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# Nurse-Led Educational Intervention to Promote Knowledge and Attitude of Folic Acid Intake among Reproductive-Age Women

**Muhmooda Abdul Razzaque** (Corresponding Author)
PhD Scholar, Lecturer, Dow Institute of Nursing and Midwifery, Dow University Health Sciences, Karachi Email: muhmooda.duhs@gmail.com
**Rukhsana M. Haroon**
MSN, Lecturer, Dow Institute of Nursing and Midwifery, Dow University Health Sciences, Karachi Email: rukhsana.haroon@duhs.edu.pk
**Waheed Ahmed Mugheri**
MSN Scholar, Clinical Instructor, College of Nursing, Female Larkana
Email: waheed.ahmed2013@gmail.com
**Rabia Danish**
MSc. Nursing, Senior Lecturer, Liaquat National Hospital & College of Nursing, Institute for Undergraduate & Postgraduate Medical Studies & Health Sciences
Email: rabiarashid.rsr@gmail.com
**Abdul Razzaque**
MSN Scholar, Lecturer, Liaquat National Hospital & College of Nursing, Institute for Undergraduate & Postgraduate Medical Studies & Health Sciences.
Email: ar750646@gmail.com

**Author Details**

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**Corresponding E-mail & Author*:**

**Muhmooda Abdul Razzaque** (Corresponding Author)
PhD Scholar, Lecturer, Dow Institute of Nursing and Midwifery, Dow University Health Sciences, Karachi Email: muhmooda.duhs@gmail.com

**Abstract**

**Background:** Pakistan continues to report a high prevalence of neural tube defects (NTDs), yet awareness of periconceptional folic acid (FA) and the adoption of a positive stance toward its use are alarmingly low. This study evaluated the effectiveness of a nurse-led educational intervention on FA knowledge and attitudes among reproductive-age women in a peri-urban community in Karachi.

**Methods:** A quasi-experimental (pre-test/post-test) study was conducted from March to November 2024 in Sachal Goath, Karachi. Using purposive sampling, 260 married women aged 15–40 years with a history of pregnancy were enrolled. A validated questionnaire comprising two sections (1) a knowledge section adapted from the CDC folic acid quiz and (2) a five-item attitude scale adapted from Sadiq and Hussein (2022) was administered before, immediately after, and six weeks following a 20-minute doorstep teaching session. Overall, 60 women (23.1%) dropped out, leaving 200 for final analysis. Primary outcomes were correct knowledge (timing, dose, preventive role) and a positive attitude (score ≥3 on the attitude scale). McNemar's test and Spearman's rank correlation were used.

**Results:** Among the 200 participants, baseline FA awareness was 33.0%. Correct timing knowledge increased from 28.5% to 86.0% post-intervention ($p < 0.001$), and correct dose knowledge from 18.0% to 80.5% ($p < 0.001$). Good or excellent knowledge rose from 13.0% to 87.5% immediately and remained at 78.0% at six

weeks. Positive attitude increased from 31.0% at baseline to 79.5% post-intervention ($p < 0.001$). A significant correlation was found between post-intervention knowledge and attitude (Spearman's rho = 0.64, $p < 0.001$).
**Conclusion:** A single nurse-led session significantly enhanced FA knowledge and favorable attitudes in reproductive-age women, sustained at six weeks. Expanding this through community health workers holds potential to reduce NTDs across Pakistan.

## Introduction

Neural tube defects (NTDs), which encompass conditions such as spina bifida and anencephaly, are among the most serious congenital malformations and stand as a major contributor to infant death and lifelong disability globally [1,2]. Worldwide, the estimated NTD prevalence ranges from 1 to 2 per 1,000 live births, with the heaviest burden falling on low- and middle-income nations (LMICs) [2,3]. Within Pakistan, national figures indicate that 50.8% of women of reproductive age are folate-deficient, and regional investigations have documented NTD rates reaching 13.9 per 1,000 deliveries [4,5].

Closure of the neural tube typically occurs by day 28 after conception, frequently before pregnancy is recognised [6]. Supplementation with folic acid (FA) during the periconceptional period has been shown to lower the likelihood of NTDs by 50–70% [7,8]. Accordingly, the Centres for Disease Control and Prevention advises a daily dose of 400 µg of FA for all women capable of becoming pregnant, initiated before conception and maintained throughout the first trimester [9].

Notwithstanding this evidence, FA-related knowledge and favourable attitudes remain critically deficient in Pakistan. Research from a tertiary care facility in Karachi revealed that 77.7% of pregnant women had a poor understanding of iron-FA supplementation [10]. A 2025 investigation conducted in Peshawar reported that merely 34.4% of pregnant women complied with prescribed FA supplements [11]. Likewise, a 2026 Lahore-based survey found that only 34% of women possessed adequate FA knowledge [12]. Beyond knowledge alone, attitude—conceptualised as an individual's evaluative disposition (favourable or unfavourable) toward enacting a health behaviour—constitutes a vital determinant of actual supplement consumption [13]. Women may be aware of FA yet harbor negative beliefs concerning its necessity, safety, or ease of use.

Nurses and community health workers serve as frontline healthcare providers who maintain regular contact with reproductive-age women across Pakistan [12]. The present study sought to assess the impact of a nurse-led educational intervention on FA knowledge and attitude among women of childbearing age.

## Methods

A quasi-experimental, single-group pretest-posttest design was employed from March to November 2024 in Sachal Goath, a low-income peri-urban community situated near Suparco Road, Karachi. The study received ethical clearance from the Institutional Review Board of Dow University of Health Sciences, Karachi (reference: IRB-3225/DUHS approval/2023/46), and all procedures adhered to the principles outlined in the Declaration of Helsinki.

Married women between 15 and 40 years of age who had experienced at least one prior pregnancy were eligible for inclusion. Individuals were excluded if they had previously participated in an FA awareness program, reported known infertility, or had active gynaecological conditions (including fibroids, menorrhagia, amenorrhea, or pelvic inflammatory disease). The sample size was determined using WHO software, with a baseline FA knowledge estimate of 33.3% drawn from earlier work [14], a 95% confidence level, 6% margin of precision, and a 20% allowance for attrition, resulting in a target of 260 participants. Non-probability purposive sampling was applied. Following the loss of 60 participants (23.1%) at various phases—owing

to refusal of follow-up, relocation, or incomplete posttest or six-week data—the final analytic sample comprised 200 women.

Data collection utilised an interviewer-administered questionnaire structured into three domains. Section 1 captured socio-demographic and clinical characteristics, including age, educational status (illiterate or literate), occupation, and obstetric history (miscarriage, abortion, previous child affected by NTD, low birth weight). Section 2 assessed FA knowledge, adapted from the CDC folic acid quiz [15], covering awareness of FA (having heard of folic acid), correct timing (preconception through first trimester), correct daily dosage (400 µg), and its preventive role against NTDs. Overall knowledge was classified as follows: Poor (<50% correct), Fair (50–69% correct), Good (70–89% correct), and Excellent (90–100% correct). Section 3 evaluated attitudes toward FA intake using a validated five-item scale, adapted from Sadiq and Hussein (2022) [16] and Ahsan et al. (2022) [17]. Each item required an Agree or Disagree response, with 1 point assigned for a correct (positive) attitude and 0 for an incorrect (negative) attitude, yielding a total score ranging from 0 to 5. Consistent with established scoring criteria [17], scores of 0–2 (<50% of maximum) denoted a negative attitude, while scores of 3–5 (≥50% of maximum) reflected a positive attitude.

The five attitude statements likewise: Folic acid is important during pregnancy, Taking folic acid can prevent birth defects, I am willing to take folic acid daily, Folic acid is only needed after pregnancy is confirmed and a healthy diet provides enough folic acid without supplements.

A 20-minute, face-to-face teaching session was delivered by the principal investigator (a trained nurse educator) at each participant's doorstep. Content included: natural folate sources; the recommended daily dose of 400 µg of FA; optimal timing (before conception through the first trimester); the link between FA deficiency and NTDs; the NTD burden in Pakistan; and the preventive efficacy of FA. A flip chart with diagrams and photographs was used. Each woman received a laminated brochure summarizing key messages. Refreshments were provided after the session.

After obtaining written informed consent, the baseline questionnaire was administered via interview. Immediately after the teaching session, the same questionnaire was re-administered. A follow-up assessment was conducted at six weeks at the participant's home. Women who missed the six-week follow-up (after three contact attempts) or had incomplete data were considered dropouts and excluded from the final analysis. Of 260 enrolled women, 60 (23.1%) dropped out: 22 (8.5%) refused the six-week follow-up, 18 (6.9%) moved away from the study area, 12 (4.6%) had incomplete post-test data, and 8 (3.1%) were lost to contact. The final analytic sample comprised 200 women who completed all three assessments (baseline, immediate post-test, six-week follow-up). Baseline characteristics of completers did not differ significantly from dropouts ($p > 0.05$ for all variables).

Data were analyzed using SPSS version 26.0. Descriptive statistics (mean ± SD, frequencies, percentages) were calculated. Pre- and post-intervention comparisons of binary knowledge items and attitude items used McNemar’s test. Spearman’s rank correlation assessed the relationship between post-intervention knowledge category (good/excellent vs. poor/fair) and post-intervention attitude category (positive vs. negative). A two-tailed $p < 0.05$ was considered significant.

## Results

### Demographic Characteristics of Participants (n = 200)

The mean age was 28.5 ± 5.1 years. Literate women comprised 117 (58.5%), and 85 (42.5%) were employed. Obstetrical history included miscarriage in 63 (31.5%), abortion in 29 (14.5%), a previous child affected by NTD in 5 (2.5%), and low birth weight delivery in 25 (12.5%). Only 66 women (33.0%) had previously heard of FA (Table 1).

**Table 1. Demographic Characteristics of Participants (n = 200)**

| Characteristic | n (%) |
|---|---|
| Age (years), mean ± SD | 28.5 ± 5.1 |
| **Education** | |
| Illiterate | 83 (41.5) |
| Literate | 117 (58.5) |
| **Occupation** | |
| Employed | 85 (42.5) |
| Unemployed | 115 (57.5) |
| **Obstetric history** | |
| Miscarriage | 63 (31.5) |
| Abortion | 29 (14.5) |
| Previous child with NTD | 5 (2.5) |
| Low birth weight child | 25 (12.5) |
| Heard of folic acid | 66 (33.0) |

**Knowledge of Participants (Pre-test and Post-test)**

At baseline, correct knowledge of FA timing (preconception to first trimester) was observed in 57 women (28.5%), correct daily dose (400 µg) in 36 (18.0%), and the preventive role against NTDs in 46 (23.0%). Overall, 62.5% had poor knowledge.

Immediately post-intervention, correct timing increased to 172 (86.0%, $p < 0.001$), correct dose to 161 (80.5%, $p < 0.001$), and awareness of the preventive role to 181 (90.5%, $p < 0.001$). Good or excellent knowledge rose from 13.0% at baseline to 87.5% post-intervention ($p < 0.001$). At the six-week follow-up, 156 (78.0%) still maintained good or excellent knowledge (Table 2).

**Table 2. Knowledge of Participants at Pre-test, Immediate Post-test, and Six-Week Follow-up (N = 200)**

| Knowledge Item | Pre-test n (%) | Immediate post-test n (%) | p-value* | Six-week follow-up n (%) |
|---|---|---|---|---|
| Correct timing (preconception to first trimester) | 57 (28.5) | 172 (86.0) | <0.001 | 156 (78.0) |
| Correct dose (400 µg) | 36 (18.0) | 161 (80.5) | <0.001 | 145 (72.5) |
| FA prevents NTDs | 46 (23.0) | 181 (90.5) | <0.001 | 162 (81.0) |
| **Overall knowledge category** | | | | |
| Poor (<50%) | 125 (62.5) | 6 (3.0) | <0.001 | 20 (10.0) |
| Fair (50–69%) | 49 (24.5) | 19 (9.5) | | 24 (12.0) |
| Good (70–89%) | 20 (10.0) | 77 (38.5) | | 67 (33.5) |
| Excellent (90–100%) | 6 (3.0) | 98 (49.0) | | 89 (44.5) |

*McNemar's test for pre-test vs. immediate post-test.

**Attitude of Participants (Pre-test and Post-test)**

At baseline, the mean attitude score was 1.9 ± 1.2 (out of 5). A positive attitude (score 3–5) was present in 62 women (31.0%). The proportion of women giving correct (positive) responses to each of the five attitude items is shown in Table 3.

Immediately post-intervention, the mean attitude score increased to 4.1 ± 0.9 ($p < 0.001$), and a positive attitude was achieved by 159 women (79.5%). The largest improvements were observed for Item 3 ("I am willing to take folic acid daily"),

which increased from 35.0% to 85.0% agreement, and Item 2 ("Taking folic acid can prevent birth defects"), which increased from 38.0% to 88.5% agreement (Table 3).

**Table 3. Attitude of Participants at Pre-test and Immediate Post-test (N = 200)**

| Attitude Item (Correct Answer) | Pre-test: Correct n (%) | Post-test: Correct n (%) | p-value* |
|---|---|---|---|
| Item 1: Folic acid is important during pregnancy (Agree) | 48 (24.0) | 166 (83.0) | <0.001 |
| Item 2: Taking folic acid can prevent birth defects (Agree) | 76 (38.0) | 177 (88.5) | <0.001 |
| Item 3: I am willing to take folic acid daily (Agree) | 70 (35.0) | 170 (85.0) | <0.001 |
| Item 4: Folic acid is only needed after pregnancy is confirmed (Disagree) | 52 (26.0) | 158 (79.0) | <0.001 |
| Item 5: A healthy diet provides enough folic acid without supplements (Disagree) | 44 (22.0) | 149 (74.5) | <0.001 |
| **Mean attitude score (0–5), mean ± SD** | 1.9 ± 1.2 | 4.1 ± 0.9 | <0.001** |
| **Positive attitude (score 3–5), n (%)** | 62 (31.0) | 159 (79.5) | <0.001* |

*McNemar's test. **Wilcoxon signed-rank test.

**Correlation between Knowledge and Attitude**

A significant positive correlation was found between post-intervention knowledge category (good or excellent vs. poor or fair) and post-intervention attitude category (positive vs. negative) (Spearman's rho = 0.64, $p < 0.001$). Among the 175 women with good or excellent post-intervention knowledge, 151 (86.3%) had a positive attitude. Among the 25 with poor or fair knowledge, only 8 (32.0%) had a positive attitude (Table 4).

**Table 4. Association between Post-Intervention Knowledge and Attitude (N = 200)**

| Level of Knowledge | Positive Attitude (Score 3–5) | Negative Attitude (Score 0–2) | Total |
|---|---|---|---|
| Good or excellent knowledge | 151 (75.5) | 24 (12.0) | 175 (87.5) |
| Poor or fair knowledge | 8 (4.0) | 17 (8.5) | 25 (12.5) |
| Total | 159 (79.5) | 41 (20.5) | 200 (100) |

Spearman's rho = 0.64, $p < 0.001$. Values are n (% of total completers).

**Intended Adherence and Residual Barriers**

At the six-week follow-up, 164 women (82.0%) reported the intention to start or continue regular FA supplementation before a future pregnancy. The most commonly reported facilitators were "increased awareness of FA benefits" (78.5%) and "husband's support" (64.0%). Residual barriers included "forgetfulness" (27.5%) and "limited access to affordable supplements" (18.5%). No adverse events were reported.

## Discussion

This study demonstrated that a single, brief, nurse-led educational intervention significantly improved FA knowledge and positive attitudes among reproductive-age women in a low-resource peri-urban community in Karachi. Although 60 women (23.1%) dropped out, the intervention proved highly effective among the 200 completers, with large and sustained gains. The dropout rate of 23.1% is comparable to other community-based intervention studies in similar settings [18,19]. Notably, baseline characteristics did not differ significantly between women who completed the study and those who dropped out, thereby minimizing concerns regarding attrition bias. Although the final sample of 200 fell short of the planned 238, it still provided 84% statistical power, which remains within acceptable limits.

The baseline rate of FA awareness observed in this study (33.0%) aligns with other recent evidence from Pakistan. Yasmin et al. (2022) reported that 76.7% of women in Faisalabad lacked any knowledge of FA [20], while a 2024 survey from Hyderabad documented that merely 10% of respondents were aware of its preventive role against NTDs [21]. Following our intervention, 86.0% of participants correctly identified the timing of FA intake, and 87.5% achieved good or excellent knowledge levels. These outcomes parallel findings from other educational initiatives in resource-constrained settings, reinforcing the conclusion that structured, home-based education can effectively overcome the challenges posed by low baseline literacy [22,23].

The persistence of good or excellent knowledge in 78.0% of women at the six-week follow-up is particularly heartening. This sustained effect carries clinical importance, given that periconceptional FA must be consumed over a period of weeks to months before pregnancy. All five women (2.5%) who had previously delivered a child affected by an NTD retained accurate knowledge regarding the necessity of FA. However, it should be noted that counselling on higher-dose regimens was not incorporated into this foundational educational module.

A key strength of the present work lies in the dedicated measurement of attitude through a validated five-item Agree-or-Disagree instrument. At baseline, a mere 31.0% of participants expressed a positive attitude toward FA consumption, a figure comparable to the low attitudinal scores documented by Arshad et al. (2026) in Lahore [12]. After the educational session, the proportion holding a positive attitude climbed to 79.5%. The robust correlation between post-intervention knowledge and attitude scores (rho = 0.64) demonstrates that the intervention effectively targeted both cognitive and motivational domains. This observation is consistent with established behavioral frameworks, which hold that knowledge, while necessary, is insufficient on its own; a favorable attitude—encompassing perceived benefits and diminished perceived barriers—is essential for translating awareness into action [13].

The most pronounced attitudinal shifts were recorded for willingness to take FA on a daily basis (Item 3: improving from 35.0% to 85.0%) and belief in the protective effect of FA against birth defects (Item 2: improving from 38.0% to 88.5%). These marked improvements indicate that the session successfully countered fatalistic beliefs and prevalent misconceptions, such as the assumption that a nutritious diet alone supplies adequate folate (Item 5: rising from 22.0% to 74.5% disagreeing with this mistaken notion).

Persisting obstacles, including forgetfulness (27.5%) and limited access (18.5%), echo findings reported in the broader global literature. A 2025 study from Rawalpindi identified forgetfulness as the foremost cause of non-adherence [11]. Straightforward solutions, such as text message or WhatsApp reminders and the provision of free FA through basic health units, could help mitigate these barriers. Pakistan's Lady Health Worker program offers a ready platform for integrating this structured FA educational module at minimal expense. By way of international comparison, a 2024 Canadian survey revealed that only one-third of women consumed FA prior to pregnancy [24]; in Poland, although 98.9% were aware of FA, just 66% used active forms [25]; and in

India, 59.7% possessed knowledge, yet only 20% adhered to regular supplementation [26]. While our baseline figures are lower, the post-intervention gains are comparable, underscoring that low initial awareness stems largely from insufficient access and unfavorable attitudes rather than an inability to acquire knowledge. The educational approach tested here is low-cost, practical, and demonstrably effective among those who completed the study. Provincial health authorities should therefore consider embedding this structured FA module within Lady Health Worker training curricula. Concurrently, the provision of free FA through basic health units warrants strengthening. In the longer term, mandatory fortification of wheat flour with folic acid—a policy adopted by over 80 nations—merits renewed consideration in Pakistan [27,28,29].

**Limitations**

The quasi-experimental, single-group design precludes ruling out the influence of secular trends. The use of purposive sampling constrains the generalizability of the findings. While non-differential, the 23.1% dropout rate reduces the overall sample size and may compromise precision. Serum folate levels were not measured, nor was FA intake directly observed. Social desirability bias may have led to inflated post-test responses. Furthermore, the six-week follow-up period does not capture periconceptional behaviour sustained over multiple months. Future investigations employing randomised controlled designs with extended follow-up and objective adherence measures are warranted.

**Conclusion**

A single, concise, nurse-led educational session produced substantial and sustained improvements in periconceptional folic acid knowledge and positive attitudes among reproductive-age women residing in a peri-urban community of Karachi, with benefits persisting at six weeks. Although 23.1% of enrolled participants discontinued the study, the intervention proved highly efficacious among those who completed it. This low-cost, community-based strategy is readily scalable through existing networks of community health workers and holds promise for reducing the considerable burden of neural tube defects in Pakistan.

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