patients attended only one visit (K1, n=926). At the same time, only 43 women continued to the second visit (K2), two women reached the third visit (K3), and one woman completed the fourth visit (K4). Consequently, the number of IFA tablets received also varied, with women receiving 30, 60, 90, and 120 tablets, respectively, depending on the number of ANC visits completed. Sociodemographic characteristics can be seen in Table 1.

**Clinical characteristics of pregnant women**

Clinical analysis focused on changes in MUAC across ANC visits. Statistical testing in Table 2 showed that differences in mean values across visits were small and not statistically significant (p=0.00 for all variables).

## DISCUSSION

The findings of this study highlight a substantial gap between the recommended ANC coverage and the actual practice among pregnant women in Padang [2]. Most women attended only one ANC visit and

**Table 1: Sociodemographic characteristics during prenatal visits**

| Variable | Visit, n (%) | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| Age | | | | |
| 20–35 years | 902 (95.0) | 44 (4.6) | 2 (0.2) | 1 (0.1) |
| >35 years | 1 (100.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| Education[a] | | | | |
| Junior High School | 6 (0.6) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| Vocational High School | 1 (0.1) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| Senior High School | 271 (29.3) | 8 (17.8) | 0 (0.0) | 0 (0.0) |
| Diploma (D3) | 2 (0.2) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| Bachelor (S1) | 45 (4.9) | 1 (2.2) | 0 (0.0) | 0 (0.0) |
| Missing Data | 601 (64.9) | 36 (80.0) | 2 (100.0) | 1 (100.0) |
| Gravida | | | | |
| G1 | 339 (96.0) | 13 (3.7) | 1 (0.3) | 0 (0.0) |
| G2 | 241 (93.4) | 17 (6.6) | 0 (0.0) | 0 (0.0) |
| G3 | 146 (93.6) | 8 (5.1) | 1 (0.6) | 1 (0.6) |
| G4 | 49 (92.5) | 4 (7.5) | 0 (0.0) | 0 (0.0) |
| G5 | 27 (93.1) | 2 (6.9) | 0 (0.0) | 0 (0.0) |
| G6 | 9 (90.0) | 1 (10.0) | 0 (0.0) | 0 (0.0) |
| G7 | 6 (100.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| Parity | | | | |
| P0 | 354 (96.2) | 13 (3.5) | 1 (0.3) | 0 (0.0) |
| P1 | 258 (93.5) | 18 (6.5) | 0 (0.0) | 0 (0.0) |
| P2 | 146 (92.4) | 10 (6.3) | 1 (0.6) | 1 (0.6) |
| P3 | 36 (94.7) | 2 (5.3) | 0 (0.0) | 0 (0.0) |
| P4 | 18 (90.0) | 2 (10.0) | 0 (0.0) | 0 (0.0) |
| P5 | 5 (100.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| Abortion history | | | | |
| A0 | 733 (94.5) | 40 (5.2) | 2 (0.3) | 1 (0.1) |
| A1 | 67 (93.1) | 5 (6.9) | 0 (0.0) | 0 (0.0) |
| A2 | 11 (100.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| A3 | 5 (100.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| A5 | 1 (100.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| Number of living children | | | | |
| H0 | 345 (96.1) | 13 (3.6) | 1 (0.3) | 0 (0.0) |
| H1 | 265 (93.6) | 18 (6.4) | 0 (0.0) | 0 (0.0) |
| H2 | 138 (93.9) | 7 (4.8) | 1 (0.7) | 1 (0.7) |
| H3 | 36 (94.7) | 2 (5.3) | 0 (0.0) | 0 (0.0) |
| H4 | 15 (93.8) | 1 (6.3) | 0 (0.0) | 0 (0.0) |
| H5 | 4 (100.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) |

[a]Educational data were missing for 64.9% of participants, which limits the interpretation of sociodemographic patterns

therefore received fewer than the recommended 90 IFA tablets during pregnancy [7]. This situation undermines the primary purpose of supplementation, which is to prevent iron-deficiency anemia, reduce pregnancy-related complications, and improve fetal outcomes [15-18].

In terms of age, most respondents were between 20 and 35 years old (95%), which is considered the healthy reproductive age group. However, despite being in this optimal age range, the continuation rate of ANC visits remained low. Educational background was dominated by women with a high school degree (29.3%) and a small proportion with a bachelor's degree (4.9%). Unfortunately, educational data were not recorded for 64.9% of participants, limiting deeper interpretation. The p=0.000 in Table 2 reflects differences in variance structure rather than true improvement. Groups with zero variance (K1) inflated the statistical significance. Even among women with higher education, consistency in ANC attendance was not evident, suggesting that education alone may not be sufficient to ensure adherence to recommended antenatal visits [19-22].

Regarding obstetric status, most women were Gravida 1 (40.8%). Yet, 96% of them attended only one ANC visit. Similar patterns were observed across other gravida categories (2–7) as well as parity, abortion, and live-birth histories. For example, among P0 women (no previous deliveries), 96.2% attended only K1, and none completed four visits. The same was true for women with previous abortions or

**Table 2: Differences in MUAC (cm) by visit and total IFA tablets received**

| Visit (total IFA tablet received) | N | Mean | Standard deviation | Standard error | Min. | Max. | p-value |
|---|---|---|---|---|---|---|---|
| K1 (30 tablets) | 926 | 0 | 0 | 0 | 0 | 0 | 0.000 |
| K2 (60 tablets) | 45 | −1.04 | 3.6 | 0.53 | −11 | 8 | |
| K3 (90 tablets) | 2 | −1.5 | 3.53 | 2.5 | −4 | 1 | |
| 4 (120 tablets) | 1 | −2 | – | – | −2 | −2 | |
| Total | 974 | −0.05 | 0.8 | 0.02 | −11 | 8 | |

Analyzed using Mann–Whitney, n=974. IFA: Iron and folic acid

**Table 3: Differences in body weight changes by visit and total IFA tablet received**

| Visit (total IFA tablet received) | N | Mean | Median | Standard deviation | Standard error | p-value |
|---|---|---|---|---|---|---|
| Body weight changes | | | | | | |
| K1 (30 tablets) | 926 | 0.00 | 0.00 | 0.00 | 0.00 | 0.000 |
| K2 (60 tablets) | 45 | −1.85 | −0.20 | 13.23 | 1.97 | |
| K3 (90 tablets) | 2 | −5.50 | 28.11 | 3.61 | 2.55 | |
| K4 (120 tablets) | 1 | −8.30 | −8.30 | - | - | |
| Prenatal body mass index | | | | | | |
| K1 (30 tablets) | 926 | 25.68 | 24.47 | 13.43 | 0.44 | 0.183 |
| K2 (60 tablets) | 45 | 25.12 | 24.06 | 5.64 | 0.84 | |
| K3 (90 tablets) | 2 | 28.10 | 28.11 | 1.47 | 1.04 | |
| K4 (120 tablets) | 1 | 18.87 | 18.87 | - | - | |

Analyzed using Kruskal–Wallis, n=974. IFA: Iron and folic acid

multiple live children. These findings suggest that prior pregnancy experience does not necessarily lead to improved compliance with ANC recommendations [5,20,23].

A value of 0 at visit 1 indicates that there was no difference yet, since MUAC measurements could only be compared starting with the second visit. At the first visit, only baseline values were recorded. The dash (–) at Visit 4 appears because only one patient completed up to the fourth visit, making it impossible to calculate standard deviation, error, and confidence intervals. At the second visit (60 IFA tablets), there was a slight trend toward a decrease in MUAC (mean −1.04 cm). For the third and fourth visits, the sample sizes were too small (n=2 and n=1, respectively) to draw meaningful conclusions. Overall, the analysis was limited by the very low continuation of ANC beyond the first visit.

The analysis of maternal bodyweight changes across different levels of IFA supplementation revealed statistically significant differences (p=0.000) as seen in Table 3. These findings suggest that increased IFA supplementation was not consistently associated with maternal weight gain during pregnancy [24,25]. In fact, the observed decreases in mean bodyweight in the higher-dose groups appear counterintuitive, as supplementation is generally expected to support maternal nutritional status and contribute to positive weight trends during gestation [26]. However, interpretation is limited by the highly unequal group sizes, with extremely small numbers in the 90- and 120-tablet groups, which makes the findings vulnerable to outliers and random variation.

The analysis of prenatal body mass index (BMI) across groups receiving varying doses of IFA supplementation showed no statistically significant difference (p=0.183). Women who received 30 tablets had a mean BMI of 25.68±13.43, while those receiving 60 tablets had a slightly lower mean of 25.12±5.64. Interestingly, women who received 90 tablets demonstrated a higher mean BMI of 28.10±1.47, though this group was very small (n=2), limiting interpretation. The single participant in the 120-tablet group had a BMI of 18.87, which fell below the normal range, but no conclusions can be drawn from a single observation. While IFA supplementation is expected to improve maternal nutritional status over time, its effect may not be readily reflected in prenatal BMI, which is influenced by multiple factors such as baseline nutritional status, dietary intake, metabolic changes during pregnancy, and gestational weight gain [24,27,28]. Future studies with larger and more balanced groups are needed to clarify whether prolonged or higher-dose IFA supplementation has a measurable impact on maternal BMI during pregnancy.

The low rate of ANC continuation may be influenced by factors such as knowledge, perception of risk, family support, and accessibility of health services [29]. The WHO (2016) emphasizes the importance of at least four ANC visits to detect complications early and ensure adequate IFA distribution [30]. Failure to meet this standard raises concerns regarding insufficient iron intake and its impact on maternal anemia, low birth weight, and adverse obstetric outcomes [31]. The effect of IFA supplementation could not be isolated from the number of antenatal visits, as tablet count is directly linked to visit frequency. This confounding limits the ability to draw causal inferences.

The lack of statistically significant differences in MUAC across ANC visits is likely due to inadequate sample distribution and to confounding factors not controlled in this study, such as dietary intake, baseline nutritional status, and socioeconomic background. Moreover, because only one participant completed four ANC visits, it was impossible to observe the long-term effects of supplementation on maternal anthropometry or clinical parameters.

Nevertheless, this study highlights the urgent need to strengthen maternal health education, enhance awareness of the importance of ANC, and promote compliance with supplementation guidelines. Community-based health promotion, family support, and integration of "class for pregnant women" programs could enhance adherence. Continuous IFA supplementation, combined with complete ANC, is crucial for reducing maternal anemia, preventing complications such as pre-eclampsia, and promoting optimal fetal growth.

**Strengths and limitations**

A strength of this study is the use of real-world data from a large number of pregnant women recorded at a primary health center, which reflects actual service delivery conditions in the community. The study also provides an overview of ANC attendance patterns and highlights critical gaps in adherence to national and WHO recommendations.

However, the study has several limitations. First, the retrospective design limited data availability, as many sociodemographic and clinical variables were incompletely recorded. Second, the continuation rate of ANC visits was extremely low, resulting in highly unequal sample sizes across groups and reducing the power to detect meaningful differences. Third, confounding factors such as dietary intake, socioeconomic conditions, and comorbidities could not be controlled. Finally, reliance on secondary data prevented verification of measurement accuracy and consistency.

## CONCLUSION

The main finding of this study is the low adherence to ANC visits, which limits the effectiveness of IFA supplementation. Improving ANC attendance and compliance is essential to realize the intended benefits of IFA. These findings suggest that poor adherence to ANC schedules is a major barrier to achieving the intended benefits of IFA supplementation. Strengthening community health education, improving family support, and ensuring consistent follow-up are essential strategies to increase ANC compliance and optimize maternal nutritional outcomes. Future studies should employ prospective designs with larger and more balanced samples to assess better the impact of IFA supplementation on maternal anthropometric and clinical outcomes.

## AUTHOR CONTRIBUTION

RA (Resti Anwar) served as the principal investigator, conducted data collection, and prepared the initial draft of the manuscript. NF (Najmiatul Fitria) acted as the lead supervisor, providing critical guidance and revising the manuscript for important intellectual content. EB (Elsa Badriyyah) contributed as co-supervisor, offering input throughout the study process. AM (Afifah Machlaurin) performed the data analysis and assisted in the interpretation of findings. All authors read and approved the final version of the manuscript.

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## ETHICAL CONSIDERATIONS

Ethical approval was obtained from the Research Ethics Committee of the Faculty of Pharmacy, Andalas University, Padang, West Sumatra, Indonesia, with number 36/UN16.10.D.KEPK-FF/2025. Permission for data collection was also obtained from the Lubuk Buaya Health Center number 070.12529/DPMPTSP-PP/XI/2024. Patient confidentiality was maintained throughout the study, and only anonymized data were used for analysis.

## CONFLICT OF INTEREST

The author(s) declare no conflict of interest.

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