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***Original Research Article***

# Evaluation of the Role of Nurses in Maternal Health Education Programs on Reducing Obstetric Complications in Resource-Limited Settings

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**Abstract:** *Maternal health education is a crucial strategy for reducing obstetric complications, particularly in resource-limited settings. Nurses play a central role in delivering structured education to enhance maternal knowledge, promote health-seeking behavior, and improve outcomes.* ***Objective:*** *To evaluate the effectiveness of a nurse-led Maternal Health Education Program (MHEP) in improving antenatal care (ANC) attendance, knowledge of obstetric danger signs, and reducing maternal complications in a Pakistani tertiary care hospital.* ***Methods:*** *A prospective, controlled evaluation was conducted from July to December 2024, involving 99 pregnant women (49 with MHEP, 50 controls). Participants in the intervention group received structured one-to-one and follow-up educational sessions based on WHO/UNICEF guidelines, adapted for local literacy and language needs. The primary outcome was a composite of maternal complications (hypertensive disorders, postpartum hemorrhage, maternal sepsis, prolonged/obstructed labor). Secondary outcomes included ANC process indicators, knowledge scores, and neonatal outcomes.* ***Results:*** *The MHEP group demonstrated significantly higher attendance at≥4 ANC visits (73.5% vs 46.0%, p = 0.005), improved iron–folate adherence (69.4% vs 38.0%, p = 0.0017), and greater birth preparedness (65.3% vs 34.0%, p = 0.0018). Mean knowledge scores on obstetric danger signs were markedly higher (14.2 ± 3.1 vs 10.7 ± 3.4, p<0.001). Composite maternal complications were reduced in the MHEP group (24.5% vs 44.0%; RR 0.56, p=0.041; NNT=5.1). A dose–response relationship was observed, indicating fewer complications with greater session attendance (p = 0.023). Multivariable analysis confirmed an independent reduction in the odds of complications associated with MHEP participation (adjusted OR, 0.41; p = 0.045).* ***Conclusion:*** *Nurse-led maternal health education significantly improved ANC utilization, maternal knowledge, and reduced maternal complications in a resource-limited setting. The observed dose–response effect highlights the importance of sustained, repeated educational engagement. Scaling such interventions could be an effective strategy to improve maternal health outcomes in similar contexts.*

**Keywords:** Maternal Health Education, Nurses, Obstetric Complications, Antenatal Care, Pakistan

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## Introduction

Maternal health education has been identified as a crucial component of effective healthcare services designed to reduce obstetric complications, particularly in resource-constrained settings. Nurses play a pivotal role in maternal health education programs, contributing to the dissemination of vital information and facilitating accessible and effective care for pregnant women. Research indicates that when women possess adequate knowledge about pregnancy and childbirth, they are better equipped to recognize and manage complications that may arise (1, 2).

Improving maternal education and the availability of healthcare services directly impacts the frequency of obstetric emergencies. For instance, studies show that higher levels of maternal education correlate with a better understanding of obstetric danger signs, leading to timely access to necessary healthcare interventions (3, 2). In many developing countries, difficulties in securing adequate maternal health care often stem from a combination of socio-cultural and informational barriers (4, 5). The reliance on healthcare providers, especially nurses and midwives, for effective communication and support becomes crucial in these situations, as their training enables them to deliver essential health education and guide women in navigating the healthcare system.

In resource-poor settings, disparities in education and access to healthcare exacerbate the risk of adverse maternal outcomes [65]. Evidence-based interventions, such as educational programs that focus on enhancing nurses' competencies in maternal health education, have been shown to lower maternal and neonatal mortality rates (7, 8). The involvement of nurses not only aids in immediate preventive measures but also supports long-term maternal health strategies through community engagement and advocacy for necessary health services (9, 6).

Specifically in Pakistan, where maternal mortality rates remain unacceptably high, addressing knowledge gaps about pregnancy among women is paramount (10). Research has indicated that a significant proportion of pregnant women in Pakistan fail to recognize crucial signs of complications, reflecting inadequacies in maternal health education efforts (10). By equipping nurses with practical educational tools and strategies, there is potential to enhance maternal health literacy, leading to improved health-seeking behaviors and a reduction in obstetric complications. This approach aligns with the growing recognition of the critical role that maternal health education plays in achieving health equity and enhancing health outcomes, particularly in underserved populations.

Thus, adequate training and a strategic focus on maternal health education for nurses can significantly contribute to reducing obstetric complications. Efforts to elevate educational levels among pregnant women, facilitated by skilled nursing staff, are essential to create an environment where maternal health challenges can be effectively addressed.

## Methodology

We conducted a prospective, controlled evaluation at a tertiary care hospital in a resource-limited Pakistani setting over a six-month period

from July 2024 to December 2024. Consecutive pregnant women aged 18–45 years with a viable singleton gestation and planning to deliver in the hospital network were screened during antenatal clinics. Women presenting beyond 28 weeks' gestation at first contact, with severe pre-existing medical disorders requiring specialist pathways (e.g., advanced cardiac disease, renal failure), or who declined participation were excluded. After obtaining informed consent, participants were enrolled in either the nurse-led maternal health education program (MHEP) or routine care, as determined by clinic day scheduling, to minimize contamination across groups. The MHEP was delivered by registered nurses trained for this study using a competency-based curriculum adapted from WHO/UNICEF materials and contextualized to literacy and language needs (Urdu and regional languages). The curriculum emphasized early and repeated ANC attendance, recognition of obstetric and neonatal danger signs, nutrition and iron–folate adherence, tetanus immunization, hygiene and infection prevention, birth preparedness and complication readiness (saving funds, arranging transport, identifying a skilled birth facility and a potential blood donor), breastfeeding initiation, and postpartum family planning. Delivery modalities included a structured one-to-one session at enrollment (≈approximately 20–25 minutes), reinforcement during routine ANC at approximately 4- and 8-week intervals, distribution of pictorial leaflets, and optional telephone reminders (voice/SMS/WhatsApp) to accommodate individuals with low literacy and those residing in rural areas. Family engagement, particularly spouses and mothers-in-law, was encouraged. The control group received the standard antenatal counseling available at the clinic without the structured nurse-led package.

Data were collected using a pilot-tested case report form that captured socio-demographic variables (maternal age, education, household income, residence), obstetric history (parity, prior cesarean section), clinical data (gestational age at booking, hemoglobin, BMI), process indicators (ANC visits, timing of first ANC, iron–folate adherence measured as proportion of prescribed tablets consumed, tetanus toxoid doses, facility delivery plan, birth preparedness index), knowledge (20-item danger-signs test scored 0–20; content-validated by three maternal health experts; Cronbach's alpha 0.82 in pilot testing), and maternal and neonatal outcomes. The primary outcome was a composite maternal complication from enrollment through delivery, defined a priori as the occurrence of any of: hypertensive disorder of pregnancy (gestational hypertension or preeclampsia), postpartum hemorrhage requiring uterotonics or transfusion, suspected maternal sepsis requiring antibiotics, or prolonged/obstructed labor necessitating instrumental delivery or emergency cesarean section for dystocia. Secondary outcomes included individual components of the composite, preterm birth (<37 weeks), low birth weight (<2500 g), neonatal ICU admission, perinatal death, and cesarean delivery for any indication. Exposure intensity was quantified as the number of MHEP sessions attended (1, 2, or ≥3). Adverse events related to the educational sessions were actively monitored, and none were anticipated.

The target sample size of approximately 99 participants (≈49 in MHEP and 50 in the control group) was determined a priori to detect a 20-percentage-point absolute reduction in the primary composite outcome (from 45% to 25%) with 80% power at a two-sided α of 0.05, allowing for up to 10% attrition. Data were double-entered and cross-checked before analysis. Continuous variables were summarized as mean ± SD or median (IQR) as appropriate; categorical variables were summarized as counts and percentages. Between-group comparisons used Welch's t-test for continuous outcomes and chi-square or Fisher's exact tests for categorical outcomes. For binary outcomes, we report risk ratios (RRs) with 95% confidence intervals (CIs), absolute risk differences, and the numbers needed to treat (NNT = 1/absolute risk reduction). A multivariable logistic regression modeled the primary composite outcome, including group allocation and prespecified covariates (age, parity ≥3, anemia at enrollment, rural residence, and prior cesarean section), with results reported as adjusted odds ratios (aORs) and 95% CIs. Dose–response was assessed across session-attendance categories using a linear trend test. Model assumptions were checked with Hosmer–Lemeshow goodness-of-fit and collinearity diagnostics; missing data were <5% for all variables and were handled by complete-case analysis. All tests were two-sided with significance set at $p<0.05$. Ethical approval was obtained from the institutional review board of the participating tertiary care center, and all participants provided written informed consent. Privacy and confidentiality were maintained throughout, and the study adhered to the Declaration of Helsinki and local regulatory requirements.

**Results**

The mean age of participants was similar between the MHEP group (26.5 ± 5.6 years) and the control group (27.1 ± 5.8 years), with no significant difference ($p = 0.60$). When categorized by age group, most participants fell within the 25–29 years (32.3%) range, followed by the 30–34 years (25.3%) range, and 28.3% were under 25 years old. Only 14.1% were aged 35 years or older. (Table 1). Women in the MHEP group demonstrated significantly better process and behavioral indicators. Attendance at four or more ANC visits was considerably higher in the intervention group (73.5% vs 46.0%, $p = 0.005$). Iron–folate adherence ≥80% was also substantially higher (69.4% vs 38.0%, $p=0.0017$).

Knowledge-related outcomes showed strong effects: the mean knowledge of obstetric danger signs was higher in the MHEP group (14.2 ± 3.1 vs. 10.7 ± 3.4), with a mean difference of 3.5 points (95% CI, 2.2 to 4.8; $p < 0.001$).

Early ANC booking (≤12 weeks), tetanus toxoid coverage (≥ two doses), facility delivery planning, and birth preparedness/complication readiness (BPCR) all showed improvements in the MHEP arm, with BPCR demonstrating statistical significance (65.3% vs 34.0%, $p = 0.0018$). (Table 2).

Composite maternal complications occurred less frequently in the MHEP group (24.5%) compared to controls (44.0%), yielding a relative risk (RR) of 0.56 (95% CI 0.31–1.00), absolute risk reduction (ARR) of 19.5 percentage points, and number needed to treat (NNT) of 5.1 ($p=0.041$).

For specific complications, MHEP participants had lower frequencies across hypertensive disorders, postpartum hemorrhage, sepsis, and prolonged/obstructed labor, though most differences did not reach statistical significance.

Neonatal outcomes, including preterm birth, low birth weight, NICU admissions, and perinatal death, were also lower in the intervention group, but differences were not statistically significant. Cesarean section rates were slightly lower (34.7% vs. 42.0%, $p = 0.54$). (Table 3).

A precise dose–response relationship was observed between the number of sessions attended and maternal outcomes. Women who attended only one session had the highest complication rate (50%), compared with 20% for two sessions and 11.8% for three or more sessions. The linear trend was statistically significant ($p = 0.023$), supporting a cumulative benefit from repeated exposure to nurse-led sessions. (Table 4).

After adjusting for potential confounders, participation in MHEP remained independently associated with a reduced odds of composite maternal complications (adjusted OR, 0.41; 95% CI, 0.17–0.98; $p = 0.045$).

Other predictors, such as higher parity (≥3), anemia at enrollment, and prior cesarean section, were associated with an increased risk, although this association was not statistically significant at the 5% level. The anemia trended towards significance (OR 2.11; 95% CI 0.95–4.72; $p = 0.067$), suggesting it may be an essential risk factor in this cohort. (Table 5).

**Table 1: Socio-demographic and obstetric profile of participants (n=99)**

| Characteristic | MHEP (n=49) | Control (n=50) | Total (n=99) | p-value |
|---|---|---|---|---|
| Age, years; mean ± SD | 26.5 ± 5.6 | 27.1 ± 5.8 | 26.8 ± 5.7 | 0.60 |
| Age groups, n (%) | | | | |
| <25 | 16 (32.7) | 12 (24.0) | 28 (28.3) | 0.46 |
| 25–29 | 17 (34.7) | 15 (30.0) | 32 (32.3) | |
| 30–34 | 11 (22.4) | 14 (28.0) | 25 (25.3) | |
| ≥35 | 5 (10.2) | 9 (18.0) | 14 (14.1) | |
| Residence, n (% rural) | 28 (57.1) | 30 (60.0) | 58 (58.6) | 0.77 |
| Education, n (%) | | | | |
| None/Primary | 11 (22.4) | 12 (24.0) | 23 (23.2) | 0.95 |
| Secondary | 25 (51.0) | 26 (52.0) | 51 (51.5) | |
| College or higher | 13 (26.5) | 12 (24.0) | 25 (25.3) | |
| Monthly household income, PKR, n (%) | | | | |
| <30,000 | 21 (42.9) | 23 (46.0) | 44 (44.4) | 0.95 |
| 30,000–60,000 | 20 (40.8) | 19 (38.0) | 39 (39.4) | |
| >60,000 | 8 (16.3) | 8 (16.0) | 16 (16.2) | |
| Parity, n (%) | | | | |
| 0 | 17 (34.7) | 16 (32.0) | 33 (33.3) | 0.96 |
| 1–2 | 18 (36.7) | 19 (38.0) | 37 (37.4) | |
| ≥3 | 14 (28.6) | 15 (30.0) | 29 (29.3) | |
| Gestational age at enrollment, weeks; mean ± SD | 22.0 ± 5.2 | 22.2 ± 5.4 | 22.1 ± 5.3 | 0.86 |
| Anemia (Hb <11 g/dL), n (%) | 22 (44.9) | 24 (48.0) | 46 (46.5) | 0.76 |
| BMI category, n (%) | | | | |
| Underweight | 6 (12.2) | 5 (10.0) | 11 (11.1) | 0.98 |
| Normal | 22 (44.9) | 22 (44.0) | 44 (44.4) | |
| Overweight | 14 (28.6) | 15 (30.0) | 29 (29.3) | |
| Obese | 7 (14.3) | 8 (16.0) | 15 (15.2) | |
| Previous cesarean section, n (%) | 9 (18.4) | 10 (20.0) | 19 (19.2) | 0.85 |

**Table 2: Process indicators and knowledge/behavioral outcomes**

| Indicator | MHEP (n=49) | Control (n=50) | Effect | p-value |
|---|---|---|---|---|
| ≥4 ANC visits, n (%) | 36 (73.5) | 23 (46.0) | Δ=+27.5 pp | 0.005 |
| Early ANC booking ≤12 weeks, n (%) | 18 (36.7) | 10 (20.0) | Δ=+16.7 pp | 0.065 |
| Iron–folate adherence ≥80%, n (%) | 34 (69.4) | 19 (38.0) | Δ=+31.4 pp | 0.0017 |
| Tetanus toxoid ≥2 doses, n (%) | 41 (83.7) | 34 (68.0) | Δ=+15.7 pp | 0.069 |
| Facility delivery planned, n (%) | 44 (89.8) | 39 (78.0) | Δ=+11.8 pp | 0.111 |
| Birth Preparedness & Complication Readiness adequate (≥4 components), n (%) | 32 (65.3) | 17 (34.0) | Δ=+31.3 pp | 0.0018 |
| Knowledge of obstetric danger signs (0–20), mean ± SD | 14.2 ± 3.1 | 10.7 ± 3.4 | MD=+3.5 (95% CI +2.2 to +4.8) | <0.001 |

**Table 3. Maternal and neonatal outcomes**

| Outcome | MHEP (n=49) | Control (n=50) | Effect size | p-value |
|---|---|---|---|---|
| Composite maternal complication (any of hypertensive disorder, PPH, sepsis, prolonged/obstructed labor) | 12 (24.5%) | 22 (44.0%) | RR 0.56 (95% CI 0.31–1.00); ARR 19.5 pp; NNT 5.1 | 0.041 |
| Hypertensive disorder (GH/preeclampsia) | 6 (12.2%) | 9 (18.0%) | RR 0.68 (95% CI 0.26–1.77) | 0.58 |
| Postpartum hemorrhage | 3 (6.1%) | 8 (16.0%) | RR 0.38 (95% CI 0.11–1.36) | 0.20 |
| Maternal sepsis | 1 (2.0%) | 4 (8.0%) | RR 0.26 (95% CI 0.03–2.20) | 0.36 |
| Prolonged/obstructed labor requiring instrumental/CS | 8 (16.3%) | 12 (24.0%) | RR 0.68 (95% CI 0.30–1.52) | 0.45 |
| Preterm birth <37 weeks | 5 (10.2%) | 9 (18.0%) | RR 0.57 (95% CI 0.20–1.57) | 0.39 |
| Low birth weight <2500 g | 7 (14.3%) | 11 (22.0%) | RR 0.65 (95% CI 0.27–1.54) | 0.44 |
| Neonatal ICU admission | 6 (12.2%) | 10 (20.0%) | RR 0.61 (95% CI 0.24–1.56) | 0.41 |
| Perinatal death | 1 (2.0%) | 2 (4.0%) | RR 0.51 (95% CI 0.05–5.45) | 1.00 |
| Cesarean delivery (any indication) | 17 (34.7%) | 21 (42.0%) | RR 0.83 (95% CI 0.50–1.37) | 0.54 |

**Table 4: Dose–response within the MHEP group: complications by the number of nurse-led sessions attended (n = 49)**

| Sessions attended | n | Composite complication, n (%) |
|---|---|---|
| 1 session | 12 | 6 (50.0) |
| 2 sessions | 20 | 4 (20.0) |

| | | |
|---|---|---|
| ≥3 sessions | 17 | 2 (11.8) |
| *Linear trend p=0.023.* | | |

**Table 5. Multivariable logistic regression for composite maternal complication (n=99).**

| Predictor | Adjusted OR (95% CI) | p-value |
|---|---|---|
| MHEP (vs routine care) | 0.41 (0.17–0.98) | 0.045 |
| Age (per 5-year increase) | 1.12 (0.79–1.60) | 0.52 |
| Parity ≥3 (vs 0–2) | 1.82 (0.79–4.20) | 0.16 |
| Anemia at enrollment (Hb <11 g/dL) | 2.11 (0.95–4.72) | 0.067 |
| Rural residence (vs urban) | 1.36 (0.59–3.13) | 0.47 |
| Prior cesarean section | 1.58 (0.58–4.30) | 0.37 |

## Discussion

The results of our study delve into the impact of a Maternal Health Education Program (MHEP) on improving maternal and neonatal health outcomes, particularly in a population with resource limitations. The analysis of socio-demographic characteristics revealed no significant differences in age, residence, or education between the MHEP group and the control group, as illustrated in Table 1. This finding aligns with previous studies that highlight the importance of socioeconomic factors, such as education and income, in healthcare outcomes; however, these factors may not always exhibit significant differences in smaller or controlled cohorts (11, 12). The mean age of study participants (26.8 years) corresponded closely with findings from Kanyesigye et al., which also reported a similar age range among participants in maternal health interventions (Kanyesigye et al., 13).

When assessing process indicators, we found significant differences in attendance at antenatal care (ANC) visits and adherence to iron–folate supplementation between the two groups (Table 2). It was observed that 73.5% of participants in the MHEP group attended four or more ANC visits compared to 46.0% in the control group (p=0.005). This finding aligns with previous literature indicating that educational interventions significantly improve ANC attendance, which is frequently cited as a critical determinant of maternal health (14, 15). Furthermore, iron–folate adherence was markedly higher in the MHEP group, which corroborates the work of Huda et al., who found that enhanced maternal education can lead to improved adherence to health-related behaviors among pregnant women (16).

Knowledge-related outcomes, particularly regarding obstetric danger signs, were also significantly positively influenced by the MHEP. The mean knowledge score in the MHEP group was substantially higher (14.2 ± 3.1) compared to the control group (10.7 ± 3.4) (p<0.001). This outcome is consistent with studies by Nove et al., which highlight the necessity of tailored education in increasing knowledge of maternal health risks and appropriate responses (17). It also reflects the growing consensus that structured educational initiatives can enhance maternal health literacy, a crucial factor in informed healthcare decision-making (18, 19).

Under maternal outcomes (Table 3), the incidence of composite maternal complications was significantly lower in the MHEP group (24.5%) compared to the control group (44.0%) (p=0.041). These findings substantiate the effectiveness of educational interventions in reducing the occurrence of complications, such as hypertensive disorders and postpartum hemorrhage, a trend echoed by Mochache et al., who found that improved maternal education was significantly correlated with lower rates of adverse clinical outcomes (20). Furthermore, while our study found a decrease in cesarean delivery rates in the MHEP group, it did not reach statistical significance, which is consistent with the findings of Gómez et al., who documented mixed results in cesarean section rates in relation to educational interventions.

The dose-response relationship observed among MHEP participants indicates that increased attendance at nurse-led sessions is correlated with fewer complications (Table 4). This finding is consistent with evaluations by Steinbrook et al., which illustrate that systematic approaches to healthcare education lead to progressively better health outcomes, emphasizing the necessity of a sustained engagement strategy in healthcare interventions (14, 22).

Finally, the multivariable logistic regression analysis revealed that participation in the MHEP significantly reduced the odds of composite maternal complications after adjusting for confounders (adjusted OR 0.41; p=0.045) (Table 5). These findings align with the broader literature, which suggests that health education and structured programs can enhance health outcomes by empowering women with knowledge and increasing their capacity to seek timely care (10, 11).

Our study emphasizes the significance of sustained educational interventions, such as MHEP, in enhancing maternal health outcomes in resource-constrained settings. Considering the prevalent barriers in such contexts, these findings are highly relevant for similar populations, such as in Pakistan, where maternal and neonatal health remains a pressing public health challenge. The demonstrated benefits in ANC attendance, knowledge of complications, and reduced adverse outcomes reiterate the need for effective nurse-led educational programs as integral components of maternal health strategies.

## Conclusion

This study demonstrates that a structured, nurse-led maternal health education program can substantially improve both process indicators and clinical outcomes for pregnant women in resource-limited settings. By increasing ANC attendance, enhancing adherence to iron–folate supplementation, and raising awareness of obstetric danger signs, the program directly contributed to a measurable reduction in maternal complications. The precise dose–response effect further highlights the importance of sustained educational contact throughout pregnancy. Given the high maternal morbidity and mortality rates in Pakistan, integrating such nurse-led interventions into routine antenatal services could represent a cost-effective, scalable approach to improving maternal health outcomes. Policymakers and healthcare administrators should consider institutionalizing such programs and providing the necessary training and resources for nurses to deliver them effectively.

## Declarations

**Data Availability statement**

All data generated or analysed during the study are included in the manuscript.

**Ethics approval and consent to participate**

Approved by the department concerned. (IRBEC-24)

**Consent for publication**

Approved

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**Conflict of interest**

The authors declared the absence of a conflict of interest.

**Author Contribution**

**MK** (Head Nurse)
*Manuscript drafting, Study Design,*
*Review of Literature, Data entry, Data analysis, and drafting an article.*
**SK**
*Conception of Study, Development of Research Methodology Design, Study Design, manuscript review, and critical input.*
***SA***
*manuscript review, critical input, Conception of Study*

*All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.*

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