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The Role of Behavioral Insight-Based Education on Improving Knowledge and Husband's Attitude as a Compliance Partner of Pregnant Women Consuming Fe Tablets

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ABSTRACT

Iron deficiency anemia in pregnancy is one of the most significantt public health problems in Indonesia, even though the Fe tablet supplementation program has been running for many years. The low adherence of pregnant women taking Fe tablets is often related to the lack of participation from the husband. This study aims to analyze the influence of Behavioral Insights-based education (BI) on increasing husbands' knowledge and attitudes as adherence partners in supporting pregnant women's compliance with Fe tablets. The research design used a pre-post quasi-experiment with a control group, involving 100 respondents (50 in the intervention group, 50 in the control group) at the Bukittinggi City Health Center. The intervention group received BI-based education through four components — simplification, visual cues, a commitment device, and a social norm message — while the control group received standard education. The analysis was performed using the Wilcoxon test for pre-post differences and the Mann–Whitney test for inter-group differences. Bootstrapping analysis with 5,000 resamples using Bias-Corrected and Accelerated (BCa) 95% confidence intervals demonstrated significantt improvements in husbands' knowledge and attitudes following Behavioral Insight-based education ($p < 0.001$. Results showed significantt improvements in knowledge ($p<0.001$) and the husband's attitude ($p<0.001$) . with substantial effect sizes ($r = 1.09$). in the intervention group compared to the controls. These findings confirm that the BI approach is effective in increasing husbands' cognitive and affective readiness as partners in preventing anemia in pregnant women. Behavior-based interventions with partner involvement need to be integrated into national Antenatal Care (ANC) programs.

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INTRODUCTION

Iron deficiency anemia (IDA) remains one of the most significant maternal nutrition problems worldwide and continues to contribute substantially to maternal and neonatal morbidity. The World Health Organization (WHO) estimates that more than one-third of pregnant women globally experience anemia, with iron deficiency recognized as the primary cause [1]. Maternal iron deficiency anemia (IDA) increases the risk of fatigue, reduced physical capacity, susceptibility to infection, postpartum hemorrhage, and hypertensive disorders during pregnancy . Furthermore, maternal IDA contributes to adverse neonatal outcomes, including low birth weight, preterm birth, increased perinatal mortality, and impaired cognitive and neurodevelopmental outcomes in offspring [2], [3], [4]. Despite the widespread implementation of iron-folic acid supplementation programs, the global burden of anemia during pregnancy remains persistently high, particularly in low- and middle-income countries [5]. Indonesia continues to face a serious burden of maternal anemia. The 2018 Indonesian Basic Health Research (Riskesdas) reported that 48.9% of pregnant women were anemic, with the highest prevalence occurring among women aged 15–24 years[6]. This condition reflects not only nutritional deficiencies but also broader social, behavioral, and health-system challenges. Although iron-folic acid supplementation has been integrated into antenatal care (ANC) services nationwide following WHO recommendations [7], adherence to iron tablet consumption among pregnant women remains suboptimal. Adherence to iron–folic acid supplementation among pregnant women in low- and middle-income countries is influenced by multiple barriers, including gastrointestinal side effects, forgetfulness, inadequate counseling from healthcare providers, limited family support, and sociocultural beliefs regarding supplement use during pregnancy [8], [9],[10], [11],[12] These findings suggest that improving adherence requires not only increasing access to supplements but also addressing behavioral and social determinants that influence maternal health practices [10], [11],[12].

Family support, particularly from husbands, has increasingly been recognized as a critical determinant of maternal health behavior[13]. In many Indonesian households, husbands play a central role in decision-making related to healthcare utilization, dietary practices, and adherence to medical recommendations[14]. Emotional encouragement, informational assistance, and practical support from husbands may positively influence pregnant women's motivation and consistency in consuming iron tablets. Previous studies demonstrated that male partner involvement contributes to improved maternal healthcare utilization, stronger social support, and better adherence to antenatal recommendations [15], [16]. Systematic reviews have further confirmed that male involvement positively affects maternal and neonatal health outcomes[17], [18]. However, maternal nutrition interventions in Indonesia still predominantly target pregnant women alone, while husbands are rarely positioned as active partners in supporting supplementation adherence. Consequently, opportunities to strengthen family-based behavioral support remain underutilized [19]. In addition, Behavioral Insights (BI) approaches have increasingly been applied in maternal health interventions to bridge the gap between knowledge and health behavior. By utilizing strategies such as reminders, social norm messaging, and simplified communication, BI can help reduce barriers to adherence and promote healthier behaviors. In the context of iron supplementation during pregnancy, husband involvement may further enhance the effectiveness of BI-based education by providing social support and reinforcing positive health norms. Therefore, integrating BI-based education with husband engagement may offer an effective approach to improving adherence to iron tablet consumption among pregnant women[20][21].

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At the same time, conventional health education approaches often demonstrate limited effectiveness in producing sustainable behavioral change. Educational interventions frequently rely on one-way information delivery and assume that knowledge alone is sufficient to alter health behavior. However, behavioral science research suggests that health-related decisions are strongly influenced by cognitive biases, social norms, environmental cues, and habitual behavior [22], [23]. In response to these limitations, Behavioral Insights (BI), derived from behavioral economics and psychology, has emerged as a promising approach for improving public health interventions. BI strategies aim to simplify decision-making processes, enhance message attractiveness, utilize social influence, strengthen reminders, and optimize the timing of interventions to encourage healthier behaviors [24]. Previous studies have shown that BI-based interventions can improve medication adherence, maternal nutrition practices, and preventive health behaviors [25]. Evidence from large-scale behavioral intervention studies also demonstrated that reminder-based nudges effectively improved patient compliance with health recommendations [26].

Nevertheless, evidence integrating Behavioral Insights strategies with male partner involvement to improve iron supplementation adherence among pregnant women remains limited, particularly in Indonesia. Existing studies generally examine either husband support or behavioral approaches independently, without exploring the potential synergistic effect of combining both strategies. Theoretically, husband involvement may strengthen subjective norms and perceived behavioral support as described in the Theory of Planned Behavior, thereby reinforcing women's adherence behavior [27],[22],[28]. In the Indonesian sociocultural context, where family influence strongly shapes maternal behavior, integrating BI-based educational approaches with husband engagement may therefore provide a more effective and contextually appropriate intervention for improving adherence to iron tablet consumption[27].
Despite its potential, implementing husband-centered Behavioral Insights interventions may also face several challenges, including limited male participation in antenatal care, sociocultural perceptions that pregnancy is solely a woman's responsibility, time constraints among working husbands, and limited healthcare resources for delivering innovative educational programs[29], [16]. Therefore, empirical evidence is needed to evaluate whether such interventions are feasible and effective within antenatal care settings in Indonesia. Based on these gaps, this study aims to evaluate the effectiveness of a Behavioral Insights-based educational intervention in improving husbands' knowledge and attitudes toward supporting iron tablet adherence among pregnant women. The findings are expected to contribute empirical evidence for integrating Behavioral Insights and male partner engagement strategies into antenatal care programs to strengthen anemia prevention efforts and improve maternal health outcomes in Indonesia.
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METHOD

1. Research Design and Setting

This study employed a quasi-experimental pretest–posttest control-group design. This design was selected because it allowed the researchers to evaluate changes in husbands' knowledge and attitudes before and after the Behavioral Insights-based educational intervention, while accommodating the practical limitations of conducting full randomization in a primary healthcare setting. The study was conducted in the working area of the Bukittinggi City Health Center, West Sumatra Province, Indonesia, from May to October 2025. The study setting was selected purposively due to the persistently low adherence to iron tablet consumption among pregnant women despite the existing antenatal iron supplementation program.

2. Population and Sample

The study population consisted of husbands accompanying pregnant women attending antenatal care (ANC) services at the Bukittinggi City Health Center. A total of 100 participants were recruited using purposive sampling based on predefined inclusion criteria. Participants were eligible if they: (1) accompanied pregnant women in the second or third trimester, (2) were able to read and write, and (3)

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agreed to participate by providing informed consent. Participants who were absent during the intervention session or failed to complete the post-test assessment were excluded from the study.
After recruitment, participants were allocated into intervention and control groups according to the ANC service schedule and health center administrative arrangements to minimize disruption to routine services. The intervention group received Behavioral Insights-based education, whereas the control group received standard education routinely delivered by midwives at the health center.
The sample size was determined using power analysis for two independent groups with an effect size of 0.5, a significance level of 95%, and statistical power of 80%, based on Cohen's recommendations (1988).

3. Research Instruments

A structured questionnaire was developed based on the Theory of Planned Behavior (TPB), the Information–Motivation–Behavioral Skills (IMB) Model, and literature from the WHO and the Indonesian Ministry of Health. The questionnaire consisted of three sections:

a) Demographic Characteristics: age, education level, occupation, and gestational age of the pregnant women.
b) Knowledge: 15 multiple-choice items regarding anemia, benefits and dosage of iron tablets, side effects, and the supportive role of husbands. Correct answers were scored 1 and incorrect answers were scored 0, with a maximum total score of 15.
c) Attitude: 10 statements measured using a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5). Negative statements were reverse-coded, and higher scores indicated more positive attitudes toward supporting iron tablet consumption.
d) Validity and Reliability Testing
Validity and reliability testing were conducted among 30 participants with characteristics similar to the study population. The validity test showed Corrected Item–Total Correlation values greater than 0.30 for all questionnaire items, indicating acceptable validity. Reliability analysis demonstrated Cronbach's Alpha coefficients of 0.939 for the knowledge scale and 0.837 for the attitude scale, indicating excellent internal consistency.

4. Intervention Materials

For the intervention group, educational materials were developed based on Behavioral Insights (BI) principles to improve participant engagement and message effectiveness. The intervention materials included:

a) Visual educational media: PowerPoint presentations, printed modules, videos, and posters using simple and contextually relevant language in accordance with the Easy and Attractive principles.
b) Reminder and commitment tools: posters, written commitment sheets, and one-month monitoring through a WhatsApp group to reinforce adherence behavior.
c) Social norm messages: educational messages emphasizing that husbands commonly support their wives in consuming iron tablets to encourage positive social influence.

5. Study Procedure

The study was conducted in three phases:

a) Preparation Phase: coordination with the health center for participant recruitment and scheduling, as well as enumerator training.
b) Intervention Phase: the intervention group received a 90-minute Behavioral Insights-based educational session applying the EAST principles (Easy, Attractive, Social, and Timely), while the control group received standard education delivered by midwives.
c) Evaluation Phase: participants' knowledge and attitudes were assessed using questionnaires at baseline (pre-test) and one month after the intervention (post-test) under enumerator supervision.

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6. Data Analysis

Data were analyzed using IBM SPSS Statistics version 29. The analysis procedures included:

a) Shapiro–Wilk test to assess data normality.
b) Wilcoxon Signed Rank Test to examine within-group pretest–posttest differences.
c) Mann–Whitney U Test to compare score changes between intervention and control groups.
d) Bias-Corrected and Accelerated (BCa) bootstrapping with 5,000 resamples to obtain robust 95% Confidence Intervals (CI).
e) Effect size (r) was calculated using the formula $r = Z / \sqrt{N}$ to determine the magnitude of the intervention effect.
f) All findings are presented as median and interquartile range (IQR) with 95% BCa Confidence Intervals. Statistical significance was established at $p < 0.05$.

7. Methodological Justification

The quasi-experimental approach was considered appropriate because complete randomization was not operationally feasible within the routine antenatal care setting. The use of purposive sampling enabled the recruitment of participants who met specific study characteristics relevant to the intervention objectives. In addition, the integration of Behavioral Insights principles introduced an innovative educational strategy targeting family support behaviors. The use of nonparametric statistics combined with BCa bootstrapping strengthened the robustness of the analysis despite non-normal data distribution.

RESULT AND DISCUSSION

Result

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Characteristics of respondents

Table 1. Frequency Distribution and Average Characteristics of Respondents

Respondent Characteristics	Intervention Group (n=50)	Control Group (n=50)
Maternal Age (years)	28.8 ± 4.04	28.8 ± 5.2
Husband's Age (years)	31.66 ± 6.25	31.22 ± 5.68
Gestational Age (weeks)	22.64 ± 6.2	24.0 ± 6.0
Hemoglobin (g/dL)	12.27 ± 1.10	12.34 ± 1.48
Parity	2 ± 1.04	2.16 ± 1.23
Maternal Education		
- Diploma	5 (14%)	7 (14%)
- Bachelor's Degree (S1)	4 (14%)	7 (14%)
- Senior High School (SMA)	34 (30%)	32 (64%)
- Junior High School (SMP)	7 (8%)	4 (8%)
Husband's Education		
- Diploma	5 (10%)	5 (10%)
- Bachelor's Degree (S1)	6 (12%)	5 (10%)
- Senior High School (SMA)	33 (66%)	33 (66%)
- Junior High School (SMP)	6 (12%)	7 (14%)
Maternal Occupation		
- Laborer	10 (20%)	8 (16%)
- Housewife	10 (20%)	16 (32%)
- Others	5 (10%)	4 (8%)

DOI: http://dx.doi.org/10.35730/jk.v17i1.1468

- Civil Servant	5 (10%)	4 (8%)
- Private Employee	10 (20%)	9 (18%)
- Entrepreneur	10 (20%)	9 (18%)
Husband's Occupation		
- Laborer	10 (20%)	8 (16%)
- Employee	14 (28%)	10 (20%)
- Farmer	5 (10%)	3 (6%)
- Civil Servant	10 (20%)	8 (16%)
- Entrepreneur	11 (22%)	21 (42%)

Table 1 shows the basic respondent characteristics of the intervention and control groups. The average age of the two groups is 28 and 8 years old, while the average age of the suami group is about 31 years old. Gestational age and haemoglobin (Hb) level also differ, indicating a relative state of basic health. According to educational theory, mothers with a high school education (SMA) were included in both intervention and control groups. The characteristics of re are pretty diverse, with a reasonably equal distribution among laborers, Housewives, officials, and the self-employed. Conversely, Husband Works is dominated by employees, particularly in the control group (42%), while the distribution group was more evenly distributed among the employees, workers, civil servants, and entrepreneurs

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Descriptive Statistical Results of Variables of Knowledge, Attitude, Before and After Behavioral Insight-Based Educational Interventions

Table 2 Descriptive Statistical Results of Variables of Knowledge, Attitude, Before and After Behavioral Insight-Based Educational Interventions

Variabel	group	Pre-test Median (IQR)	BCa 95% CI Lower – Upper	Post-test Median (IQR)	BCa 95% CI Lower – Upper	Δ (Post–Pre)	p-value[a]
Knowledge	Intervention	10	9.00 – 10.00	12	11.00 – 13.25	2	< .001
	control	10	10.00 – 11.00	10	10.00 – 11.00	0	0.505
Attitude	Intervention	35.5	33.0–38.5	39	38.0–42.0	3.5	< .001
	control	34	33.0–35.0	34	33.0–34.0	0	0.622

Based on a bootstrapping analysis (B = 5000, CI 95% BCa), the median knowledge score and the husband's attitude in the intervention group showed a significantt increase after receiving Behavioral Insight-based education ($p < 0.001$). The median knowledge increased from 10 (95% CI 9.00–10.00) to 12 (95% CI 11.00–13.25), while the median attitude increased from 35.5 (95% CI 33.0–38.5) to 39 (95% CI 38.0–42.0). In contrast, the control group showed no significantt changes in either knowledge or attitudes ($p > 0.05$). These results confirm that Behavioral Insight-based education is effective in increasing the husband's understanding and positive attitude in supporting the wife's compliance in taking Fe tablets during pregnancy.

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Data Normality Test Results

Table 3 Data Normality Test Results

Variabel	group	Shapiro–Wilk (Sig.)	information
Knowledge (pre)	control	0.031	Abnormal
	Intervention	0.080	Normal
Knowledge (post)	control	0.147	Normal
	Intervention	0.006	Abnormal
Attitude (pre)	control	0.215	Normal
	Intervention	0.020	Abnormal
Attitude (post)	control	0.371	Normal
	Intervention	0.047	Abnormal

Based on the Shapiro–Wilk normality test results in Table 3, the data distribution for the research variable differs between the control and intervention groups. In the control group, the majority of the variables had a significantce level greater than 0.05 ($p > 0.05$), which indicates that the data had a normal distribution. Conversely, in the intervention group, a few variables, including post knowledge ($p = 0{,}006$), attitude-pre ($p = 0{,}020$), and attitude-post ($p = 0{,}047$), indicate a significantce level that is slightly below 0.05 ($p < 0.05$), indicating that the data does not follow a normal distribution. Since most of the data do not support the assumption of normality, the hypothesis is tested using nonparametric tests: the Mann-Whitney U Test for comparisons between groups (intervention vs. control) and the Wilcoxon Signed Rank Test for comparisons within groups (pre-post).

Results of Change in Knowledge and Attitudes in The Group

Table 4 Results of the Wilcoxon Test of Knowledge and Attitude Change in the Control and Intervention Group

Group	Variabel	Z	p-value	Keterangan
control	Knowledge	-0.667	0.505	No significantt
control	Attitude	-0.493	0.622	No significantt
Intervention	Knowledge	-6.245	<0.001	Signifikan
Intervention	Attitude	-6.248	<0.001	Signifikan

*uji wilcoxon Signed Rank Test

Based on the results of the Wilcoxon Signed Rank Test in Table 4, it can be shown that there is no significantt difference between the pre-test and post-test scores for the control group, either in the

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knowledge variable (Z = -0,667; p = 0,505) or in the attitude variable (Z = -0,493; p = 0,622). This indicates that over the research period, the control group did not experience an increase in knowledge and Attitude Conversely, there is a significantt difference between the pre-test and post-test scores for the variables of knowledge (Z = -6,245; p < 0,001) and attitude (Z = -6,248; p < 0,001) in the intervention group. Negative Z score indicates that the post-test score is higher than the pre-test score. Thus, it can be concluded that Behavioral Insight based education was effective in improving respondents' knowledge and attitudes compared to the control group that did not receive similar interventions.

Comparison of Changes in Knowledge and Attitudes Between Groups

Table 5. Comparison of Changes (Δ) in Knowledge, Attitudes, between Control Groups and Interventions Based on the Mann-Whitney Test

Variable	Mann–Whitney U	Z	Sig. (2-tailed)
Knowledge _delta	190.000	-7.594	< .001
Attitude _delta	0	-8.752	< .001

* Uji Mann-Whitney

Based on the Mann–Whitney U Test results in Table 5, there is a significantt difference between the control and intervention groups on the knowledge and attitude variables. The test value shows U = 190,000; Z = -7,594; p < 0.001 for knowledge and U = 0; Z = -8,752; p < 0.001 for attitude. The significantce value (p < 0.05) indicates that the change in knowledge and attitude scores in the intervention group differed significanttly from that of the control group. A negative Z-value indicates that the knowledge and attitude improvement score (delta) in the intervention group is higher than in the control group.

The Effect of The Size of BI Intervention on The Knowledge and Attitude of Husbands Between Groups

Table. 6 the effect of the size of BI intervention on the knowledge and attitude of husbands between groups

Group	Variable	r	Category	Interpretation
Control	Knowledge	0.12	Small	No significantt effect
Control	Attitude	0.09	Small	No significantt effect
Intervention	Knowledge	1.09	Very large	The intervention effect is very strong
Intervention	Attitude	1.09	Very large	The intervention effect is very strong

Table 6 shows that the BI-based educational intervention had a substantial effect on both knowledge (r = 1.09) and attitude (r = 1.09) in the intervention group, indicating a substantial impact of the program. In contrast, the control group showed only minor and insignificantt effects on both variables.

Discussion

1. **Group Comparability**
   Baseline characteristics showed no significant differences between the intervention and control groups regarding age, education, occupation, gestational age, and hemoglobin levels (p > 0.05). This indicates that both groups were comparable at baseline, thereby reducing potential confounding effects and strengthening the internal validity of the study findings. The relatively balanced educational

 DOI: http://dx.doi.org/10.35730/jk.v17i1.1468

background of participants also suggests that both groups had sufficient literacy levels to understand the educational materials delivered during the intervention.

2. Effectiveness of Behavioral Insights-Based Education on Husbands' Knowledge

The intervention group demonstrated a significant improvement in knowledge scores after receiving Behavioral Insights (BI)-based education, whereas the control group showed no meaningful change. These findings indicate that BI-based education was more effective than conventional health education in improving husbands' understanding of anemia prevention, iron supplementation, and their supportive role during pregnancy.

The effectiveness of the intervention may be attributed to the use of simplified messages, visual educational materials, and socially relevant communication strategies that made health information easier to understand and remember. This finding is consistent with previous studies showing that behaviorally informed educational approaches improve maternal nutrition knowledge and adherence-related behaviors [24], [26]. The absence of significant improvement in the control group further suggests that traditional one-way educational approaches may be insufficient to promote meaningful cognitive change[22].

3. Effectiveness of Behavioral Insights-Based Education on Husbands' Attitudes

In addition to improving knowledge, the intervention significantly enhanced husbands' attitudes toward supporting iron tablet consumption among pregnant women. Positive attitude changes are important because attitudes strongly influence behavioral intention and supportive practices within maternal healthcare.

The improvement observed in this study may be related to the integration of social norm messages and contextual reminders that emphasized husbands' responsibilities in supporting maternal health. By positioning husband involvement as a positive and socially valued behavior, the intervention encouraged stronger emotional engagement and support toward iron supplementation adherence. These findings support previous evidence indicating that male partner involvement and behavioral approaches positively influence maternal health behaviors and family support practices [17], [18]. Furthermore, the observed attitudinal improvements may reflect the intervention's ability to influence motivational determinants of behavior, particularly through reinforcing positive social expectations and perceived family responsibilities. Behavioral science research suggests that social norms can shape attitudes and intentions by providing cues about behaviors that are socially approved and commonly practiced within a community. When individuals perceive a behavior as socially desirable, they are more likely to develop favorable attitudes toward that behavior and engage in supportive actions. In the context of maternal health, strengthening husbands' positive attitudes may increase their willingness to provide reminders, emotional encouragement, and practical assistance to pregnant women, thereby contributing to better adherence to iron supplementation. Such findings highlight the importance of incorporating socially oriented and family-centered behavioral strategies into antenatal education programs to foster sustained support for maternal health practices [30] .

4. Practical Implications

The large effect sizes observed in the intervention group indicate that the BI-based educational intervention produced not only statistically significant but also practically meaningful improvements in husbands' knowledge and attitudes. Given its relatively short duration, simple delivery format, and use of existing antenatal care infrastructure, this intervention has strong potential for integration into routine maternal healthcare services in Indonesia.

The findings suggest that antenatal education programs should move beyond conventional information delivery by incorporating Behavioral Insights principles such as simplified communication, visual prompts, social norm activation, and behavioral reminders. In addition, involving husbands as active adherence partners may strengthen family support systems and improve maternal health behaviors, particularly in communities where family decision-making strongly influences healthcare practices.

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5. Limitations and Future Research

This study has several limitations. First, the quasi-experimental design without complete randomization may introduce selection bias, although baseline comparability between groups reduced this risk. Second, the study relied on self-reported measures of knowledge and attitudes, which may be influenced by social desirability bias. Third, the one-month follow-up period was relatively short and did not allow evaluation of long-term behavioral sustainability.

Future studies are recommended to employ randomized controlled trial designs with larger and more diverse populations, longer follow-up periods, and objective adherence indicators such as direct monitoring of iron tablet consumption or maternal hemoglobin measurements. Further research is also needed to explore the effectiveness of digital Behavioral Insights interventions, including mobile reminders and WhatsApp-based educational support, in strengthening maternal supplementation adherence programs.

Conclusion

This study demonstrated that Behavioral Insights-based education significantly improved husbands' knowledge and attitudes toward supporting pregnant women's Fe tablet adherence ($p < 0.001$), with substantial effect sizes ($r = 1.09$). By applying the EAST principles (Easy, Attractive, Social, and Timely), the intervention effectively strengthened husbands' roles as "adherence partners" in maternal anemia prevention. These findings highlight the potential of Behavioral Insights-based couple education as a practical and scalable approach within antenatal care programs in Indonesia. Integrating husband involvement and behavioral nudging strategies into routine maternal health services may help improve Fe tablet adherence and support better maternal health outcomes. Further studies are needed to evaluate long-term effectiveness and broader implementation across different settings.

AUTHOR CONTRIBUTIONS

Diana Putri contributed to study conception, data collection, analysis, and manuscript drafting. Aida Andriani contributed to study supervision and manuscript revision. Wiwie Putri Adila contributed to data analysis and manuscript editing. All authors approved the final manuscript.

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