

A Two-Site Controlled Pilot Evaluation of an mHealth Intervention to Strengthen Respectful Maternity Care in Rural Uttar Pradesh, India

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Abstract

Background: Respectful maternity care (RMC) is crucial for quality maternal health services; however, disrespect, poor communication, and restricted autonomy continue in numerous resource-limited environments. Digital interventions can aid in bridging informational and interpersonal gaps but cannot replace the need for enhancing health systems.

Aim: To evaluate if a dual-audience mHealth intervention for expectant mothers and maternity-care providers led to improved person-centred maternity care in two rural public health facilities located in Kushinagar, Uttar Pradesh.

Methods: A controlled pilot evaluation was carried out at two sites: CHC Motichak (intervention) and CHC Kaptanganj (control). A total of 260 expectant mothers (130 from each location) were included. The intervention combined Hindi audio-visual modules for women with short digital training for providers. Results were evaluated with the validated Person-Centered Maternity Care (PCMC) scale. Due to the presence of only one CHC in each arm, comparisons at the participant level were considered exploratory; a reliable estimate of the intraclass correlation coefficient was not feasible, and the effects of facilities and interventions could not be distinguished.

Results: The intervention site had a higher mean PCMC score than the control site (88.6 ± 7.4 vs 75.2 ± 9.1 ; unadjusted mean difference 13.4 points, 95% CI 11.4–15.4; exploratory $p < 0.001$). Higher scores were also observed for communication, dignity and respect, trust, transparency in payment, and facility environment. The percentage of women who completed more than three antenatal-care visits was 67.7% at the intervention site and 61.5% at the control site (a difference of 6.2 percentage points, 95% CI –5.4 to 17.8; exploratory $p = 0.30$). Open-ended feedback indicated enhanced awareness of rights and increased confidence in asking questions, while also highlighting a reliance on guided access and family assistance.

Conclusion: The results advocate for additional assessment of mHealth as a complement to RMC enhancement, rather than a separate solution. A more extensive multi-cluster study with objective observation, recorded exposure, extended follow-up, and specific evaluation of digital access and structural limitations is necessary before any claims about causality or scalability can be asserted.

Keywords: respectful maternity care; mHealth; person-centred maternity care; controlled pilot study; rural India; Uttar Pradesh

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1. Introduction

Respectful maternity care (RMC) encompasses dignity, privacy, informed choice, effective communication, non-discrimination, continuous support, and freedom from mistreatment during maternity care. In Donabedian's structure–process–outcome model, women's interactions with providers are part of the care process rather than an optional addition to clinical quality (Donabedian, 1988). The World Health Organization (WHO) similarly places

experience of care alongside evidence-based clinical practice in its quality-of-care vision and recommendations for a positive childbirth experience (Tunçalp et al., 2015; World Health Organization, 2018). This broader view is consistent with calls to avoid both insufficient care and unnecessary intervention while preserving respectful, evidence-based maternity services (Miller et al., 2016). The early landscape analysis by Bowser and Hill described physical abuse, non-consented care, non-

confidential care, non-dignified care, discrimination, abandonment, and detention as recurring manifestations of disrespect and abuse (Bowser and Hill, 2010). Subsequent global syntheses confirmed that mistreatment is produced through interactions among provider behaviour, facility conditions, social inequality, and health-system governance (Bohren et al., 2015; Sen et al., 2018; Shakibazadeh et al., 2018). Perceived quality, fear of discrimination, distance, and cost can also influence whether women seek facility-based delivery, showing that increasing institutional births without improving experience of care is insufficient (Bohren et al., 2014).

Evidence from India demonstrates that mistreatment may include verbal or physical abuse, inadequate consent, lack of privacy, neglect, and discrimination (Bhattacharya and Sundari Ravindran, 2018; Nawab et al., 2019). Studies from Uttar Pradesh further show that women's status, empowerment, and social position shape how care is experienced, while provider mistreatment has been associated with maternal health complications (Sudhinaset et al., 2016; Diamond-Smith et al., 2017; Raj et al., 2017). Provider workload, professional hierarchies, facility layout, privacy constraints, and weak accountability can reinforce these patterns; education or communication interventions alone cannot remove the structural drivers (Mayra et al., 2022; Athira et al., 2025). The India-validated Person-Centered Maternity Care (PCMC) scale provides a structured measure of women's reported experiences of dignity, communication, autonomy, support, trust, and facility conditions (Afulani et al., 2018).

India's Janani Suraksha Yojana illustrates how policy can increase facility-based childbirth, but utilization gains do not by themselves establish that care is respectful or person-centred (Lim et al., 2010). Continuous support during labour can improve women's childbirth experiences and selected clinical outcomes, reinforcing the importance of relational as well as technical care (Bohren et al., 2017). Interventions for RMC should therefore combine rights awareness and communication with changes in routine service delivery.

Mobile health (mHealth) interventions offer opportunities to provide standardized, repeatable, and locally adapted information to women and health workers. Early maternal-and-child mHealth application development demonstrated the feasibility of user-centred digital content, although pilot usability does not establish clinical effectiveness (Lestantri et al., 2018). Evidence from India indicates broad acceptability but also recurring barriers related to connectivity, digital literacy, household responsibilities, privacy, shared or mediated phone access, and weak integration into routine workflows (Small et al., 2024; Fivian et al., 2024; Cox et al., 2025). Large-scale Indian programmes further show that operational viability, governance, cost, and government ownership are central to sustainability (Chamberlain et al., 2021).

This study evaluated a dual-audience mHealth intervention in two Community Health Centres

(CHCs) in Kushinagar district, Uttar Pradesh. The intervention aimed to strengthen rights awareness and patient-provider communication within the constraints of the existing health system. The primary objective was to compare PCMC scores between the intervention and control sites. Secondary objectives were to describe antenatal-care attendance and summarize participants' open-ended feedback.

2. Materials and Methods

2.1 Study design and setting

This was a two-site controlled pilot evaluation conducted in two predominantly rural blocks of Kushinagar district, Uttar Pradesh. CHC Motichak delivered the intervention and CHC Kaptanganj served as the control. Each facility therefore constituted both a study site and a study arm. With only one CHC per arm, the design cannot distinguish an intervention effect from a facility effect and is not presented as a confirmatory cluster-randomized trial.

2.2 Participants and recruitment

Pregnant women in the second trimester or later were approached if they had a registered pregnancy, attended antenatal care (ANC), and were willing to provide informed consent. Women with unregistered pregnancies or significant obstetric complications were excluded. Of 314 eligible women approached, 54 were not enrolled because of relocation or lack of interest. The final sample comprised 260 women, with 130 enrolled at each site; all enrolled participants completed follow-up. Participants were recruited purposively to obtain equal site-level sample sizes.

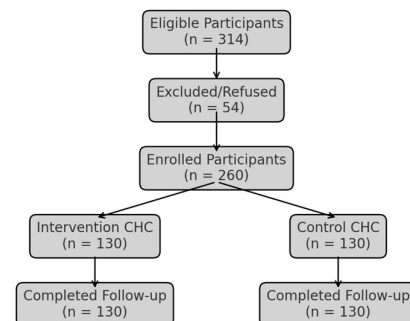


Figure 1. Participant flow through the two-site pilot evaluation.

2.3 Intervention

The intervention used two complementary digital modules:

- **Provider module:** approximately 30-minute, video-based microlearning sessions on RMC principles, ethical patient engagement, verbal and non-verbal communication, consent, and privacy, supported by quizzes and reminders.
- **Patient module:** Hindi audio-visual content on maternity rights, service expectations, common procedures, and feedback options, delivered through tablets or smartphones at the CHC and during facilitated home visits.

Audio-visual content and guided viewing by frontline workers were used to reduce literacy barriers. Facility tablets, replayable content, and assistance from nurses or Accredited Social Health Activists (ASHAs) partially reduced dependence on personal data access. However, the study recorded smartphone ownership without distinguishing exclusive ownership from shared or family-mediated access, and it did not quantify module exposure or completion at the participant level.

2.4 Outcomes and data collection

The primary outcome was the total PCMC score, measured using the India-validated PCMC scale (Afulani et al., 2018). The scale covers dignity and respect, communication, privacy, autonomy, social support, trust, facility environment, and transparency in payments; total scores range from 0 to 104, with higher scores indicating more person-centred care. Secondary measures included selected domain scores and whether participants completed more than three ANC visits.

2.5 Qualitative feedback

Open-ended feedback and interview narratives were collected from a subset of intervention participants and providers and grouped descriptively around recurrent topics. These observations were used to contextualize the quantitative results rather than as a stand-alone qualitative study. The qualitative component did not document the subsample size, saturation criteria, coding procedure, or whether interviewers were independent of the care team; the quotations should therefore be interpreted as illustrative.

2.6 Statistical analysis

Data were analysed in SPSS version 26. Baseline characteristics were summarized descriptively. Participant-level mean differences were evaluated using independent-sample comparisons, and 95% confidence intervals were calculated from the reported means, standard deviations, and group sizes. ANC attendance was compared using an unadjusted two-proportion test. An individual-level ANCOVA including age, education, caste, parity, and ANC attendance was used as a sensitivity analysis.

Methodological note. The treatment was assigned at the CHC level, but the study included only two clusters—one per arm. This is insufficient for a reliable estimate of the intracluster correlation coefficient (ICC) or cluster-robust standard errors. Intervention status is perfectly confounded with facility. Accordingly, all confidence intervals and p-values are labelled exploratory and must not be interpreted as confirmatory causal estimates. Future evaluation should follow the CONSORT extension for cluster trials and include enough clusters per arm for valid cluster-level inference (Campbell et al., 2012).

2.7 Ethics

The study was conducted in accordance with the Declaration of Helsinki and approved by the University Research Ethics Committee of DIT University, Uttarakhand, India (DITU/UREC/2022/04/8; 12 May 2022). Informed

consent was obtained from all participants before enrolment.

3. Results

3.1 Participant characteristics

The mean age was similar at the two sites (25.1 ± 4.6 years at the intervention site and 24.6 ± 4.8 years at the control site). The distributions of education, religion, caste group, reported smartphone ownership, and internet access were also broadly similar descriptively (Table 1). Because each arm contained only one CHC, apparent participant-level balance does not establish facility-level comparability.

Table 1. Baseline characteristics of participants (n = 260)

Characteristic	Intervention site (n = 130)	Control site (n = 130)
Age, years, mean $\pm$ SD	25.1 ± 4.6	24.6 ± 4.8
Primary education or less, n (%)	56 (43.1)	61 (46.9)
Hindu religion, n (%)	102 (78.5)	106 (81.5)
SC/ST/OBC, n (%)	118 (90.8)	116 (89.2)
Reported smartphone ownership, n (%)	97 (74.6)	93 (71.5)
Internet access, n (%)	49 (37.7)	45 (34.6)
>3 ANC visits, n (%)	88 (67.7)	80 (61.5)

Note: Smartphone ownership was recorded, but exclusive versus shared or family-mediated access was not. ANC, antenatal care; OBC, Other Backward Class; SC, Scheduled Caste; ST, Scheduled Tribe.

3.2 Person-centred maternity care outcomes

The intervention site had a higher overall PCMC score than the control site (88.6 ± 7.4 vs 75.2 ± 9.1), corresponding to an unadjusted participant-level mean difference of 13.4 points (95% CI 11.4–15.4; exploratory $p < 0.001$). Higher scores were also observed across each reported domain (Table 2). The individual-level ANCOVA retained the same direction of association after adjustment for measured covariates; however, it did not and could not adjust for the facility-level confounding created by one CHC per arm.

Table 2. Exploratory participant-level comparison of PCMC scores

Outcome	Intervention mean $\pm$ SD	Control mean $\pm$ SD	Difference (95% CI)	p-value
Overall PCMC	88.6 ± 7.4	75.2 ± 9.1	13.4 (11.4–15.4)	<0.001

Outcome	Intervention mean $\pm$ SD	Control mean $\pm$ SD	Difference (95% CI)	p-value
Communication	11.2 $\pm$ 1.3	6.7 $\pm$ 1.5	4.5 (4.2–4.8)	<0.001
Dignity and respect	19.5 $\pm$ 1.2	15.6 $\pm$ 2.1	3.9 (3.5–4.3)	<0.001
Trust	5.8 $\pm$ 0.9	2.7 $\pm$ 1.1	3.1 (2.9–3.3)	<0.001
Transparency in payment	5.6 $\pm$ 0.6	3.9 $\pm$ 1.2	1.7 (1.5–1.9)	<0.001
Facility environment	15.2 $\pm$ 2.3	12.3 $\pm$ 2.7	2.9 (2.3–3.5)	<0.001

Note: Differences, confidence intervals, and p-values were calculated at the participant level from the reported summary statistics. They do not account for clustering and are exploratory because the study had one CHC per arm. PCMC, Person-Centered Maternity Care.

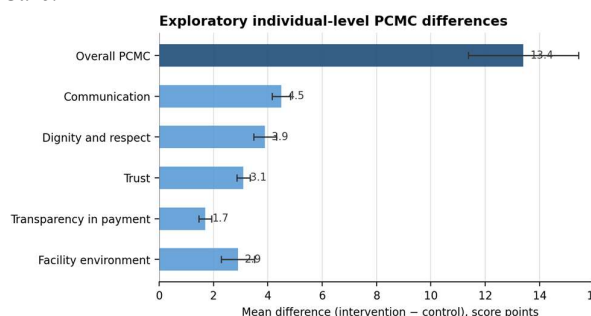


Figure 2. Unadjusted participant-level PCMC mean differences with 95% confidence intervals. The figure is descriptive and does not account for clustering.

3.3 Antenatal-care attendance

More than three ANC visits were reported by 88 of 130 women (67.7%) at the intervention site and 80 of 130 (61.5%) at the control site. The unadjusted difference was 6.2 percentage points (95% CI –5.4 to 17.8; exploratory $p = 0.30$). The available data therefore do not support a statistically clear difference in this secondary outcome.

3.4 Illustrative qualitative observations

Open-ended feedback suggested three recurring topics: greater awareness of maternity-care rights, more active communication with providers, and increased trust when procedures were explained. The following quotations illustrate these perceptions:

“For the first time, I was told what to expect during labour and delivery. I felt respected, not just treated like a number.” — 22-year-old participant, CHC Motichak

“Earlier, I felt nervous asking questions during check-ups. But after seeing the video about our

rights, I asked the nurse why I needed an internal examination, and she explained it patiently.” — Participant, intervention site

“Women are asking more questions. They are more aware of their rights and more cooperative when they understand why we are doing certain procedures.” — Auxiliary Nurse Midwife, intervention site

Some women valued replayable content and the ability to share it with husbands or mothers-in-law. This may have supported household engagement, but it also underscores that women’s digital access was not necessarily autonomous. The study did not systematically measure whether increased questioning added to provider workload or created friction within clinical workflows.

4. Discussion

In this two-site pilot, participants at the intervention CHC reported higher overall and domain-specific PCMC scores than participants at the control CHC. The largest reported differences concerned communication, dignity and respect, and trust. Illustrative feedback was consistent with improved rights awareness and confidence in asking questions. These findings are compatible with the intended pathway of the intervention: locally adapted information may help women understand expected standards of care, while provider-facing modules may reinforce respectful communication. This interpretation is consistent with qualitative evidence on respectful childbirth and evidence that continuous support can improve women’s experiences, although those studies do not validate this intervention’s causal effect (Bohren et al., 2017; Shakibazadeh et al., 2018). The results should not be interpreted as definitive evidence that the intervention caused the observed differences. Intervention status and facility were perfectly confounded, and unmeasured differences in staffing, leadership, patient flow, layout, or baseline culture could explain part or all of the contrast. Global and Indian evidence shows that RMC is shaped by institutional power, accountability, working conditions, and social inequality as well as individual knowledge and behaviour (Sen et al., 2018; Mayra et al., 2022; Athira et al., 2025). Digital training is therefore best understood as one component of a broader quality-improvement strategy that also addresses staffing, privacy, supplies, supervision, and accountability.

Digital access also requires a more cautious interpretation. Although reported smartphone ownership was relatively high, the study did not distinguish individual ownership from shared or family-mediated access, did not measure dose of exposure, and relied partly on guided viewing. Pilot mHealth development and Indian implementation research indicate that usability, connectivity, household workload, family support, privacy, and facilitator guidance can determine engagement (Lestantri et al., 2018; Small et al., 2024; Fivian et al., 2024; Cox et al., 2025). The intervention may therefore have reached women unevenly even when aggregate ownership appeared similar.

The self-reported PCMC outcome may be influenced by social desirability and normalization of poor care, particularly when interviews occur close to the facility or are conducted by personnel perceived as connected to the health system. Direct observation, independent interviewing, and triangulation with complaints, consent practices, staffing, and facility-process indicators would strengthen future evaluation. The descriptive qualitative observations are supportive but cannot compensate for the absence of documented sampling, analytic procedures, or interviewer independence.

The ANC attendance difference was modest and statistically uncertain in participant-level exploratory analysis. Claims regarding improved health-seeking behaviour should therefore be limited until a larger design with pre-specified secondary outcomes and cluster-appropriate inference is completed. Prior Indian policy evidence shows that facility use can respond to incentives, but utilization and experience of care remain distinct outcomes that require separate measurement (Lim et al., 2010).

5. Limitations

- Only two CHCs were included, with one facility per arm; the intervention effect cannot be separated from the facility effect, and the ICC cannot be estimated reliably.
- Participants were recruited purposively, which may introduce selection bias and limits generalizability.
- Participant-level confidence intervals and p-values do not account for clustering and are exploratory.
- The PCMC outcome was self-reported and may be affected by social desirability, courtesy bias, and normalization of mistreatment; direct observation was not used.
- Smartphone ownership was not separated into individual and shared access, and intervention exposure, completion, privacy, and family gatekeeping were not quantified.
- The qualitative component lacked a documented sample size, coding framework, saturation assessment, and confirmation that interviewers were independent of clinical care.
- Provider behaviour, workload, implementation fidelity, and possible friction arising from increased patient questioning were not measured directly.
- Follow-up was short and did not establish long-term maternal, neonatal, postpartum, cost-effectiveness, or sustainability outcomes.

6. Policy Implications and Future Research

The intervention may be suitable for further development as an adjunct to programmes such as LaQshya and SUMAN, provided that digital education is coupled with health-system strengthening. Efforts to increase facility birth should be paired with action on perceived quality, discrimination, consent, privacy, and accountability (Bohren et al., 2014; Lim et al., 2010; Sen et al., 2018). Integration should use existing ASHA and Auxiliary Nurse Midwife networks while protecting women's privacy and avoiding additional

uncompensated workload. Facility tablets, offline content, interactive voice response, and household engagement may reduce access barriers, but implementation should not assume personal smartphone ownership.

Before scale-up, a multi-site cluster-randomized trial should include an adequate number of CHCs per arm, a pre-specified sample-size calculation incorporating an assumed ICC, baseline and end-line measurement, cluster-adjusted analysis, and confidence intervals for all primary and secondary outcomes. Future studies should document intervention dose, digital access and gatekeeping, provider workload, fidelity, adverse events, cost, and long-term outcomes. Independent qualitative interviews and direct observation should be used to triangulate self-reported PCMC scores.

Sustainability will depend on integration into routine clinical workflows, content governance, data protection, recurrent financing, technical support, and monitoring—not solely on the availability of a mobile application. Lessons from the transition of large Indian mHealth programmes to government systems reinforce the need for operational and governance planning from the outset (Chamberlain et al., 2021).

7. Conclusion

This two-site pilot found substantially higher participant-reported PCMC scores at the intervention CHC and qualitative indications of improved rights awareness and communication. However, the design does not permit a causal estimate because each arm contained only one facility. The findings justify a larger, rigorously cluster-adjusted evaluation of mHealth as one element of a comprehensive RMC strategy. Claims of effectiveness, equity, or scalability should remain provisional until replicated across multiple facilities and supported by objective and long-term outcomes.

8. Declarations

Ethics and consent: The study was conducted in accordance with the Declaration of Helsinki and approved by the University Research Ethics Committee of DIT University, Uttarakhand, India (DITU/UREC/2022/04/8; 12 May 2022). Informed consent was obtained from all participants before enrolment.

Data availability: The data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to ethical and privacy requirements.

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Author contributions: M.A.B.: conceptualization, methodology, data curation, formal analysis, visualization, and writing—original draft. R.K.S.: conceptualization, methodology, supervision, and writing—review and editing. M.G.: methodology, validation, and writing—review and editing. H.C.: supervision, validation, and writing—review and editing. All authors read and approved the final manuscript.

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Abbreviations

Abbreviation	Full form
ANC	Antenatal care
ANM	Auxiliary Nurse Midwife
ASHA	Accredited Social Health Activist
CHC	Community Health Centre
ICC	Intraclass correlation coefficient
mHealth	Mobile health
PCMC	Person-Centered Maternity Care
RMC	Respectful maternity care
SC/ST/OBC	Scheduled Caste / Scheduled Tribe / Other Backward Class
SUMAN	Surakshit Matritva Aashwasan
UREC	University Research Ethics Committee
WHO	World Health Organization

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